JSPM's Bhivarabai Sawant Institute of Technology & Research, Wagholi, (412207)Pune

CRITERION 1 – CURRICULAR ASPECTS

1.2
Academic Flexibility

1.2.1
Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

DEPARTMENT OF FIRST YEAR ENGINEERING

Nagaraj
Kalyanappa
Timalapur

Digitally signed by Nagaraj Kalyanappa Timalapur
DN: CN = Nagaraj Kalyanappa Timalapur, C = IN, S = Maharashtra, O = JSPM'S Bhivarabai Sawant Institute of Technology & Research, OU = OTHERS
Reason: I attest to the accuracy and integrity of this document
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साविञीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology

National Education Policy (NEP)-2020 Compliant Curriculum

First Year Engineering (2024 Pattern)

[Common to All UG Engineering Programs]

(With effect from Academic Year 2024-25)

NEP 2020 Compliant Curriculum Structure

First Year Engineering (2024 Pattern)

Level 4.5														
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Theory	Tutorial	Practical	Total
Semester I														
BSC-101-BES	Basic Science Course	Engineering Mathematics- I	3	1	-	30	70	25	-	-	3	1	-	4
BSC-102-BES/ BSC-103-BES	Basic Science Course	Engineering Physics / Engineering Chemistry	3	-	2	30	70	25	-	-	3	-	1	4
ESC-101-ETC / ESC-102-ELE	Engineering Science Course	Basic Electronics Engineering / Basic Electrical Engineering	2	-	2	30	70	25	-	-	2	-	1	3
ESC-103-MEC/ ESC-104-CVL	Engineering Science Course	Engineering Graphics / Engineering Mechanics	2	-	2	30	70	25	-	-	2	-	1	3
ESC-105-COM	Engineering Science Course	Fundamentals of Programming Languages	2	-	2	30	70	25	-	-	2	-	1	3
VSE-101/ VSE-102	Vocational and Skill Enhancement Course	Manufacturing Practice Workshop/ Design Thinking and Idea Lab	-	-	2	-	-	25	-	-	-	-	1	1
AEC-101	Ability Enhancement Course	Professional Communication Skills	-	2	-	-	-	25	-	-	-	2	-	2
CCC-101	Co-Curricular Courses	Co-Curricular Course-I	-	-	4	-	-	25	-	-	-	-	2	2
Total			**12**	**03**	**14**	**150**	**350**	**200**	**-**	**-**	**12**	**03**	**07**	**22**

CCE*: Comprehensive Continuous Evaluation

NEP 2020 Compliant Curriculum Structure

First Year Engineering (2024 Pattern)

Level 4.5														
Course Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks					Credits			
			Theory	Tutorial	Practical	CCE*	End-Sem	Term work	Practical	Oral	Theory	Tutorial	Practical	Total
Semester II														
BSC-151-BES	Basic Science Course	Engineering Mathematics-II	3	1	-	30	70	25	-	-	3	1	-	4
BSC-103-BES/ BSC-102-BES	Basic Science Course	Engineering Chemistry/ Engineering Physics	3	-	2	30	70	25	-	-	3	-	1	4
ESC-102-ELE/ ESC-101-ETC	Engineering Science Course	Basic Electrical Engineering/ Basic Electronics Engineering	2	-	2	30	70	25	-	-	2	-	1	3
ESC-104-CVL/ ESC-103-MEC	Engineering Science Course	Engineering Mechanics/ Engineering Graphics	2	-	2	30	70	25	-	-	2	-	1	3
PCC-151-ITT	Program Core Course	Programming and Problem Solving	2	-	2	30	70	25	-	-	2	-	1	3
VSE-102/ VSE-101	Vocational and Skill Enhancement Course	Design Thinking and Idea Lab / Manufacturing Practice Workshop	-	-	2	-	-	25	-	-	-	-	1	1
IKS-151	Indian Knowledge System	Indian Knowledge System	-	2	-	-	-	25	-	-	-	2	-	2
CCC-151	Co-Curricular Courses	Co-Curricular Course-II	-	-	4	-	-	25	-	-	-	-	2	2
Total			**12**	**03**	**14**	**150**	**350**	**200**	**-**	**-**	**12**	**03**	**07**	**22**

CCE*: Comprehensive Continuous Evaluation

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Preface

The New Education Policy (NEP) 2020 has ushered a new era of change, in India's education system to better meet the needs of the 21st century. SPPU is committed to the effective and fruitful implementation of NEP 2020 in its true spirits emphasizing holistic and multidisciplinary education as per the directives of Maharashtra government. It emphasizes a multidisciplinary approach, aiming to develop critical thinking and creativity, thereby contributing to the holistic development of individuals.

We are delighted to present the first-year engineering syllabus -2024 pattern, which has been meticulously designed in alignment with the NEP 2020 with effect from academic year 2024-25. This curriculum aim to provide students with a holistic approach to engineering education ensuring a strong foundation in Mathematics and Science courses. This curriculum also includes components of vocational and skill enhancement courses, Indian Knowledge System and Co-curricular courses to shape well-rounded engineers who can adapt to global demands. Also, this document provides information on the credit system, course contents, examination and evaluation scheme along with guidelines to make best use of the curriculum designed.

The syllabus encourages experiential learning, where theoretical concepts are supported by practical laboratory sessions. Also promotes research and innovation, encouraging students to engage in projects from the early stages of their academic journey. I wish to thank all the Board of Studies chairpersons and members who contributed in designing this curriculum.

We believe that this syllabus, crafted with the essence of the NEP 2020, will equip our students with the necessary skills and knowledge to excel in their future endeavors. We look forward to embarking on this exciting academic journey with our students.

Dr. Pramod D. Patil
Dean – Science and Technology
Savitribai Phule Pune University, Pune

Program Outcomes (POs)

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Abbreviations

AEC	Ability Enhancement Course
BSC	Basic Science Course
CCC	Co-Curricular Courses
CCE	Comprehensive Continuous Evaluation
CEP	Common Engineering Project
CO	Course Outcome
ELC	Experiential Learning Courses
ESC	Engineering Science Course
FP	Field Project
IKS	Indian Knowledge System
INT	Internship
MDM	Multidisciplinary Minor
NEP	National Education Policy
OE	Open Elective
OJT	On Job Training
PCC	Program Core Course
PEC	Programme Elective Course
PO	Program Outcomes
PR	Practical
PRJ	Project
PSO	Program Specific Outcome
RM	Research Methodology
TH	Theory
TU	Tutorials
VEC	Value Education Course
VSE	Vocational and Skill Enhancement Course

Guidelines for Examination Scheme

Theory Examination: The theory examination shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE)

Comprehensive Continuous Evaluation (CCE) of 30 marks based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1.	Unit Test	12 Marks	Units 1 & Unit 2 (6 Marks/Unit)
2.	Assignments / Case Study	12 Marks	Units 3 & Unit 4 (6 Marks/Unit)
3.	Seminar Presentation / Open Book Test/ Quiz	06 Marks	Unit 5

Format and Implementation of Comprehensive Continuous Evaluation (CCE)

Unit Test:

Format: Questions designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).
Implementation: Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.
Sample Question Distribution:

- Remembering (2 Marks): Define key terms related to [Topic from Units 1 and 2].
- Understanding (2 Marks): Explain the principle of [Concept] in [Context].
- Applying (2 Marks): Demonstrate how [Concept] can be used in [Scenario].
- Analyzing (3 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
- Evaluating (3 Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].

Assignments / Case Study:

Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit 4.
Format: Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.
Implementation: Distribute the assignments or case study after covering Units 3 and 4. Provide clear guidelines and a rubric for evaluation.

Seminar Presentation:

Seminar Presentation Format:

- Oral presentation on a topic from Unit 5, followed by a Q&A session.
- Deliverables: Presentation slides, a summary report in 2 to 3 pages, and performance during the presentation.

Implementation: Schedule the seminar presentations towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.

Open Book Test:

Format: Analytical and application-based questions to assess depth of understanding.
Implementation: Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.

Quiz :

Format: Quizzes can help your students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.
Implementation: Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc

Example Timeline for conducting CCE:

Weeks 1-4	: Cover Units 1 and 2
Week 5	: Conduct Unit Test (12 marks)
Weeks 6-8	: Cover Units 3 and 4
Week 9	: Distribute and collect Assignments / Case Study (12 marks)
Weeks 10-12	: Cover Unit 5
Week 13	: Conduct Seminar Presentations or Open Book Test or Quiz (6 marks)

Evaluation and Feedback:

Unit Test: Evaluate promptly and provide constructive feedback on strengths and areas for improvement.
Assignments / Case Study: Assess the quality of submissions based on the provided rubric. Offer feedback to help students understand their performance.
Seminar Presentation: Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.
Open Book Test: Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.
By following this scheme, you can ensure a structured and comprehensive evaluation of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 70 marks written theory examination based on all the unit of course syllabus scheduled by university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester.

Format and Implementation of End-Semester Examination (ESE)

Question Paper Design

Below structure is to be followed to design an End-Semester Examination (ESE) for a theory subject of 70 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 14 marks allocated per unit:

Balanced Coverage: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze, Evaluate, and Create. The questions should be structured to cover:

- Remembering: Basic recall of facts and concepts.
- Understanding: Explanation of ideas or concepts.
- Applying: Use of information in new situations.
- Analyzing: Drawing connections among ideas.
- Evaluating: Justifying a decision or course of action.
- Creating: Producing new or original work (if applicable).

Detailed Scheme: Unit-Wise Allocation (12 Marks per Unit): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

Guidelines for Term Work Evaluation

Term Work assessment shall be conducted for the theory courses, lab practical, VSE, IKS, AEC and CCC assignments submitted in journal form. Term work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding.

It should be assessed by subject teacher of the institute and the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the Savitribai Phule Pune University (SPPU) at the end of the semester.

Overview:

Students will submit a journal documenting their practical assignments, providing a comprehensive record of their practical work and learning experiences throughout the course. The journal will include detailed descriptions of the practical assignments, observations, results, reflections, and any additional relevant materials.

Journal Components:

Practical Assignments: Each practical assignment should be clearly labelled and dated. Include the assignment prompt, objectives, materials used, procedures, observations, and results. Ensure assignments cover a variety of practical skills and techniques as outlined in the syllabus.

Reflections: Reflective entries should accompany each practical assignment. Discuss the learning process, challenges faced, and how they were overcome. Highlight key takeaways and how the practical assignment contributed to overall understanding.

Supplementary Materials: Include any additional materials relevant to the practical assignments (e.g., raw data, sketches, photographs, feedback received). Supplementary materials should be organized and clearly linked to the corresponding assignments.

Evaluation Criteria:

- **Completeness (20%):** All practical assignments are included, completed, and properly labeled. Reflective entries are present for each practical assignment.
- **Quality of Work (40%):** Practical assignments are completed with a high level of accuracy and thoroughness. Demonstrates a strong understanding of practical techniques and principles. Reflective entries provide meaningful insights into the learning process.
- **Organization (20%):** The journal is well-organized and easy to navigate. Practical assignments and reflections are clearly labeled and ordered chronologically. Supplementary materials are appropriately linked and referenced.
- **Presentation (10%):** The journal is neatly presented and free of spelling and grammatical errors. Includes a cover page with the student's name, course title, and submission date. Utilizes a consistent format and style throughout.
- **Creativity and Engagement (10%):** Demonstrates creativity in approach and presentation. Engages deeply with the practical work, going beyond surface-level understanding. Shows evidence of critical thinking and personal engagement with the assignments.

Submission Guidelines:

Journals should be submitted in a bound or digital format as specified by the instructor. Ensure that all components are included and properly organized before submission. Late submissions may be subject to penalties as per the course policy.

Example Timeline:

- **Weeks 1-3 :** Complete and document Practical Assignments 1 and 2, including reflections.
- **Weeks 4-6 :** Complete and document Practical Assignments 3 and 4, including reflections.
- **Weeks 7-9** : Complete and document Practical Assignments 5 and 6, including reflections.
- **Week 10 :** Finalize and organize the journal.
- **Week 11 :** Submit the completed journal for evaluation.

Benefits:

- Encourages regular and consistent engagement with practical work.
- Provides a comprehensive record of student progress and learning.
- Develops skills in reflection, organization, and presentation.
- Allows for personalized feedback and growth opportunities.
- By structuring term work evaluation through journal submissions, students can benefit from a holistic and continuous assessment process that supports their practical skills development and academic growth.

Guidelines for conducting 1 Hour Tutorial Session

Conducting a two-hour tutorial session allows for more in-depth exploration and interaction compared to shorter sessions. Here are comprehensive guidelines to effectively conduct a two-hour tutorial session for a theory subject:

1. Preparation:

Review Content: Ensure a thorough understanding of the theory subject and select key topics or concepts to cover during the session.

Set Objectives: Define clear learning objectives that align with the course syllabus and students' learning needs.

Prepare Materials: Gather necessary materials such as lecture notes, slides, handouts, and any supplementary resources or examples.

2. Structure of the Tutorial:

Introduction and Agenda Setting (05 minutes): Welcome students and outline the agenda for the tutorial session. Clarify the learning objectives and expectations for the session.

Recap or Review (07 minutes): Recap briefly the key points from previous sessions or relevant topics. Address any lingering questions or uncertainties from the previous material.

Presentation and Explanation (15 minutes): Present new material or delve deeper into selected topics. Provide clear explanations using examples, diagrams, or visual aids to aid understanding. Break down complex ideas into manageable parts and ensure clarity in explanations.

Interactive Discussion and Q&A (12 minutes): Engage students in discussions related to the presented material. Encourage active participation and critical thinking through open-ended questions. Address student queries and encourage them to ask questions for clarification.

Application and Practice (15 minutes): Assign activities or problem-solving exercises that apply the newly learned concepts. Monitor students' progress and provide guidance as they work through the tasks. Facilitate peer-to-peer learning by encouraging students to discuss their approaches with peers.

Summary and Conclusion (05 minutes): Summarize the main points covered during the tutorial session. Reinforce key concepts and their relevance to the broader course objectives. Prepare students for the next steps in their learning journey related to the topic.

Feedback and Next Steps (05 minutes): Gather feedback from students on the tutorial session, including what they found most helpful and any areas needing improvement. Provide recommendations for further study, additional resources, or upcoming assignments related to the topic.

3. Engagement Strategies:

Active Participation: Encourage all students to actively engage in discussions and activities throughout the session.

Use of Technology: Utilize multimedia presentations or online tools to enhance learning experiences and engagement.

Group Activities: Incorporate group discussions or collaborative activities to promote peer learning and interaction.

4. Assessment and Evaluation:

Formative Assessment: Assess student understanding through informal assessments, discussions, and problem-solving activities.

Feedback Mechanism: Provide timely feedback on students' participation and comprehension to support their learning progress.

5. Logistics and Environment:

Classroom Setup: Ensure a comfortable and conducive learning environment with adequate seating, lighting, and equipment for presentations.

Time Management: Manage time effectively to cover all planned activities within the two-hour duration.

6. Post-Tutorial Follow-Up:

Reflection: Reflect on the tutorial session to evaluate its effectiveness and identify areas for improvement in future sessions.

Student Support: Offer additional office hours or online support for students who may need further assistance with tutorial material or assignments.

By following these guidelines, you can conduct a structured and engaging two-hour tutorial session that enhances students' understanding and retention of theory subjects while fostering active learning and participation.

Guidelines for The Students Induction Programme (SIP) for First Year Engineering

When First Year Engineering students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Induction programme for First Year Engineering students is introduced to familiarize them to the new environment and encourage them to learn beyond classrooms.

Objective is to help new students adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self-exploration. Induction Program should be preferably of 3 weeks (2 weeks at beginning first semester and 1 week at the beginning of second semester).

In order to implement the (SIP) the following activities can be taken at college.

a) **Physical Activity**: - This would involve a daily routine of physical activity with games and sports.

b) **Creative Arts:** - Every student would choose one skill related to arts whether visual arts or performing arts.

c) **Mentoring and Universal Human values**: -Mentoring and connecting the students with faculty members and other students is the most important part of student induction. This can be effectively done by forming a group of 22-24 students with a faculty mentor each. This can be implemented through group discussion and real-life activities rather than only lecturing.

d) **Familiarization with College, Department and Branch:**- The incoming student should be told about the credit, grading system and scheme of the examination. They should be explained how the study in College differs from the study in school. They should be taken on College tour and shown important facilities such as library, canteen, gymkhana etc. They should be shown their own department.

e) **Literary Activity**:- Literary Activity would compass reading book, writing a summary, debating, enacting a play etc.

f) **Proficiency modules:** - The modules can be designed to overcome some critical lacunas that students might have like English Speaking, Computer familiarity etc.

g) **Lectures by Eminent People: -** The lectures of Eminent people be organized to expose the students to social activity and public life.

h) **Visit to local Area:-** A couple of visits to the landmarks of the city or a hospital are orphanage could be organized.

i) **Extracurricular activities in College**:- The new students should be introduced to the extracurricular activities at the College.

j) **Feedback and Report on the program**:-Students should be asked to give their mid program Feedback wherein each group of 22-24 students should be asked to prepare a single report on their experience of the program.

These are summarized guidelines to be given to the student inducing induction programme (SIP). Please refer SIP Manual published by AICTE for detail guidelines at https://www.aicte-india.org/content/student-induction-program-detailed-guide.

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Savitribai Phule Pune University
Faculty of Science and Technology

National Education Policy (NEP) Compliant Curriculum

Semester - I

First Year Engineering (2024 Pattern)

www.unipune.ac.in

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: BSC-101-BES Course Name: Engineering Mathematics-I

Teaching Scheme			Credit	Examination Scheme		
Theory	:	3 Hours/Week	03	CCE	:	30 Marks
Tutorial	:	1 Hour/Week	01	End-Semester	:	70 Marks
				Term Work	:	25 Marks

Prerequisite Courses, if any:

- Differentiation, Integration, Maxima and Minima, Matrices and Determinants.

Course Objectives:

To familiarize the students with concepts and techniques in Calculus, Fourier series and Linear Algebra. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems. **Determine** the Fourier series representation and harmonic analysis of periodic functions in engineering applications.

CO2: Evaluate derivative functions of several variables that are essential in various engineering problems.

CO3: Apply the concept of Jacobian to find partial derivatives of implicit function and functional dependence. Use of partial derivatives in estimating errors & approximations and finding extreme values of the function.

CO4: Apply the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, Linear dependence & Independence, finding linear and orthogonal transformations.

CO5: Determine Eigen values & Eigen vectors. Use it to diagonalize matrix and to reduce quadratic form to canonical form, applicable to engineering problems.

Course Contents

Unit I	Single Variable Calculus	(08 Hours)

Rolle's Theorem, Mean Value Theorems, Taylor's and Maclaurin's Series, Indeterminate Forms and L' Hospital's Rule.

Fourier series: Full range and Half rage Fourier series, Harmonic analysis, Applications to problems in Engineering

Unit II	Multivariable Calculus – Partial Differentiation	(08 Hours)

Introduction to functions of several variables, Limit, Continuity and Partial Derivatives. Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative and Change of

Independent variables.

Unit III	Applications of Partial Differentiation	(08 Hours)

Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers and Applications to problems in Engineering

Unit IV	Linear Algebra – Matrices and System of Linear Equations	(08 Hours)

Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in Engineering.

Unit V	Linear Algebra - Eigen Values, Eigen Vectors and Diagonalization	(08 Hours)

Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonalization of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations. Application to problems in Engineering.

Learning Resources

Text Books:

1.Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)

2.Higher Engineering Mathematics by B. S. Grewal (Khanna Publication)

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Elementary Linear Algebra. by Ron Larson and David C. Falvo (Houghton Mifflin Harcourt Publishing Company)

MOOC / NPTEL/YouTube Links: -
https://youtube.com/playlist?list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&si=3xAONJdT2ph_jcvG

Tutorial and Term Work:

1. Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.
2. Term work shall consist of six assignments each on unit-I to unit-VI and is based on performance and continuous internal assessment.

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: BSC-102-BES Course Name: Engineering Physics

Teaching Scheme	Credit	Examination Scheme
Theory : 03 Hours/Week **Practical : 02 Hours/Week**	**03** **01**	**CCE : 30 Marks** **End-Semester : 70 Marks** **Term Work : 25 Marks**

Prerequisite Courses, if any:

Bohr's atomic theory, properties of mechanical and electromagnetic waves, Huygens' principle and wavefront, interference and polarization of light, wave particle duality, intrinsic and extrinsic semiconductors, basics of magnetism, trigonometry and calculus.

Course Objectives:

The objective of the course is to impart the knowledge of fundamentals of physics through hands-on experiments and extend it to relevant engineering applications.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Develop the understanding of working principle of lasers, optical fibers and extend it to holography and fiber optic communication.

CO2: Deduce Schrödinger's wave equations and apply it to problems on the bound states by summarizing fundamentals of quantum physics.

CO3: Explain phenomena of interference in thin films, polarization, double refraction and connect to the Anti-Reflection Coating, LCD.

CO4: Develop understanding of Fermi level and Fermi energy in semiconductors on the basis of results of Fermi Dirac statistics and relate them with the working of semiconducting devices. Extend the **understanding** of Ultrasonic to thickness measurement, flaw detection.

CO5: Explain properties of nanoparticles and estimate engineering applications; Explain phenomenon of Superconductivity and estimate engineering applications.

Course Contents

Unit I	Fundamentals of Photonics	(08 Hours)

Laser: Spontaneous and stimulated emission, population inversion, pumping, active medium & active center, resonant cavity; Characteristics of lasers, CO2 laser: construction and working, Engineering applications of laser (IT, medical, industry), Holography (recording, reconstruction, applications); Optical

Optical fibers: Critical angle, acceptance angle, acceptance cone, numerical aperture, total internal reflection and propagation of laser; Classification of optical fibers: Single mode & multimode, step index & graded index, Attenuation: attenuation coefficient, causes of attenuation; Advantages of optical fiber communication, numerical problems on parameters of optical fiber.

Unit II	Quantum Physics	(08 Hours)
de Broglie hypothesis of matter waves, de Broglie wavelength for a particle accelerated by KE "E" and a charged particle accelerated by PD "V", properties of matter waves; Wave function and probability density, mathematical conditions for wave function, problems on de Broglie wavelength; Need and significance of Schrödinger's equations, Schrödinger's time independent and time dependent equations; Energy of a particle enclosed in a rigid box and related numerical problems; Quantum mechanical tunneling, alpha particle decay, principle and applications of STM; Principles of quantum computing: concept of qbit, superposition and entanglement, comparison of classical & quantum computing, potential applications of quantum computing.		
Unit III	**Wave optics**	**(08 Hours)**
Interference in thin film of uniform thickness, conditions of maxima and minima for reflected system; Conditions for maxima and minima for wedge shaped film (qualitative), engineering applications – ARC, determination of optical flatness; Numerical problems on thin film and wedge shaped film; Types of polarization: Unpolarized, Polarized, PPL, CPL and EPL, Malu's law and related numerical problems; Double refraction: geometry of calcite crystal, Huygens' theory; Engineering applications of polarization: LCD, communication & radar, 3D movies (recording, projection).		
Unit IV	**Semiconductor Physics and Ultrasonics**	**(08 Hours)**
Semiconductor Physics: Valence band, conduction band, band gap energy, classification of solids on the basis of band theory; Fermi level and Fermi energy for metal, FD distribution function and its temperature dependence, position of Fermi level in intrinsic semiconductors (derivation); Fermi level for extrinsic semiconductors, working of PN junction diode on the basis of Fermi energy; Solar cell: principle, working, IV-characteristics, efficiency and fill factor, measures to improve efficiency of solar cell, advantages and applications in environmental sustainability; Hall effect: derivation for Hall voltage and Hall coefficient and related numerical problems. **Ultrasonics:** Characteristics and properties of ultrasonic waves, Generation of ultrasonic waves by inverse piezoelectric effect (using transistor); Engineering applications - thickness measurement, flaw detection and related numerical problems.		
Unit V	**Physics of Nanoparticles and Superconductivity**	**(08 Hours)**
Nanoparticles: Quantum confinement and its effect on properties of nanoparticles, synthesis methods - ball milling and Physical Vapor Deposition; Properties of nanoparticles (optical, electrical, mechanical, magnetic); Applications of nanotechnology: Electronics (GMR effect and its application in read-write head of HDD), automobiles, environmental & energy, medical field (targeted drug delivery). **Superconductivity:** Temperature dependence of resistivity, critical magnetic field, critical current, Meissner effect and perfect diamagnetism; Type I and Type II Superconductors, Numerical problems on critical magnetic field; Formation of Cooper pairs, DC and AC Josephson effect, SQUID: working principle and applications; Engineering applications: electronics, principle of Maglev train.		

List of Laboratory Experiments/Assignments (Any 8 from the given list)

1. An experiment based on Laser: To determine the divergence of a laser beam or to determine diameter of a thin wire or to perform beam profile analysis of a laser beam.
2. An experiment based on optical fiber: To determine the numerical aperture or attenuation coefficient or critical angle of incidence for given a glass slab or any experiment to calculate parameters of optical fiber.
3. Determination of Planck's constant using available experimental setup.
4. Newton's rings - to understand the interference and determine radius of curvature of a given plano-convex lens or determine wavelength of given monochromatic light.
5. An experiment based on diffraction: determination of number of lines per centimeter on grating surface using normal incidence method or determination of wavelength of laser using transmission grating or to determine wavelength of light using diffraction grating & spectrometer.
6. An experiment based on polarization: To verify cosine square law of Malus Law for plane polarized light or to determine the specific rotation of the given sample with the help of a polarimeter or to determine refractive indices of extraordinary and ordinary rays using double refractive prism.
7. To determine the band gap energy of a semiconductor sample using a PN junction diode.
8. To plot I-V characteristics and determine fill factor and efficiency of a given solar cell.
9. To determine Hall coefficient and charge carrier density of a given semiconductor sample.
10. Determination of velocity of ultrasonic waves and compressibility of given liquid by using Ultrasonic Interferometer
11. An experiment based on physical measurements developed using Arduino interface for Hall effect sensor or Ultrasonic sensor.
12. Study tour / visit to a research laboratory / facility and submit a report.

Note: Apart from the above list, any one experiment related to the curriculum available in the institute / developed in-house / performing experiment on Virtual Lab platform may also be considered to be performed out of eight experiments.

Learning Resources

Text Books:

- A Textbook of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar & TVS Arun Murthy, S. Chand Publications.
- Engineering Physics, R. K. Gaur and S. L. Gupta, Dhanpat Rai Publications.

Reference Books:

- Optics, Ajoy Ghatak, Tata Mc Graw Hill
- Introduction to Solid State Physics, C. Kittel, Wiley and Sons.
- Quantum Mechanics, A. K. Ghatak, S. Lokanathan, Laxmi Publications.
- Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni, Capital Publishing.
- Physics for Scientists and Engineers with Modern Physics, Serway and Jewett, Cengage Publications.

e-Books:

1. Feynman Lecture series: https://www.feynmanlectures.caltech.edu/
2. Concepts of Modern Physics, Arthur Beiser: https://nitsri.ac.in/Department/PHYSICS/Beiser_Modern_Physics.pdf

MOOC / NPTEL/YouTube Links:

1. Lectures by Walter Lewin: https://www.youtube.com/channel/UCiEHVhv0SBMpP75JbzJShqw
2. Quantum Mechanics Lecture Series by Prof. H. C. Verma: https://www.youtube.com/playlist?list=PLWweJWdB_GuISnGkAafMpzzDBvTHg02At

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: BSC-103-BES Course Name: Engineering Chemistry

Teaching Scheme	Credit	Examination Scheme
Theory : 03 Hours/Week **Practical : 02 Hours/Week**	**03** **01**	**CCE : 30 Marks** **End-Semester : 70 Marks** **Term Work : 25 Marks**

Prerequisite Courses, if any: Types of titrations, structure property relationship, classification and properties of polymers, electromagnetic radiation, electrochemical series.

Course Objectives:

To acquire knowledge of water quality analysis technology and electro-analytical techniques for chemical analysis. Learn about specialty polymers and nanomaterials. Study conventional and alternative fuels, and understand corrosion mechanisms and prevention methods.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the practical approaches and techniques required to effectively monitor water quality.

CO2: Select appropriate electro analytical techniques for understanding the materials.

CO3: Demonstrate the structure and properties of advanced engineering materials for various technological applications.

CO4: Analyze different types of conventional and alternative fuels.

CO5: Explain causes of corrosion and methods for minimizing corrosion.

Course Contents

Unit I	Water Technology	(08 Hours)

Impurities in water, hardness of water: Types, Units and Numerical. Determination of hardness (by EDTA method using molarity concept) and alkalinity, numerical. Ill effects of hard water in boilers - priming and foaming, scale and sludge. Water treatment: i) Zeolite method and numerical ii) Demineralization method. Purification of water: Reverse osmosis and Electrodialysis. Modern technique for /of atmospheric water generation.

Unit II	Instrumental Methods of Analysis	(08 Hours)

Introduction: Types of reference electrode (calomel electrode), indicator electrode (glass electrode), ion selective electrode (solid membrane electrode)

[A] Conductometry: Introduction, conductivity cell, conductometric titrations of acid versus base with titration curve. (Strong acid- Strong base). Applications of conductometry**.**

[B] pHmetry: Introduction, standardization of pH meter, pH metric titration of strong acid versus strong base with titration curve and its applications.

[C] UV-Visible Spectroscopy: Introduction, statement of Beer's law and Lambert's law, Electronic transitions in organic molecule, terms involved in UV-visible Spectroscopy. Instrumentation (double beam) and its applications. Numerical: Based on Absorption laws i.e. Molar absorptivity and concentration.

Unit III	Advanced Engineering Materials	(08 Hours)

A] Polymers: Introduction, Definition Polymer, Monomer, Functionality of monomers, Classification of polymer (Thermal Behavior-Thermoplastics and Thermosetting).

Specialty polymers: Introduction, preparation, properties and applications of the following polymers: 1. Engineering Thermoplastic: Polycarbonate, 2. Bio-degradable polymers: Poly (hydroxybutyrate-hydroxyvalerate), 3. Conducting Polymer: Polyacetylene.

[B] Nanomaterials: Introduction, classification of nanomaterials based on dimensions (zero dimensional, one-dimensional, two-dimensional and three-dimensional), structure, properties and applications of graphene and carbon nanotubes, quantum dots (semiconductor nanoparticles).

Unit IV	Energy Sources	(08 Hours)

Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel), Calorific value, Higher calorific value and Lower calorific value, Determination of calorific value: Principle, construction and working of Bomb calorimeter and Boy's gas calorimeter and numerical, Solid fuel. Coal: Analysis of Coal-Proximate and Ultimate analysis, numerical, Alternative fuels: Power alcohol and biodiesel. Hydrogen gas as a future fuel. Lithium Ion Battery, construction, working, advantages, applications.

Unit V	Corrosion and its Prevention	(08 Hours)

Introduction, Types of corrosion – Dry and Wet corrosion, mechanism of dry corrosion, nature of oxide films and Pilling-Bedworth's rule, wet corrosion – mechanism: hydrogen evolution and oxygen absorption, Factors influencing rate of corrosion. Methods of corrosion control and prevention: Cathodic Protection (Sacrificial Anode and Impressed Current), metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, electroplating. Corrosion Resistant / Anti corrosive paints.

List of Laboratory Experiments (Any 8 experiments from the given list).

1. To determine hardness of water by EDTA method.
2. To determine alkalinity of water.
3. To determine strength of strong acid using pH meter
4. To determine maximum wavelength of absorption of CuSO4/FeSO4/ KMnO4, verify Beer's law and find unknown concentration of given sample.

5. Titration of a mixture of weak acid and strong acid with strong base using conductometer.
6. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin.
7. To determine molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
8. Proximate analysis of coal
9. To coat copper and zinc on an iron plate using electroplating.
10. Preparation of biodiesel from oil.
11. Colloidal synthesis of 2-6 or 3-5 semiconductor quantum dots nanoparticles.

Learning Resources

Text Books:

1.Textbook of Engineering Chemistry by Dr. S. S. Dara, Dr. S. S. Umare, S. Chand & Company Ltd.

2.Engineering Chemistry by O. G. Palanna, Tata Magraw Hill Education Pvt. Ltd.

3.Textbook of Engineering Chemistry by Dr. Sunita Rattan, S. K. Kataria& Sons Publisher.

Reference Books:

1.Basic Concept of Analytical Chemistry, 2ed, S. M. Khopkar, New Age-International Publisher.

2.Instrumental Methods of Chemical Analysis, G. R. Chatwal& S. K. Anand, Himalaya Publishing House.

3.Spectroscopy of organic compounds, 2ed, P. S. Kalsi, New Age-International Ltd., Publisher.

4.Polymer Science, V. R. Gowarikar, N. V. Viswanathan, jayadev Sreedhar, Wiley Eastern Limited.

5. Inorganic Chemistry, 5ed, Shriver and Atkins, Oxford University Press.

6. Fundamentals of Nanotechnology, G. L. Hornyak, J. J. Moone, H. F. Tihhale, J. Dutta, CRC press.

e-Books:

1. **https://chem.nju.edu.cn/_upload/article/files/b5/6f/01f0f2434d708df797208aea2613/83f2b441-65ee-44a6-ac47-ed21db462c5d.pdf.**
2. **https://edisciplinas.usp.br/pluginfile.php/5955761/mod_resource/content/1/CORROSION_AND CORROSION_CONTROL_An_Intro%20%20Revie%20and%20Uhlig.pdf**

MOOC / NPTEL/YouTube Links:

1. **https://nptel.ac.in/courses/113104082**

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: ESC-101-ETC Course Name: Basic Electronics Engineering

Teaching Scheme	Credit	Examination Scheme
Theory : 02 Hours/Week **Practical : 02 Hours/Week**	**02** **01**	**CCE : 30 Marks** **End – Sem : 70 Marks** **Term Work : 25 Marks**

Prerequisite Courses, if any:
Basic Physics and Mathematics, Semiconductor Physics, Digital Electronics, Circuit Theory, Analog Electronics, Sensors and Transducers

Companion Course, if any: Laboratory Practical

Course Objectives:

1. To **understand** the working principles of PN junction diode and Special purpose diodes.
2. To **study** the operating principle and applications of Bipolar Junction Transistors & MOSFET.
3. To **learn** the concepts of various logic gates, digital circuits, Microprocessor & Controller.
4. To **understand** the concepts of Opamp, its applications and electronic Instruments.
5. To **know** the methods of measurement of physical parameters using sensors and transmission with the help of communication systems.

Course Outcomes:

On completion of the course, learner will be able to:

CO1: Know about the working of P-N Junction diode and its application as rectifier & switch, basics of LED & Photodiode.

CO2: Understand the working of BJT & MOSFET, their characteristics & compare.

CO3: Learn logic gates & realization of the digital circuits.

CO4: **Understand** the functioning of Opamp and electronic instruments.

CO5: Select sensors based on their working principle for specific applications and its implementation with Communication system.

Course Contents

Unit I	Diodes and Applications	(06 Hours)

Evolution of Electronics, Current trends in Electronics, Impact of Electronics in industry and society. Introduction to active and passive components.

P-N Junction Diode: P-N Junction diode construction and its working in forward and reverse bias conditions, V-I characteristics of P-N junction Diode, Diode as a switch, Half wave rectifier, Full wave and Bridge rectifier.

Special purpose diodes: Light Emitting Diode (LED) and photo diode along with V- I characteristics and their applications.

#Exemplar	LED TV, IR-Remote Controller, Rolling Displays, SMPS, Mobile & Laptop Chargers

Unit II	Transistors and Technology	(06 Hours)

Bipolar Junction Transistor: Construction, type, Operation, V-I Characteristics in common emitter mode, BJT as switch and Common Emitter(CE) amplifier.

Enhancement Metal Oxide Semiconductor Field Effect Transistors (EMOSFET): Construction, Types, Operation, V-I characteristics, MOSFET as switch & amplifier. Introduction to VLSI Technology, Feature size/Channel Length, N Well method of VLSI CMOS manufacturing.

#Exemplar	Audio Amplifier / PA System, CMOS ICs in Cell phone & Laptops, Pen Drives.	
Unit III	**Logic Gates and Digital Circuits**	**(06 Hours)**

Number System: Introduction of Binary, Decimal, Octal, Hexadecimal, Conversion of Binary to Decimal, Decimal to Binary, Binary addition.

Logic Gates - AND, OR, NOT, XOR, XNOR. Universal Gates – NAND, NOR. De-Morgan's theorem.

Logic circuits - Half & Full adders. SR, JK, T & D Flip Flops.

Introduction to Microprocessor and Microcontroller (Only block diagram and explanation). Digital IC design flow, IC Fabrication process flow.

#Exemplar	Memories in Cell Phone, Laptop, Pen drive, ECU in Advanced car, Automation in manufacturing using PLC, Arduino Boards.	
Unit IV	**Operational Amplifier and Electronic Instruments**	**(06 Hours)**

Operational amplifier: Functional block diagram of operational amplifier, Ideal & practical values of performance parameters, Op-amp applications: Inverting, Non-inverting amplifier.

Electronic Instruments: Block diagram of Digital Multimeter, Function Generator, Digital Storage Oscilloscope (DSO), DC power supply.

#Exemplar	Domestic Energy Meter, Battery Charging Station, ICU Monitor in Hospital.	
Unit V	**Sensors and Communication Systems**	**(06 Hours)**

Classification of sensors: Active /Passive Sensors, Selection Criteria/Characteristics of sensor. Motion Sensors (LVDT), Temperature Sensors (Thermocouple, RTD), Mechanical Sensors (Strain Gauge), Biosensors. Block diagram of IoT based Data Acquisition and Automation System.

Communication Systems: Block Diagram, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Cellular concept, Block diagram of GSM system.

#Exemplar	Digital Thermometer, Weighing Machine, Green House Automation in Agricultural, Home Automation. 4G & 5G Technology, Satellite Communication, Radar/Military Communication

List of Laboratory Experiments (Any 8 experiments from the given list)

1.	Electronic Components: Study of Active and Passive components a) Resistors (Fixed &Variable), Calculation of resistor value using color code. b) Capacitors (Fixed &Variable) c) Inductors, Calculation of inductor value using color code.

	d) Devices such as Diode, BJT, MOSFET, various IC packages e) Switches & Relays
2.	Measurements using various measuring instruments: a) Setup CRO and function generator for measurement of AC & DC voltages and frequency b) Measure Voltage, Resistance using digital Multimeter. Also use Multimeter to check diode, BJT.
3.	V-I characteristics of P-N Junction Diode (Study the datasheet of typical PN junction diode)
4.	Rectifier circuits: Implement DC Regulated Power Supply using bridge rectifier & diodes.
5.	Build and test Common Emitter (CE) BJT Amplifier Circuit. a) Calculate the Gain of CE Amplifier
6.	Linear applications of Op-amp: Build inverting and non-inverting amplifier using op-amp(Study the data sheet of typical Op-Amp741)
7.	Test and verify the truth tables of: a) Basic and Universal Gates (Study the datasheet of respective ICs) b) Half & Full Adder
8.	Study of transducers/sensor (Any3)
9.	Build and test any circuit using BJT/MOSFET/Op-Amp/Logic Gates using any one sensor.
10.	Case Study of any one electronics appliances with block diagram, specification etc.

Guidelines for Instructor's Manual

- The instructor’s manual is to be developed as a hands-on resource and reference.
- Copy of Curriculum, Conduction & Assessment guide lines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Objective
3. Apparatus with their detailed specifications.
4. Brief theory related to the experiment.
5. Connection diagram /circuit diagram.
6. Observation table
7. Sample calculations for one/two reading.
8. Result tabl
9. Graph and Conclusions.

Guidelines for Laboratory Conduction

- All the experiments (Any Eight) mentioned in the syllabus are compulsory.
- Use of open source software and recent version is to been courage.

Guidelines for Lab/TW Assessment

- Continuous assessment of laboratory work is to be done based on overall performance.
- Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each laboratory assignment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.

Learning Resources

Text Books:

1. Electronics Devices by Thomas.` L. Floyd, 9th Edition, Pearson
2. Modern Digital Electronics by R. P. Jain, 4th Edition, Tata McGraw Hill
3. Electronic Instrumentation by H. S. Kalsi, 3rd Edition, Tata McGraw Hill
4. Sensors and Transducers by D. Patrnabis, 2nd Edition, PHI
5. Electronic Communication Systems by Kennedy & Davis, 4th Edition, Tata McGraw Hill
6. Mobile Wireless communication by M. Schwartz, Cambridge University Press

Reference Books:

1. Digital Fundamentals by Thomas. L. Floyd, 11th Edition, Pearson
2. Mobile Communication by J. Schiller, 2nd Edition, Pearson
3. Sensors Handbook, by S. Soloman, 2nd Edition.
4. CMOS Circuit Design, Layout & Simulation, by Baker, 2nd Edition, Wiley IEEE Press

e-Books:

1. https://www.pearson.com/en-us/subject-catalog/p/electronic-devices-electron-flow-version/P200000001048

MOOC / NPTEL/YouTube Links:

1. https://nptel.ac.in/courses/117103063
2. https://nptel.ac.in/courses/117103064
3. 3. https://archive.nptel.ac.in/courses/106/105/106105166/

Savitribai Phule Pune University First Year of Engineering (2024 Pattern) Course Code: ESE-102-ELE Course Name: Basic Electrical Engineering		
Teaching Scheme	**Credit**	**Examination Scheme:**
Theory : 02 Hours/Week **Practical : 02 Hours/Week**	**02** **01**	**CCE : 30 Marks** **End - Semester : 70 Marks** **Term Work : 25 Marks**

Prerequisite Courses, if any: Electric charges and fields, Coulomb's laws, Voltage, Potential, Current, Ohms law, Magnetism, EMF, Faraday's Laws, Alternating current, AC Generator, Power.

Companion Course, if any: Laboratory Practical

Course Objectives:

To impart the fundamental knowledge of electrical engineering to all the students of various disciplines and give comprehensive idea about AC and D C circuit analysis, working principles and applications of basic electric machines. The aim is also to familiarize students with different wiring components, wiring schemes and electricity bill.

Course Outcomes:

On completion of this course, learners will be able to:

CO1: Apply Kirchhoff's Laws, Superposition theorem and network simplification techniques for DC circuit analysis.

CO2: Analyze the magnetic circuit parameters, self-Inductance, mutual Inductance and Electromotive Forces (EMF's).

CO3: Calculate AC quantities using mathematical equations, waveforms and phasor diagrams.

CO4: Compute the voltage, current and power of the given 1-phase and 3-phase AC circuits

CO5: Understand the working principle of 1-Phase Transformer, Motors (DC, Induction) and their practical applications.

Course Contents

Unit I	Elementary Concepts and DC Circuits	(06 Hours)

Elementary concepts: Resistance, EMF, current, potential difference, Ohm's law. Overview of elementary power system showing stages such as Generation, Transmission, and Distribution of electrical energy.

DC Circuits: Classification of electrical networks, simplifications of networks using series-parallel combinations and star delta transformation technique, Kirchhoff's Laws and their applications for network solutions using loop analysis, Superposition theorem

#Exemplar	Electric power system, Electrical Load Distribution box, Robotics

Unit II	Electromagnetism	(06 Hours)

Magnetic Circuit: Concept of flux density, field strength, permeability, MMF, reluctance, their units, and relationships. Simple series magnetic circuit, comparison of electric and magnetic circuit.

Electromagnetic Induction: Faradays Laws of electromagnetic induction, Fleming's right-hand rule, statically and dynamically induced emf, self and mutual inductance, coefficient of coupling. Energy stored in magnetic field.

#Exemplar	Loudspeaker, Motor, Generator, Transformer

Unit III	**AC Fundamentals**	**(06 Hours)**
Generation of single-phase sinusoidal voltages and currents, their mathematical and graphical representation, Concept of cycle, period, frequency, instantaneous, peak, average and RMS. values, peak factor and form factor. Phase, Phase difference, lagging, leading in phase quantities and their phasor representation. Rectangular and polar representation of phasor. Study of AC circuits consisting of pure resistance, pure inductance, pure capacitance.		
#Exemplar	Generator, Electrical appliances response, Electrical heater, radio circuits, capacitor	
Unit IV	**AC Circuits**	**(06 Hours)**
Single Phase AC Circuits: Series R-L, R-C and R-L-C circuits, concept of impedance, power factor, phasor diagrams, Voltage, current and power waveforms. Concept of active, reactive and apparent power. Resonance in RLC series circuits. **Three Phase AC Circuits**: Concept of three-phase AC symmetrical system, phase sequence, balanced and unbalanced load. Voltage, current and power relations in three phase balanced star and delta connected loads along with phasor diagrams.		
#Exemplar	Machine windings, Electric power network	
Unit V	**Introduction to Electric Machines**	**(06 Hours)**
Single Phase Transformer: Construction, working principle, EMF equation, transformation ratio, rating, types, losses, regulation and efficiency at different loading conditions. **Electrical Motors :** a) **D.C. Motors**: Construction, working principle, types, voltage equation, characteristics and Applications. b) **Three Phase Induction Motor**: Working principle using rotating magnetic field theory, types and applications. c) **Single Phase Induction Motor**: Construction, working principle of single phase Induction motor. Applications of split phase, capacitor start and capacitor run motors.		
#Exemplar	Mobile charger, electric substations, UPS, Lathe machine, compressor, lifts, hoists, ceiling fan etc	
List of Laboratory Experiments (Any 8 experiments from the given list).		
1. To study safety precautions while working on electrical systems, handling of various equipment's such as rheostat, multi-meter, ammeters, voltmeters, wattmeter's etc. 2. Study of wiring materials, switch board and different wiring schemes. (Simple wiring & staircase wiring). 3. To verify Kirchhoff's laws experimentally 4. To verify Superposition theorem experimentally 5. To determine efficiency and regulation of transformer by using direct loading test experimentally 6. To measure steady state response of series RL and RC circuits experimentally		

7. To study RLC series resonance experimentally
8. To verify the relation between phase and line quantities in three phase balanced star delta connections of load experimentally
9. Study of cut view section of single phase/ three phase Induction motor.
10. To measure insulation resistance by using megger and study of Single-Phase LT electricity bill.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about university / program/ institute / department / foreword / preface), University syllabus, conduction & Assessment guidelines, topics under consideration-concepts, objectives, and outcomes.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Objective
3. Apparatus with their detailed specifications
4. Brief theory related to the experiment
5. Connection diagram /circuit diagram
6. Observation table
7. Sample calculations for one/two reading
8. Result table
9. Graph and Conclusions.

Guidelines for Laboratory/ TW Assessment

1. Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of student.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment include- timely completion, performance, efficiency, punctuality, and neatness.

Learning Resources

Textbooks:

1. B.L. Theraja,A K Theraja "ABC of Electrical Engineering", S Chand Publications,2012
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill Education, 2nd edition 2019.

Reference Books:

1. C. L. Wadhwa, "Basic Electrical Engineering", New Age International (P) Limited 5th edition 2024
2. S K Bhattacharya, "Electrical Machines", McGraw Hill Education, 2nd edition, 2008
3. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford University Press, 2nd edition 2018.

e-Books: https://www.schandpublishing.com/books/tech-professional/electrical-engineering-electronics/abc-electrical-engineering/9788121939096/

MOOC / NPTEL/YouTube Links: https://nptel.ac.in/courses/108105112

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: ESC-103-MEC Course Name: Engineering Graphics

Teaching Scheme		Credit	Examination Scheme		
Theory	: 02 Hours/Week	02	CCE	:	30 Marks
Practical	: 02 Hour/Week	01	End-Semester	:	70 Marks
			Term Work	:	25 Marks

Prerequisite Courses, if any:

- Basic Geometric Shapes
- Basic geometrical measurements (linear and angular), Construction
- Deviation of line, circle and polygon, Co-ordinate geometry.
- Computer literacy.

Course Objectives:

This course aims to cultivate students' ability to conceptualize physical objects and effectively translate them onto paper for communication in engineering contexts. It focuses on enhancing manual drawing skills, honing drawing interpretation abilities, and fostering a practical understanding of object dimensions. Additionally, the course seeks to introduce students to essential drawing and design software tools for a well-rounded skill set.

Course Outcomes:

On completion of the course, learner will be able to:

CO 1 – **Explain** the fundamentals of Engineering Graphics and basic principles of geometric construction and apply the knowledge of Projections, Methods to prepare the drawings for points and lines.

CO 2 - **Apply** the types of Projections, Methods to prepare the drawings for planes.

CO 3 – **Construct** the various engineering curves and illustrate the application of various engineering curves and draw the development of the lateral surface of solid.

CO 4 - **Apply** the concept of orthographic projection of an object to draw several 2D views for visualizing the physical state of the object.

CO 5 - **Apply** the visualization skill to draw an isometric projection from given orthographic views.

Course Contents

Unit I	Fundamentals of Engineering Drawing and Projection of Point and Line	(06 Hours)

Fundamentals of Engineering Drawing: Introduction to drawing instruments and their uses, Drawing sheets sizes and their layouts, Types of Lines, Dimensioning methods, General rules of dimensioning. Projection of Point and Line.

Theory of projection - Projection of points in all possible quadrants. Projection of line when parallel to both the reference planes, Projections of lines when it is perpendicular to one of the reference planes, when line is inclined to one and parallel to other reference plane, Line inclined to both reference planes (first angle projection).

Unit II	Projection of Plane	(06 Hours)

Introduction, Projection of plane when plane is Parallel to one and perpendicular to other, Projection of plane when plane is inclined to one plane and perpendicular to other Projections of planes when it is inclined to both reference planes.

Unit III	Engineering Curves and Development of Lateral Surfaces	(06 Hours)

Engineering Curves: Conic Sections- Ellipse, Parabola and Hyperbola by directrix and focus and rectangle method, Helix (one convolution) on Cylinder and Cone, Cycloid, Involute of a circle, Archimedean spiral (one convolution)

Development of Lateral Surfaces: Introduction, Method of development, development of lateral surfaces of right solids, cube, prisms, cylinder, pyramids, and cone.(No sectioned solids)

Unit IV	Orthographic Projection	(06 Hours)

Introduction, Principle of projection, Plane of Projection, Method of Projection, Orthographic Projection First and Third angle method of projection, Hidden features, curved features, circular features. etc. Typical problems by first angle projection method

Unit V	Isometric Projection	(06 Hours)

Introduction of isometric projection, Isometric lines, planes, non-isometric lines and planes, Isometric scale, Isometric projection and view, Construction of isometric view/ projection from given orthographic views.

List of Laboratory Experiments

Guidelines for Practical Evaluation: Assignment problems to be drawn on A2 size drawing sheet and two problems must be drawn by using any CAD software.

List of Assignments

1. Draw two problems on projection of lines
2. Draw two problems on projection of planes
3. Draw two problems on Engineering curves and development of lateral surfaces
4. Draw two problems on Orthographic projections
5. Draw two problems on Isometric projections

Learning Resources

Text Books:

1. Bhatt, N. D. and Panchal, V. M., (2016), "Engineering Drawing", Charotar Publication, Anand, India
2. K. Venugopal, K, (2015), "Engineering and Graphics", New Age International, New Delhi
3. Jolhe, D. A., (2015), "Engineering Drawing with introduction to AutoCAD", Tata McGraw Hill, New Delhi
4. Rathnam, K., (2018), "A First Course in Engineering Drawing", Springer Nature Singapore Pte. Ltd., Singapore

Reference Books: 1. Madsen, D. P. and Madsen, D. A., (2016), "Engineering Drawing and design", Delmar Publishers Inc., USA 2. Bhatt, N. D., (2018), "Machine Drawing", Charotor Publishing House, Anand, India 3. Dhawan, R. K., (2000), "A Textbook of Engineering Drawing", S. Chand, New Delhi 4. Luzadder, W. J. and Duff, J. M., (1992), "The Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production", Peachpit Press, USA 5. Giesecke, F. E., Mitchell, A., Spencer, H. C., Hill, I. L., Loving, R. O., Dygon, J. T., (1990), "Principles of engineering graphics", McMillan Publishing, USA
e-Books:
MOOC / NPTEL/YouTube Links: NPTEL Course: Engineering Graphics and Design **https://onlinecourses.nptel.ac.in/noc21_me128/preview** NPTEL Course: Introduction and Geometric Construction **https://archive.nptel.ac.in/content/storage2/courses/112103019/module1/lec3/1.html** NPTEL Course: Computer Aided Design and Manufacturing". **https://archive.nptel.ac.in/courses/112/102/112102101/**

Note: Some units of theory can be taught during practical sessions and more emphasis can be given on hands on skills.

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: ESC-104-CVL Course Name: Engineering Mechanics

Teaching Scheme	Credit	Examination Scheme
Theory : 2 Hours/Week **Practical : 2 Hours/Week**	**02** **01**	**CCE : 30 Marks** **End-Semester : 70 Marks** **Term Work : 25 Marks**

Prerequisite Courses, if any:

- Basic Calculus, Trigonometry, Geometrical expressions, Laws of motion, Concept of mass, acceleration with Fundamental knowledge of Engineering Mathematics and Physics.

Companion Course, if any: **Laboratory Practical.**

Course Objectives:

The objectives of this course is to make students to learn basics of engineering Mechanics concepts and its application to the real-world problems, solve problems involving Forces, loads and Moments and know their applications in allied subjects.

Course Outcomes:

On completion of the course, learner will be able to:

CO1. Understand basic concept of forces, moments and couples in two-dimension force system
CO2. Apply concept of free body diagram for static equilibrium in two-dimension force system
CO3. Analyze the practical example involving friction and application of two force members
CO4. Analyze rectilinear and curvilinear motion of particle
CO5. Apply Newton's second law, work energy and impulse momentum principles for particles

Course Contents

Unit I	Force systems and its resultants	(06 Hours)

Introduction, type of motion, fundamental concepts and principle, force system, resolution and composition of forces, resultant of concurrent force system, moment of a force, Varignon's theorem, resultant of parallel force system, couple and resultant of general force system. Introduction, centroid of basic figures, centroid of composite figure, moment of inertia of simple geometrical figure, parallel axis theorem, perpendicular axis theorem, moment of inertia of composite figure.

Unit II	Equilibrium	(06 Hours)

Introduction, free body diagram, equilibrium of coplanar forces, equilibrium of two forces, three force principle, equilibrium of concurrent, parallel and general force system, type of load, type of support, type of beam and support reaction.

UNIT III	Friction and trusses	(06 Hours)

Introduction, sliding and rolling friction, laws of coulomb friction, coefficient of friction, angle of repose, angle of friction, cone of friction, friction on inclined plane, ladder friction and belt friction.

Trusses: two force and multi force member, assumption of analysis, analysis of truss, identification of zero force members, method of joint and method of section.

UNIT IV	Kinematics of particle	(06 Hours)
Introduction, basic concept, rectilinear motion: motion with uniform acceleration, gravitational acceleration and variable acceleration, curvilinear motion: rectangular components, motion of projectile, normal and tangential components.		
UNIT V	**Kinetics of particle**	**(06 Hours)**
Introduction, Newton's second law of motion, equation of motion, Newton's law of gravitation, application of Newton's second laws to rectilinear and curvilinear motion, conservative and non-conservative forces, work energy principle, conservation of energy, impulse momentum principle and impact		

List of Laboratory Experiments

Journal consist of the following

A. Compulsory experiments as per following list

1. Verification of the Polygon law of forces
2. To find support reaction of beam
3. To determine coefficient of friction
4. Determination of coefficient of restitution

B. Graphical Solution of the following

1. Equilibrium of concurrent force system
2. Equilibrium of parallel force system
3. Forces in the member of pin jointed truss
4. Moment of Inertia

C. Assignment on each unit: minimum four example on each unit

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Objective
3. Apparatus with their detailed Drawing.
4. Brief theory related to the experiment.
5. Observation table
6. Sample calculations for one/two reading.
7. Result table
8. Graphs (if any) and Conclusions.

Guidelines for Laboratory/ TW Assessment

a. Continuous assessment of laboratory work is to be done based on overall performance and Laboratory performance of student.
b. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment include timely completion, performance, efficiency, punctuality, and neatness.

Learning Resources
Text Books: 1. Engineering Mechanics, Ferdinand Singer, 3rd edition, Harper and Row 2. Engineering Mechanics (Statics and Dynamics) by Hibbeler R. C., Pearson Education
Reference Books: 1. Engineering Mechanics, S Timoshanko and Young, Tata McGraw Hill Education Pvt. Ltd. New Delhi. 2. Vector Mechanics for Engineers – Statics, Beer and Johnston, Tata McGraw Hill 3. Vector Mechanics for Engineers – Dynamics, Beer and Johnston, Tata McGraw Hill. 4. Engineering Mechanics - Statics and Dynamics, Meriam J. L. and Kraige L.G., John Wiley and Sons

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: ESC-105-COM Course Name: Fundamentals of Programming Languages

Teaching Scheme	Credit	Examination Scheme
Theory : 2 Hours/Week Practical : 2 Hours/Week	02 01	CCE : 30 Marks End – Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses, if any:
- Basics of Computers
- Basic Mathematics

Companion Course, if any: Fundamentals of Programming Languages Lab

Course Objectives:

1. To understand the fundamental Concepts of C Programming
2. To acquire knowledge and Compare usage of Operators and Expressions in C Programming
3. To apply Control Flow structures in C Programming for Problem solving
4. To design a solution using Arrays, Character and String Arrays in C programming
5. To design a develop solution for simple computational problems using User Defined Functions and structures in C Programming

Course Outcomes:

On completion of the course, students will be able to:

CO1: To **Design** algorithms for simple computational problems.

CO2: To **Use** mathematical, Logical Operators and Expressions.

CO3: To **apply** Control Flow structures for decision making.

CO4: To **design** a solution using Arrays, Character and String Arrays.

CO5: To **D**esign and apply user defined functions and structures.

Unit I	Introduction to Program Planning & C Programming	(06 Hours)

Program Design Tools: Art of Programming through Algorithms, Flowcharts.

Overview of C: History and importance C, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of variables, Storage Class, Assigning Values to variables, Defining Symbolic Constants, declaring a Variable as Constant, Declaring a Variable as Volatile.

#Exemplar/Case Studies	Study of "C" Program compilation Process, testing and debugging.

Unit II	Operators and Expressions	(06 Hours)

Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Bitwise Operators,

Special Operators. Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic Operators, Operator Precedence and Associativity, Mathematical Functions.		
#Exemplar/Case Studies	Study of Infix, Prefix and Postfix expressions.	
Unit III	**Control Flow**	**(06 Hours)**
Decision Making and Branching: Simple If Statement, If-Else,Else-If,Switch Statement, Goto Statement **Decision Making and Looping:** While Statement, Do-While, For Statement, Break and Continue		
#Exemplar/Case Studies	Design simple calculator and Generating a Calendar	
Unit IV	**Arrays**	**(06 Hours)**
Arrays: One Dimensional Arrays, Declaration of One-dimensional Arrays, Initialization of One-dimensional Arrays, Two –dimensional Arrays, Initialization of Two- dimensional Arrays. **Character Arrays and Strings:** Declaration and Initialization String Variables, Reading Strings from Terminal, Writing Strings to Screen, Putting Strings Together, Comparison of Two Strings, Introduction to String handling Functions		
#Exemplar/Case Studies	Matrix multiplication	
Unit V	**User Defined Functions**	**(06 Hours)**
User Defined Functions: Need for User-defined Functions, A Multi-Function Program, Elements of User defined Functions, Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but No Return Values, Arguments with Return values, No Arguments but Returns a Value, Functions that Return Multiple Values, Nesting of Functions, Recursion **Structures :** What is a Structure? Structure Type Declarations, Structure Declarations, Referencing Structure Members, Referencing Whole Structures, Initialization of Structures.		
#Exemplar/Case Studies	Tower of Hanoi, Generation of Monthly balance sheet	

List of Laboratory Experiments/Assignments (Any 6 to 8 laboratory assignments) based on Programming	
1	To accept the number and Compute a) square root of number, b) Square of number, c) Cube of number d) check for prime, d) factorial of number e) prime factors.
2	To accept from user the number of Fibonacci numbers to be generated and print the Fibonacci series.
3	To accept an object mass in kilograms and velocity in meters per second and display its Momentum. Momentum is calculated as e=mc^2 where m is the mass of the object and c is its velocity.

4	In array do the following: 1. Find given element in array 2. Find Max and Min element 3. Find frequency of given element in array 4. Find Average of elements in Array.
5	Write a C program for employee salary calculation given, Basic, H.R.A. 20 % of Basic and D.A. 150 % of Basic.
6	To accept a student's marks for five subjects, compute his/her result. Student is passing if he/she scores marks equal to and above 40 in each course. If student scores aggregate greater than 75%, then the grade is distinguished. If aggregate is 60>= and <75 then the Grade of first division. If aggregate is 50>= and <60, then the grade is second division. If aggregate is 40>= and <50, then the grade is third division.
7	To accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these two numbers.
8	Write a C program that accepts a string from the user and performs the following string operations- i. Calculate length of string ii. String reversal iii. Equality check of two Strings iii. Check palindrome ii. Check substring
9	Create Structure EMPLOYEE for storing details (Name, Designation, gender, Date of Joining and Salary), and store the data and update the data in structure.
10	Create class STORE to keep track of Products (Product Code, Name and price). Display menu of all products to users. Generate bills as per order.
Mini-Projects	
1	Calculator with basic functions. Add more functionality such as graphic user interface and Complex calculations.
2	Program that simulates rolling dice. When the program runs, it will randomly choose a number between 1 and 6 (Or other integer you prefer). Print that number. Request user to roll again. Set the min and max number that dice can show. For the average die, that means a minimum of 1 and a maximum of 6.
3	Guess Number: Randomly generate a number unknown to the user. The user needs to guess what that number is. If the user's guess is wrong, the program should return some sort of indication as to how wrong (e.g. the number is too high or too low). If the user guesses correctly, a positive indication should appear. Write functions to check if the user input is an actual number, to see the difference between the inputted number and the randomly generated numbers, and to then compare the numbers.
4	To calculate the salary of an employee given his basic pay (take as input from user). Calculate gross salary of employee. Let HRA be 10 % of basic pay and TA be 5% of basic pay. Let employees pay professional tax as 2% of total salary. Calculate net salary payable after deductions.
Learning Resources for Practical	
Text Books: Programming in ANSIC, 8e –E. Balagurusamy	

Reference Books:

1. B. S. Gottfried, Programming with C (Schaum's Outline Series), 2nd ed. McGraw-Hill, 1996.
2. S. C. Kochan, Programming in C, Sams Publishing, 3rd ed. 2004.
3. B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2 nd ed. UK: Prentice Hall, 1988.
4. W. Kernighan and B. Pike, The Practice of Programming, UK: Addison-Wesley, 1999
5. H. M. Deitel and P. J. Deitel, C: How to program, 8 th ed. Pearson Education, 2015.
6. P. Prinz & T. Crawford, C in a Nutshell: The Definitive Reference, 2nd ed., O'Reilly Media, 2016

e-Books:https://studylib.net/doc/25796931/programming-in-ansic--8e---balagurusamy

MOOC / NPTEL/YouTube Links: https://onlinecourses.nptel.ac.in/noc22_cs40/preview
: https://onlinecourses.nptel.ac.in/noc23_cs53/preview

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about University/program/ institute/ department/foreword/ preface etc), copy of curriculum, conduction & Assessment guidelines, topics under consideration- concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of tool/framework/language used, Design, test cases, conclusion. Program codes with sample output of all performed assignments are to be submitted as softcopy.
As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journals may be avoided. Use of Drive containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

List of laboratory assignments is provided below for reference. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy should address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute them among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of coding style, proper indentation and comments.
Use of open source software and recent versions is to be encouraged.
In addition to these, instructors may assign one real life application in the form of a mini-project.

based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to each branch beyond the scope of the syllabus.

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: VSE-101 Course Name: Manufacturing Practice Workshop

Teaching Scheme	Credit	Examination Scheme
Practical : 02 Hours/Week	**01**	**Term Work : 25 Marks**

Prerequisite Courses, if any:

- Basic Science
- Drawing

Course Objectives:

1. To acquire the basic knowledge of Machine Tools.
2. To inculcate the basics of various manufacturing processes.
3. To impart practical aspects of Machine Tools and Manufacturing processes used in industrial applications
4. To develop the skill through hands-on practices using hand tools, power tools, machine tools in manufacturing and assembly shop

Course Outcomes:

On completion of the course, learner will be able to:

CO1	Illustrate various sections of a typical workshop and different types of tools and machinery commonly found in a workshop	2-Understand
CO2	Explain the importance of workshop safety and apply general workshop safety rules and guidelines.	3-Apply
CO3	Demonstrate proficiency in various cutting techniques such as sawing, shearing, and laser cutting.	3-Apply
CO4	Plan and complete a simple sheet metal job from start to finish, incorporating shearing, bending, and joining operations.	3-Apply
CO5	Describe the applications, advantages and operation of advanced computerized machine tools in modern manufacturing.	2-Understand
CO6	Apply 3D Printing Technology including setup, operation, and post-processing to print simple mechanical component.	3-Apply

List of Laboratory Experiments/Assignments

01	Draw a typical layout of workshop with arrangement of equipment's considering a specific application
02	Identify and explain the following safety related consideration, 1) Potential hazards present in workshop 2) General workshop safety rules and guidelines 3) List various safety devices used in workshop Note : Photo evidences of above are expected in report
03	Develop any Mechanical component using the tools available in the workshop which includes any five of he following operations, 1) Cutting

	2) Shearing 3) Bending 4) Welding 5) Rivetting 6) Filing 7) Drilling Note: Product must be usable for Institute of domestic also write a sequence of operation in the report with its production time.
04	Demonstration (construction and operation) of any one advance machine tool such as CNC turn / mill, VMC, plasma arc machining, Laser cutting, CNC wood router etc.
05	Write program on sequence of operations performed to develop any mechanical component using any suitable programming language.
06	Create simple 3D models using CAD software and print using 3D printer including pre and post processes (Component manufactured should be related to specific branch)
	Note: Above experiments to be performed in group of four to five students. There should not be any repetition of layout/ jobs/ programs and models. For Experiment No. 1 and 2 students supposed to visit nearby workshop or industry.

Learning Resources

Text Books:

1. H.S.Bawa, "Workshop Practice", Tata McGraw Hill Education (Publisher)
2. S. K. Hajra Choudhary, Nirjhar Roy, "Element of Workshop Technology: Vol.1 and 2", Media Promoters and Publishers Pvt. Ltd., 15th Edition, 2012

Reference Books:

1. MikellP.Groover,"IntroductiontoManufacturingProcesses",WileyPublications
2. John,K.C., "Mechanical Workshop Practice", Prentice Hall Publication, New Delhi
3. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.
4. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person India, 2007 2nd edition.

e-Books:-

MOOC / NPTEL/YouTube Links: -

- NPTEL Course on Fundamentals of Additive Manufacturing Technologies by Prof. Sajan Kapil, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc21_me115/preview
- NPTEL Course on Fundamentals of Industrial safety by Prof. Thomas, IIT Madras https://www.youtube.com/watch?v=3VReVbsmjKI
- NPTEL Course on Computer Numeric Control Of Machine Tools And Processes by Prof. A. Roy Chaodhary, IIT Kharagpur https://www.youtube.com/watch?v=ImtSsDLgAaI&list=PLSGws_74K01KX9YtVZACpOoFYy6oaJIC

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: VSE-102 Course Name: Design Thinking and Idea Lab

Teaching Scheme	Credit	Examination Scheme
Practical : 2 Hour/Week	**02**	**Term Work : 25 Marks**

Course Objectives:

- **Understand** the core principles of design thinking and its role in engineering.
- **Apply** the six hats of design thinking to analyze and solve complex problems.
- **Develop** creative and user-centered solutions to real-world challenges.
- **Demonstrate** effective communication and collaboration in multidisciplinary teams.
- **Evaluate** and analysis design concepts and prototypes.
- **Develop** a mindset for continuous innovation and improvement.

Course Outcomes:

On completion of the course, learner will be able to:

CO1 Identify and define problems from a user's perspective and articulate design criteria.

CO2 Apply empathy and observation to gain insights into user needs and behaviors

CO3 Generate innovative ideas and solutions through brainstorming and ideation.

CO4 Prototype and test design solutions to refine and improve them

CO5 Present and communicate design ideas effectively using visual aids and storytelling

CO6 Collaborate with peers and industry professionals to address real-world design challenges

Note: -

1. The practical lab is designed to provide students with hands-on experience in applying the theoretical concepts they have learned in the course. The session aims to enhance their understanding, critical thinking, and problem-solving skills. (1 hour for explaining the concept and 1 hour for activity/ assignment / group discussion / brainstorming session)
2. Incorporating hands-on labs with access to various lab and workshop facilities in the Institute, can enhance the practical aspect of the course and provide students with opportunities to prototype and test their designs.

Laboratory Experiments/Assignments

Week	**1-2**	**Introduction to Design Thinking** • Understanding the design thinking process • Role of empathy and user-centric design • Practical Lab: Empathy mapping and user interviews • Assignment 1: Problem identification

Week	**3-4**	**Ideation and Creativity** • Techniques for idea generation and brainstorming • Practical Lab: Brainstorming sessions • Assignment 2: Idea generation and selection
Week	**5-6**	**Prototyping and Testing** • Creating prototypes to validate design concepts • Practical Lab: Rapid prototyping • Assignment 3: Prototyping and user testing
Week	**7-8**	**Analysis and Evaluation** • Applying the six hats of design thinking • Practical Lab: Six thinking hats analysis • Assignment 4: Six hats analysis of a case study
Week	**9-10**	**Communication and Collaboration** • Visual communication and storytelling • Group project and industry collaboration • Assignment 5: Design project presentation • Assignment 6: Reflection and lessons learned

Learning Resources

Reference Books:

1. Design Thinking: Understanding How Designers Think and Work by Nigel Cross
2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" by Tim Brown
3. Design Thinking for Visual Communication" by Ranjan Nayar and Jaidip Subedi
4. The Design of Everyday Things" by Don Norman• "Design Thinking: Creativity and Innovation" by S. Balaram
5. Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days" by Jake Knapp
6. Creative Confidence: Unleashing the Creative Potential Within Us All" by Tom Kelley and David Kelley (with a foreword by Ratan Tata)

Case Studies:

- **Design Thinking in Healthcare:** Redesigning a patient's waiting room experience.
- **Design Thinking in Product Development:** The evolution of the smartphone.
- **Design Thinking in Social Innovation:** Improving access to clean drinking water in rural areas.

- **Tata Nano:** The People's Car: Explore how Tata Motors aimed to revolutionize the automobile industry by creating an affordable and compact car for the masses, known as the Tata Nano.
- **Aravind Eye Care System:** Investigate how Aravind Eye Care System in India used innovative design thinking to provide high-quality, affordable eye care services to a large population, often in remote areas.
- **Project Shakti by Hindustan Unilever:** Analyze how Hindustan Unilever's Project Shakti empowered rural women in India by turning them into micro-entrepreneurs, distributing Unilever products in their communities.
- **Aadhaar: India's Unique Identification Program:** Explore how the Aadhaar program used biometric data and design thinking to provide millions of Indians with a unique identification system, enhancing access to government services and benefits.
- **Ola Cabs:** Transforming Transportation in India: Learn how Ola, an Indian ride-sharing platform, disrupted the traditional taxi industry by applying innovative design thinking to its services and business model.
- **Swiggy: Redefining Food Delivery:** Investigate how Swiggy, an Indian food delivery platform, leveraged design thinking to enhance the food delivery experience for customers and partner restaurants.
- **Lifebuoy: Promoting Hygiene in Rural India:** Explore how Lifebuoy, a brand under Unilever, used design thinking to develop innovative marketing campaigns and products to promote handwashing and hygiene in rural India.
- **Amul: The White Revolution in India:** Analyze how the Amul cooperative transformed the dairy industry in India through a unique business model, design thinking, and innovative marketing strategies
- **Flipkart: E-commerce Success Story:** Study how Flipkart, one of India's leading e-commerce platforms, employed design thinking to grow its business and offer a wide range of products and services.
- **ISRO's Mars Orbiter Mission**: Learn about how the Indian Space Research Organisation (ISRO) successfully launched the Mars Orbiter Mission (Mangalyaan) on a limited budget, showcasing innovation and design thinking in space exploration.
- **Designing Google's Self-Driving Car:** Explore how Google used design thinking to develop autonomous vehicles that redefine transportation.
- **Dyson**: Revolutionizing Vacuum Cleaners and Hand Dryers: Investigate how Dyson's innovative design thinking has transformed household appliances.

- **SpaceX**: Advancing Space Exploration Through Design Thinking: Analyze SpaceX's approach to space technology and how it has disrupted the aerospace industry.
- **Red Bull**: Creating an Energy Drink Empire: Learn how Red Bull's unique design thinking approach contributed to the success of their energy drink and brand.
- **McDonald's**: Evolution of Fast Food Service: Study the design thinking principles applied by McDonald's to enhance their customer experience and streamline operations.
- **Nest**: Reinventing Thermostats and Home Automation: Examine how Nest Labs, a subsidiary of Google, reimagined home automation with their smart thermostats and other products.
- **LEGO:** Building a Design-Centric Toy Empire: Investigate how LEGO has used design thinking to create a global brand that fosters creativity and learning through play.
- **IBM Design Thinking:** A Cultural Transformation: Explore IBM's adoption of design thinking to reshape its corporate culture and enhance its software and services.
- **Starbucks**: Brewing Design Innovation in the Coffee Industry: Analyze how Starbucks incorporates design thinking into its store layouts, product offerings, and customer experiences.
- **Amazon: Customer-Centric** Design in E-commerce: Discover how Amazon's design thinking philosophy has played a pivotal role in its e-commerce dominance

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: AEC-101 Course Name: Professional Communication Skills

Teaching Scheme	Credit	Examination Scheme
Tutorial : 2 Hour/Week	**02**	**Term Work : 25 Marks**

Prerequisite Courses, if any:

- 12th English - Basic knowledge of Listening, Speaking, Reading, and Writing. (LSRW) skills.

Course Objectives:

To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcomes:

On completion of the course, learner will be able to:

CO1: Recognize, identify, and express advanced skills of Technical Communication in English through Language Laboratory.

CO2: Understand, categorize, differentiate, and infer listening, speaking, reading, and writing skills in societal and professional life.

CO3: Articulate and present the skills necessary to be a competent Interpersonal communicator.

CO4: Deconstruct, appraise, and critique communication behaviors.

CO5: Adapt, negotiate, and facilitate with multifarious socio-economical and professional arenas with effective communication and interpersonal skills.

Laboratory work should cover the following guideline topics for conduction of Laboratory activities:

Unit I	**Introduction to the Language Lab** a) The Need for a Language Laboratory b) Tasks in the Lab c) Writing a Laboratory Notebook
Unit II	**Active Listening Skills** Basic Listening Skills: Introduction, the process, importance and types of listening, Effective Listening: Principles and Barriers, Guidelines to increase listening, a) What is Active Listening? b) Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking c) Listening in Business Telephony
Unit III	**Speaking**

	a) Speaking—Accuracy and Fluency Parameters b) Pronunciation Guide—Basics of Sound Scripting, Stress, and Intonation c) Fluency-focussed activities—JAM (Just a Minute), Conversational Role Plays, Speaking using Picture/Audio Visual inputs. d) Group Discussion: Principles and Practice e) Giving a Presentation—Learning Presentation Basics and Giving Micro Presentations f) Activities to enhance listening Speaking Skills: Introducing yourself, describing a person, place, situation and event, giving instruction, Making inquiries – at a bank, post- office, air-port, hospital, reservation, counter
Unit IV	**Reading and Writing Skills**
	Effective Reading: Process, types and reading rate adjustment, Tips for improving reading skills, Reading Comprehension.
	Effective Written Communication: **Introduction**, Importance of written communication, Writing a Book/ small article/ Film Review, Scripting a Short Presentation
	Letter Writing: Types, Formats, Official Correspondence: Memo, Notice and Circulars, Agenda and Minutes, **Report Writing:** Purpose and Scope of a Report, Fundamental Principles of Report Writing, Project Report Writing, Summer Internship Reports. sentences Precise writing through meticulous editing, proofreading Writing abstracts and conclusions.
Unit V	**Workplace Communication**
	Greeting, Welcoming, Dealing with Complaints, Giving Instructions or Directions, Giving Information: About Various Facilities, Distance, Area, Local Specialties Consultation and Solution of Problems, Accepting Praises and Criticism, Apologizing. Fluency and Etiquette, Polite sentences and Words, Use of Persuading words, Intonation and Voice Modulation, Developing.

List of Laboratory Experiments/Assignments

Minimum eight practical/ assignments should be performed to cover entire curriculum of the course. The list of practical given below is just a guideline.

1. Speech/Seminar presentation
2. Observation of a recorded seminar and suggestions for improvement.
3. Technical Report Writing and presentation.
4. Role Plays
5. Interview Simulations
6. Reading and Listening Comprehension

7. Group Discussions
8. Resume Building
9. Business Correspondence
10. Cross-Cultural Communication
11. Situational Writing
12. SWOT analysis
13. Public Speaking Exercises
14. Greetings for different occasions.
15. Participation in institute/National level Elocution/Essay/G.D. Competitions

Guidelines for compressive continuous assessment (CCE)

- CCE should support for regular performance of practical by student and his/her regular assessment with proper understanding of practical carried out.
- It is a representative list of practical. The instructor may choose practical as per his requirements (so as to cover entire contents of the course) from the list.

Learning Resources

Text Books:

1. Communication Skills for Engineers by S. Mishra & C. Muralikrishna (Pearson)
2. Communication Skills for Technical Students by T.M. Farhatullah (Orient Longman)
3. Written Communication in English by Saran Freeman (Orient Longman)
4. Essential English Grammar (Elementary & Intermediate) Raymond Murphy (CUP)
5. Communication for Business: A Practical Approach by Shirley Tailor (Longman)

Reference Books:

1. Developing Communication Skills by Krishna Mohan & Meera Banerji (Macmillan)
2. Business Correspondence and Report Writing, R. C. Sharma & Krishna Mohan (Tata McGraw Hill)
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: CCC-101 Course Name Co-Curricular Course – I

Teaching Scheme	Credit	Examination Scheme
Practical : 4 Hours/Week	**02**	**Term work : 25 Marks**

Objectives:

Students are required to go through the list of following Co-curricular Courses and select any one of their interests. They will be allocated one course from the list. Experts from respective course will conduct classes on campus/Online through activities, discussions, presentations, and lecture methods. Students are required to **submit hard copy of a report along with certificate on the activities performed** related to topics of opted Co-curricular Course.

Evaluation will be done based on the report of activities submitted by student. Faculty members will be allotted for mentoring the activities related to Co-curricular Course topic. Faculty members will frame the **list activities to be performed by students** with the help of experts in respective course.

Selecting co-curricular courses that align with your interests and goals can significantly enrich your educational journey. Remember to maintain a balance and choose courses that you are genuinely excited about. This approach will help you gain the most from your co-curricular activities.

Basket of Co-curricular Courses :

1. Health and Wellness
2. Yoga education
3. Meditation
4. Dancing
5. Cultural Activities
6. Basics of Music Composition
7. Physical Fitness
8. Visual Arts
9. Painting
10. Personality Development
11. Art of Short Film Making / Cinematography

Here are some tips and ideas to help you choose the right courses

1. Consider Your Interests and Hobbies

Think about what you enjoy doing in your free time or what activities you have always wanted to try. Co-curricular courses can be a great opportunity to pursue passions outside your major.

2. Explore Different Fields

Choosing courses from different areas can provide a well-rounded experience. For instance, you might pick one course related to arts, another in sports, and a third in community service.

. Balance Your Schedule

Ensure that the co-curricular courses fit well with your academic schedule and personal commitments. Avoid overloading yourself, as these courses should enhance your experience, not add undue stress.

4. Look at Course Benefits

Some co-curricular courses offer skills that can be beneficial in your future career or personal development. For example, leadership training, public speaking, or project management.

5. Consult with Advisors or Seniors

Talking to academic advisors, professors, or senior students can give you insights into which courses are popular, have good instructors, or offer valuable experiences.

सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University
Faculty of Science and Technology

National Education Policy (NEP) Compliant Curriculum

Semester - II

First Year Engineering
(2024 Pattern)

www.unipune.ac.in

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: BSC-151-BES Course Name: Engineering Mathematics – II

Teaching Scheme	Credit	Examination Scheme
Theory : 03 Hours/Week **Tutorial : 01 Hour /Week**	**03** **01**	**CCE : 30 Marks** **End-Semester : 70 Marks** **Term Work : 25 Marks**

Prerequisites:

- Integration, Differential Equation, Three-dimensional coordinate systems

Course Objectives:

To familiarize the students with Advanced techniques of integration, Tracing of curve, Solid geometry, Multiple integrals and their applications, Mathematical modeling of physical systems using differential equations. The aim is to equip them with the concept and tools to understand advanced level mathematics and its applications, that would enhance thinking power, useful in their disciplines.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply advanced integration techniques such as Reduction formulae, Beta functions, Gamma functions, Differentiation under integral sign and Error functions useful in evaluating multiple integrals and their applications.

CO2: Trace the curve for a given equation and measure arc length of various curves. **Apply** the concepts of solid geometry to solve problems on sphere, cone and cylinder in a comprehensive manner.

CO3: Evaluate multiple integrals and its application to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.

CO4: Apply the effective mathematical tools for solving first order ordinary differential equations such as Exact and Reducible to exact Linear and reducible to Linear.

CO5: Model physical systems using ordinary differential equations, **solve and analyze** the solutions apply to Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.

Course Contents

Unit I	Integral Calculus	(08 Hours)
Reduction Formulae, Beta and Gamma functions, Differentiation Under Integral Sign and Error functions.		
Unit II	**Curve Tracing and Solid Geometry**	**(08 Hours)**
Tracing of Curves – Cartesian, Polar and Parametric curves, Rectification of curves. Cartesian, Spherical polar and Cylindrical coordinate systems, Sphere, Cone and Cylinder.		
Unit III	**Multiple Integrals and Applications**	**(08 Hours)**
Double and Triple integrations, change of order of integration, Applications to find Area, Volume, Mass, Centre of Gravity and Moment of Inertia.		

Unit IV	First Order Ordinary differential Equation	(08 Hours)
Exact differential equations, Equations reducible to exact form. Linear differential equations, Equations reducible to linear form and Bernoulli's equation.		
Unit V	**Applications of Differential Equations**	**(08 Hours)**
Applications of Differential equations to Orthogonal Trajectories, Newton's Law of Cooling, Kirchhoff's Law of Electrical Circuits, Rectilinear Motion, Simple Harmonic Motion, One dimensional Conduction of Heat.		

Learning Resources

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning).
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson).
5. Applied Mathematics (Vol. I and II) by P.N. Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Differential Equations by S. L. Ross (John Wiley and Sons).

MOOC / NPTEL/YouTube Links:

https://youtube.com/playlist?list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&si=3xAONJdT2ph_jcvG

Tutorial and Term Work:

1. Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.
2. Term work shall consist of six assignments each on unit-I to unit-VI and is based on performance and continuous internal assessment.

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: PCC-151-ITT Course Name: Programming and Problem Solving

Teaching Scheme	Credit	Examination Scheme
Theory : 02 Hours/Week Practical : 02 Hours/Week	02 02	CCE : 30 Marks End – Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses, if any:

- Basics of Computers and Basic Mathematics
- Fundamentals of Programming Languages (COM108)

Companion Course, if any: Fundamentals of Programming Languages Lab

Course Objectives:

To understand problem solving aspects and to know python programming with learning data types, decision control statements, function, strings, file handling in Python. To learn features of object oriented programming concepts using python.

Course Outcomes:

On completion of the course, learner will be able to:

CO1: Inculcate and **apply** various skills in problem solving.

CO2: Choose appropriate programming constructs and features to **solve** the problems in diversified domains.

CO3: Exhibit the programming skills for the problem-solving using functions and string manipulations.

CO4: Demonstrate File handling and dictionaries in Python.

CO5: Apply Object Oriented concepts in Python.

Course Contents

Unit I	Unit I : Problem Solving, Programming and Python Programming	(04 Hours)

General Problem Solving Concepts- Problem solving in everyday life, types of problems, problem solving with computers, difficulties with problem solving, problem solving aspects, top down design. Problem Solving Strategies,

Basics of Python Programming: Features of Python, History and Future of Python, Programming Paradigm, Features of Object Oriented Programming, Applications of Python Languages.

Unit II	Advance Data Types and Decision Control Statements	(04 Hours)

Advance data types- Tuples, Lists, Sets and Dictionary. Decision Control Statements: Decision control statements, Selection/conditional branching

Statements: if, if-else, nested if, if-elif-else statements. Basic loop Structures/Iterative

Statements, while loop, for loop, selecting appropriate loop. Nested loops, The break, continue, pass, else statement used with loops.

Unit III	Functions and Strings	(03 Hours)

Need for functions, Function: definition, call, variable scope and lifetime, the return statement. Defining functions, Lambda or anonymous function, documentation string, good programming practices.

Introduction to modules, Introduction to packages in Python, Introduction to standard library modules. Strings and Operations- concatenation, appending, multiplication and slicing. Strings are immutable, strings formatting operator, built in string methods and functions. Slice operation, ord() and chr() functions, in and not in operators, comparing strings, Iterating strings, the string module.

Unit IV	File Handling and Dictionaries	(04 Hours)

Files: Introduction, File path, Types of files, Opening and Closing files, Reading and Writing files. File Positions, Renaming and deleting files. Directory Methods, Dictionaries creating, assessing, adding and updating values. Case Study: Study design, features, and use of any recent, popular and efficient system developed using Python. (This topic is to be excluded for theory examination)

Unit V	Object Oriented Programming	(04 Hours)

Structured and object oriented: Features of Object oriented programming-classes, objects, methods and message passing, inheritance, polymorphism, containership, reusability, delegation, data abstraction and encapsulation.

Classes and Objects: classes and objects, class method and self-argument, __init__() method, class variables and object variables, __del__() method, public and private members, Built in function to check, Get, Set and Delete class attribute, Garbage collection, class methods, Static Method.

List of Laboratory Experiments/Assignments

Group A

Practical on Unit I

Program Design Tools: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms. Writing and executing Python program, Literal constants, variables and identifiers, Data Types, Input operation, Comments, Reserved words, Indentation, Operators and expressions, Expressions in Python.

1. Installation of Python
2. Program to display data of different types using variable and literal constants.
3. Program to read variables from the user.
4. Program to exhibit indentation errors.
5. Program to perform all operation (addition, multiplication, subtraction, division, modules) and expression.
6. Program to convert degree Fahrenheit into degree Celsius.
7. To calculate salary of an employee given his basic pay (take as input from user). Calculate gross salary of employee. Let HRA be 10 % of basic pay and TA be 5% of basic pay. Let employee pay professional tax as 2% of total salary. Calculate net salary payable after deductions

Practical on Unit II

1. Type Conversion, Type casting, Comment
2. Program to demonstrate operation on lists
3. Program to determine whether a person is eligible to vote or not
4. Program to find whether the given number is even or odd
5. Program to determine whether the character entered is a vowel or not.
6. Program to calculate the sum and average of first 10 numbers
7. Program to find whether the given number is an Amstrong number or not.
8. Program to enter a number and then calculate the sum of its digits.
9. Program to print the multiplication table of n, where n value is entered by user.

Practical on Unit III

1. Program to concatenate two string using + operator.
2. Program to append a string using += operator.
3. Program to display power of a number without using formatting characters.
4. Program to display power of a number using formatting characters.
5. Program to demonstrate slice operation on string objects.
6. Program to understand how characters in a string are accessed using negative indexes.
7. Program to understand ord() and char() function.
8. Program that uses split() to split a multiline string.
9. Program that counts the occurrences of a character in a string. Do not use built in function.
10. Program to reverse of string by user defined function.
11. Write a python program that accepts a string from user and perform following string operations- i. Calculate length of string ii. String reversal iii. Equality check of two strings iii. Check palindrome ii. Check substring

Practical on Unit IV

1. Program to open a file and print its attribute values.
2. Program to access a file after it is closed
3. Program to write a file using the writelines() method.
4. Program to append data to an already existing file.
5. Program to display the contents of a file.
6. Program to split the line into a series of words and use space to perform the split operation.
7. Program that tells and sets the position of the file pointer.
8. Program that reads data from a file and calculates the percentage of vowels and consonants in the file.
9. Program that changes the current directory to our newly created directory.
10. Program to print the absolute path of a file using os.path.join
11. Program that counts the number of tabs, space and newline character in a file.
12. To copy contents of one file to another. While copying a) all full stops are to be replaced with commas b) lower case are to be replaced with upper case c) upper case are to be replaced with lower case.

Practical on Unit V

1. Program to access class variable using class object.
2. Program to access class members using class object.
3. Program to illustrating the use of __int__() method.
4. Program to differentiate between class and object variable.
5. Program to illustrating the use of __del__() method.
6. Program to illustrating the difference between public and private variable.
7. The program should subtract the DOB from todays date to find out whether a person is eligible to vote or not.
8. Create class EMPLOYEE for storing details (Name, Designation, gender, Date of Joining and Salary). Define function members to compute a)total number of employees in an organization b) count of male and female employee c) Employee with salary more than 10,000 d) Employee with designation “Asst Manager”

Group B

Teachers should frame assignments from Mechanical Engineering, Civil Engineering, Electrical Engineering application domains.

Faculty from these course branches to design and conduct the practical sessions.

Electrical Engineering:

1. Develop algorithms, draw flow chart, and write a program to solve electrical network (KVL/KCL) using python.
2. Develop algorithms, draw flow chart, and write a program for star delta conversion using python.
3. Develop algorithm, draw flow chart, and write a program to calculate the impedance of RLC circuit using python.
4. Develop algorithm, draw flow chart, and write a program to calculate efficiency of single-phase transformer using python.

Civil Engineering:

1. A concentrated load of 1000KN is applied at the ground surface. Write a program to compute the vertical pressure (i) at a depth of 4m below the load , (ii) at a distance of 3m at the same depth. Use Boussinesq's equation.
2. A Filtered water discharge of 1MLD has a chlorine demand of 4.8 mg/l. It is required to maintain a chlorine residual of 0.2 mg/l. Write a program to determine the quantity of bleaching powder necessary of 6 months (Chlorine Available-25%).
3. A simply supported beam AB having spam of 4 meters loaded with following cases: Case 1) 100 KN at centre. Case 2) 50 KN at 1 meter from A support. Write a program to determine support reactions at A and B.
4. Two forces P and Q acting on a body 180 KN and 240 KN respectively. The angle between the two forces is 60 degrees. Determine the resultant of force P and Q and it's direction with respect to Q force.

Mechanical Engineering:

1. On a certain planet a correctly calibrated spring balance shows the weight of a body 12 N, the mass of which is 4.893 kg. Write a program to find the value of gravity on this planet.
2. Write a program to estimate the heat loss through a red brick wall of length 5m, height 4m and thickness 0.25m, if the temperatures of the wall surfaces are maintained at 110 degree centigrade and 40 degree centigrade respectively. K for red brick is 0.70 W/mk.
3. Assume five liters of Oil weigh 61.80 N. Write a program to calculate i) Specific Weight ii) Specific mass using python.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept in brief, features of tool/framework/language used, Design, test cases, conclusion.

Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

All students should submit the term work consisting of 14 programming assignments. At least 2 assignments from each unit for Group A. Faculty can select any 4 assignments from Group B.

Learning Resources

Text Books:

1. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press, ISBN 13: 978-0-19-948017-6
2. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press; Second edition ISBN10:938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL

Reference Books:

1. R. G. Dromey, “How to Solve it by Computer”, Pearson Education India; 1st edition, ISBN10: 8131705625, ISBN-13: 978-8131705629 Maureen Spankle, “Problem Solving and Programming Concepts”, Pearson; 9th edition, ISBN-10: 9780132492645, ISBN-13: 978-0132492645
2. Romano Fabrizio, “Learning Python”, Packt Publishing Limited, ISBN: 9781783551712, 1783551712
3. Paul Barry, “Head First Python- A Brain Friendly Guide”, SPD O’Reilly, 2nd Edition, ISBN:978-93-5213-482-3
4. Martin C. Brown, “Python: The Complete Reference”, McGraw Hill Education, ISBN-10:9789387572942, ISBN-13: 978-9387572942, ASIN: 9387572943
5. Jeeva Jose, P. Sojan Lal, “Introduction to Computing & Problem Solving with Python”, Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810

Savitribai Phule Pune University
First Year of Engineering (2024 Pattern)
Course Code: IKS-151 Course Name: Indian Knowledge System

Teaching Scheme	Credit	Examination Scheme
Tutorial : 02 Hours/Week	**02**	**Term Work : 25 Marks**

Course Objectives:

1. To introduce students to the foundational concepts of Indian knowledge systems and their significance.
2. To familiarize students with key dates in Indian history and the historical timeline.
3. To provide an overview of Indian philosophical systems and their relevance.
4. To explore significant scientific achievements in ancient India and analyze scientific texts and inventions.
5. To examine the role of engineering in ancient India and its contributions to metallurgy, materials science, and architectural techniques.

Course Outcomes:

On completion of this course, learners will be able to:

CO 1 - Understand the significance and historical context of Indian knowledge systems.

CO 2 - Comprehend Indian philosophical concepts, scientific achievements, and their interplay.

CO 3- Recognize the role of engineering in ancient India and its impact on architecture and materials.

CO 4- Apply ancient Indian engineering principles in modern practices while considering cultural and environmental aspects.

IKS Syllabus should be followed from the following link:
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2024/Indian%20Knowledge%20Systems%20(IKS)%20(Generic)%20Academic%20Year%202024-25_03062024.pdf

Note: This course will be available in online mode on SPPU portal for the all students.

Assignments for Term Work

Note: Students have to complete all Assignments and two activates from the following given list.

Assignment 1: **S**tudents should search for literature and create a presentation on a specific key date or event in Indian history. They should explain its significance and how it contributed to Indian knowledge systems.

Learning Outcome: Enhances research skills and understanding of the historical context.

Assignment 2: Assign groups to compare and contrast the BC/CE dating system with other historicaldating systems from different cultures.

Learning Outcome: Promotes critical thinking and cross-cultural understanding.

Assignment 3: **S**tudents should study and create presentations or reports on significant scientific inventions or discoveries from ancient India.

Learning Outcome: Develops research and presentation skills while enhancing knowledge of Indian scientific achievements

Assignment 4: Ask students to work in groups to research and present on ancient Indian contributionsto metallurgy and materials science. They can also create simple experiments to demonstrate metallurgical processes.

Learning Outcome: Enhances research and experimentation skills while deepening understanding of materials science

Assignment 5: Assign students to choose a modern engineering project in India that incorporates sustainability principles. They should analyze the project's design, materials, and environmental impact.

Learning Outcome: Develops critical analysis skills and an understanding of sustainable engineering practices.

Assignment 6: A group of students should present case studies on modern engineering projects that consider cultural and environmental aspects. Discuss how cultural sensitivity is integrated into these projects.

Learning Outcome: Promotes teamwork, presentation skills, and cultural awareness

Assignment 7: Encourage students to propose and discuss how ancient Indian engineering principles could be integrated into a modern construction project. They should consider cultural, environmental,and sustainability aspects.

Learning Outcome: Encourages creative problem-solving and understanding of cultural relevance in engineering.

Activities (At least 4 Activities to be performed)

Activity 1: Organize in-class debate on Mathematics in Indus Valley Civilization

Activity 2: Organize in-class debate Aryabhata and His Contributions

Activity 3: Students to submit a report on Innovations in Number Systems and Zero

Activity 4: Aryabhata: The Pioneer of Indian Astronomy

Activity 5: Rise of Trade Centers and Urbanization

Activity 6: The Role of Poetry in Ancient Indian Literature

Case Studies (At least 4 case studies by an individual or group of students)

Case Study 1: The Sun Temple, Konark

Case Study 2: Evolution of Regional Dance Forms

Case Study 3: Training and Discipline in the Military

Case Study 4: Influence on Medicine and Wellness

Case Study 5: Indian Knowledge Systems: Global Influence

Case Study 6: Ancient Indian Sciences

Savitribai Phule Pune University First Year of Engineering (2024 Pattern) Course Code: CCC-151 Course Name: Co-Curricular Courses - II		
Teaching Scheme	**Credit**	**Examination Scheme**
Practical : 04 Hours/Week	**02**	**Term Work : 25 Marks**

Course Objectives:

Students are required to go through the list of following Co-curricular Courses and select any one of their interests. They will be allocated one course from the list. Experts from respective course will conduct classes on campus/Online through activities, discussions, presentations, and lecture methods.

Students are required to **submit hard copy of a report along with certificate** on the activities performed related to topics of opted Co-curricular Course. Evaluation will be done based on the report of activities submitted by student.

Faculty members will be allotted for mentoring the activities related to Co-curricular Course topic. Faculty members will frame the list activities to be performed by students with the help of experts in respective course.

Selecting co-curricular courses that align with your interests and goals can significantly enrich your educational journey. Remember to maintain a balance and choose courses that you are genuinely excited about. This approach will help you gain the most from your co-curricular activities.

Basket of Co-curricular Courses

1. Sports
2. NSS
3. NCC
4. Fine Arts
5. Applied Arts
6. Performing Arts
7. Self Defense for Women
8. Jeevan Vidya (Work Life Balance)
9. Integrated
10. Design Thinking
11. Innovation and Creativity
12. Principle Centered Leadership
13. Mentoring of School Children
14. Basics of Fire Safety

Here are some tips and ideas to help you choose the right courses:

1. Consider Your Interests and Hobbies

Think about what you enjoy doing in your free time or what activities you have always wanted to try. Co-curricular courses can be a great opportunity to pursue passions outside your major.

2. Explore Different Fields

Choosing courses from different areas can provide a well-rounded experience. For instance, you might pick one course related to arts, another in sports, and a third in community service.

3. Balance Your Schedule

Ensure that the co-curricular courses fit well with your academic schedule and personal commitments. Avoid overloading yourself, as these courses should enhance your experience, not add undue stress.

4. Look at Course Benefits

Some co-curricular courses offer skills that can be beneficial in your future career or personal development. For example, leadership training, public speaking, or project management.

5. Consult with Advisors or Seniors

Talking to academic advisors, professors, or senior students can give you insights into which courses are popular, have good instructors, or offer valuable experiences.

FE – 2024 Pattern –National Education Policy (NEP)-2020 Compliant Syllabus

Task Force for Curriculum Design and Development

Advisors & The Chairmen - Board of Studies

Dr. D. S. Bormane	Dr. G. K. Kharate
Dr. V. H. Patil	Dr. Sunil Thakare
Dr. S. D. Shirbahadurkar	Dr. Sanjay Deokar
Dr. Pradeep Patil	Dr. Sudeep Thepade
Dr. Vaibhav Dixit	Dr. Nilesh Uke
Dr. Nitin Mujumdar	Dr. Kalpana Joshi
Dr. Radhika Memon	Dr. Vivek Rane
Dr. Shirish Sane	Dr. Keshav Nandurkar
Dr. Manmohan Bhumkar	Dr. Somnath Nandi

Team Members for Course Design

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JSPM's Bhivarabai Sawant Institute of Technology & Research, Wagholi, Pune (412207)

CRITERION 1 - CURRICULAR ASPECTS

1.2
Academic Flexibility

1.2.1
Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

DEPARTMENT OF COMPUTER ENGINEERING

Faculty of Science and Technology
Savitribai Phule Pune University
Maharashtra, India

http://unipune.ac.in

Curriculum
for
Second Year of Computer Engineering
(2019 Course)
(With effect from 2020-21)

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Table of Contents

Savitribai Phule Pune University
Bachelor of Computer Engineering

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1	**Professional Skills**-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
210241	Discrete Mathematics	03	-	-	30	70	-	-	-	100	03	--	-	03
210242	Fundamentals of Data Structures	03	-	-	30	70	-	-	-	100	03	-	-	03
210243	Object Oriented Programming (OOP)	03	-	-	30	70	-	-	-	100	03	-	-	03
210244	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
210245	Digital Electronics and Logic Design	03	-	-	30	70	-	-	-	100	03	-	-	03
210246	Data Structures Laboratory	-	04	-	-	-	25	50	-	75	-	02	-	02
210247	OOP and Computer Graphics Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210248	Digital Electronics Laboratory	-	02	-	-	-	25	-	-	25	-	01	-	01
210249	Business Communication Skills	-	02	-	-	-	25	-	-	25	-	01	-	01
210250	Humanity and Social Science	-	-	01	-	-	25	-	-	25	-	-	01	01
210251	Audit Course 3													
										Total Credit	**15**	**06**	**01**	**22**
	Total	**15**	**12**	**01**	**150**	**350**	**125**	**75**	**-**	**700**	**-**	**-**	**-**	**-**

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
207003	Engineering Mathematics III	03	-	01	30	70	25	-	-	125	03	--	01	04
210252	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
210253	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
210254	Microprocessor	03	-	-	30	70	-	-	-	100	03	-	-	03
210255	Principles of Programming Languages	03	-	-	30	70	-	-	-	100	03	-	-	03
210256	Data Structures and Algorithms Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210257	Microprocessor Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
210258	Project Based Learning II	-	04	-	-	-	50	-	-	50	-	02	-	02
210259	Code of Conduct	-	-	01	-	-	25	-	-	25	-	-	01	01
210260	Audit Course 4													
										Total Credit	**15**	**05**	**02**	**22**
	Total	**15**	**10**	**02**	**150**	**350**	**150**	**25**	**25**	**700**	**-**	**-**	**-**	**-**

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. These **Program Outcomes (POs)** are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @:**CO and PO Mapping Matrix** (Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there is no correlation between the respective CO and PO.

3. **#:Elaborated examples/Case Studies-** For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *:For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.

5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.

6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.

8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed. Use of open source software is appreciated.

9. **Term Work**[1]–Term work is continuous assessment that evaluates a student's progress throughout the semester[1]. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous

standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

10. **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

11. **Tutorial**[1] **-** Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. **Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.**

12. **Audit Course**[1]: The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP'/'PP'' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

13. **$**:For courses 210249: Business Communication Skills, 210250: Humanity and Social Science and 210260: Code of Conduct, one credit can be earned by student if student successfully completes the Swayam course as listed in curriculum of respective course in this document.

    UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer [2].

    SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.[2]

Note: For Examination rules, pattern and assessment please refer [1]

[1]http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
[2] https://swayam.gov.in/about

Abbreviations		
TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**TUT: Tutorial**	**Sem: Semester**

Semester III

Home

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210241: Discrete Mathematics

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisites: Basic Mathematics

Companion Course : ---

Course Objectives:

To introduce several Discrete Mathematical Structures found to be serving as tools even today in the development of theoretical computer science.

- To introduce students to understand, explain, and apply the foundational mathematical concepts at the core of computer science.
- To understand use of set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
- To acquire knowledge of logic and proof techniques to expand mathematical maturity.
- To learn the fundamental counting principle, permutations, and combinations.
- To study how to model problem using graph and tree.
- To learn how abstract algebra is used in coding theory.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.

CO2: Apply appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts.

CO3: Design and analyze real world engineering problems by applying set theory, propositional logic and to construct proofs using mathematical induction.

CO4: Specify, manipulate and apply equivalence relations; construct and use functions and apply these concepts to solve new problems.

CO5: Calculate numbers of possible outcomes using permutations and combinations; to model and analyze computational processes using combinatorics.

CO6: Model and solve computing problem using tree and graph and solve problems using appropriate algorithms.

CO7: Analyze the properties of binary operations, apply abstract algebra in coding theory and evaluate the algebraic structures.

Course Contents

Unit I	Set Theory and Logic	(07 Hours)

Introduction and significance of Discrete Mathematics, **Sets–** Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. **Types of Sets** – Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set, **Propositional Logic-** logic**,** Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.

#Exemplar/Case Studies	Know about the great philosophers- Georg Cantor, Richard Dedekind and Aristotle
*Mapping of Course Outcomes for Unit I	CO1, CO2, CO3

Unit II	Relations and Functions	(07 Hours)

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Relations and their Properties, n-ary relations and their applications, Representing relations, Closures of relations, Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm. **Functions-** Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.		
#Exemplar/Case Studies	Know about the great philosophers-Dirichlet	
***Mapping of Course Outcomes for Unit II**	CO2,CO4	
Unit III	**Counting Principles**	**(07 Hours)**
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.		
#Exemplar/Case Studies	Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hank-shake Puzzle and algorithm to solve it.	
***Mapping of Course Outcomes for Unit III**	CO2,CO5	
Unit IV	**Graph Theory**	**(07 Hours)**
Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring.		
#Exemplar/Case Studies	Three utility problem, Web Graph, Google map	
***Mapping of Course Outcomes for Unit IV**	CO1,CO2,CO6	
Unit V	**Trees**	**(07 Hours)**
Introduction, properties of trees, Binary search tree, tree traversal, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network).		
#Exemplar/Case Studies	Algebraic Expression Tree, Tic-Tac-Toe Game Tree	
***Mapping of Course Outcomes for Unit V**	CO1,CO2,CO6	
Unit VI	**Algebraic Structures and Coding Theory**	**(07 Hours)**
The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and Congruence relations, Rings, Integral Domains and Fields, Coding theory, Polynomial Rings and polynomial Codes, Galois Theory –Field Theory and Group Theory.		
#Exemplar/Case Studies	Cryptography used in world war II	
***Mapping of Course Outcomes for Unit VI**	CO1, CO2, CO7	
Learning Resources		

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics"‖, TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.

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Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications"‖, Tata McGraw-Hill, ISBN 978-0-07-288008-3
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures"‖, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.

e-Books:

- https://www.ebookphp.com/discrete-mathematical-structures-6th-edition-epub-pdf/
- http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf
- https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf

MOOC/ Video Lectures available at:

- https://www.nptel.ac.in/courses/106/106/106106094/
- https://nptel.ac.in/courses/106/106/106106183/
- https://nptel.ac.in/courses/106/103/106103205/
- https://nptel.ac.in/courses/106/105/106105192/
- https://nptel.ac.in/courses/111/106/111106050/
- https://nptel.ac.in/courses/111/106/111106102/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	2	1	2	-	-	-	-	-	-	-	-
CO7	1	2	2	-	-	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210242: Fundamentals of Data Structures		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: Data Structures Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To understand the standard and abstract data representation methods.
- To acquaint with the structural constraints and advantages in usage of the data.
- To understand various data structures, operations on it and the memory requirements
- To understand various data searching and sorting methods.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Design the algorithms to solve the programming problems, **identify** appropriate algorithmic strategy for specific application, and **analyze** the time and space complexity.

CO2: Discriminate the usage of various structures, **Design/Program/Implement** the appropriate data structures; use them in implementations of abstract data types and Identity the appropriate data structure in approaching the problem solution.

CO3: Demonstrate use of sequential data structures- Array and Linked lists to store and process data.

CO4: Understand the computational efficiency of the principal algorithms for searching and sorting and choose the most efficient one for the application.

CO5: Compare and **contrast** different implementations of data structures (dynamic and static).

CO6: Understand, Implement and apply principles of data structures-stack and queue to solve computational problems.

Course Contents

Unit I	Introduction to Algorithm and Data Structures	(07 Hours)

Introduction: From Problem to Program (Problem, Solution, Algorithm, Data Structure and Program). Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures).

Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart. **Complexity of algorithm:** Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic. **Algorithmic Strategies:** Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

#Exemplar/Case Studies	Multiplication technique by the mathematician Carl Friedrich Gauss and Karatsuba algorithm for fast multiplication.
*Mapping of Course Outcomes for Unit I	CO1, CO2

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Unit II	Linear Data Structure Using Sequential Organization	(07 Hours)
Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Concept of Ordered List, **Single Variable Polynomial**: Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication. **Sparse Matrix:** Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.		
#Exemplar/Case Studies	Study use of sparse matrix in Social Networks and Maps. Study how Economists use polynomials to model economic growth patterns, how medical researchers use them to describe the behaviour of Covid-19 virus.	
*Mapping of Course Outcomes for Unit II	CO1, CO2, CO3	
Unit III	**Searching and Sorting**	**(07 Hours)**
Searching: Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search- Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search. **Sorting:** Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.		
#Exemplar/Case Studies	Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. Timsort as a hybrid stable sorting algorithm	
*Mapping of Course Outcomes for Unit III	CO1, CO2, CO4	
Unit IV	**Linked List**	**(07 Hours)**
Introduction to Static and Dynamic Memory Allocation, **Linked List:** Introduction, of Linked Lists, Realization of linked list using dynamic memory management,operations, Linked List as ADT, **Types of Linked List:** singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List- Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Polynomial Manipulations-Polynomial addition. Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.		
#Exemplar/Case Studies	Garbage Collection	
*Mapping of Course Outcomes for Unit IV	CO1, CO2, CO3, CO5	
Unit V	**Stack**	**(07 Hours)**
Basic concept, stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations. **Recursion-** concept, variants of recursion- direct, indirect, tail and tree, backtracking algorithmic strategy, use of stack in backtracking.		
#Exemplar/Case Studies	Android- multiple tasks/multiple activities and back-stack, Tower of Hanoi, 4 Queens problem.	
*Mapping of Course Outcomes for Unit V	CO1, CO2, CO3, CO5, CO6	

Unit VI	Queue	(07 Hours)

Basic concept, Queue as Abstract Data Type, Representation of Queue using Sequential organization,Queue Operations, Circular Queue and its advantages, Multi-queues,Linked Queue and Operations**.** **Deque**-Basic concept, types (Input restricted and Output restricted), Priority Queue-Basic concept, types (Ascending and Descending).

#Exemplar/Case Studies	Priority queue in bandwidth management
***Mapping of Course Outcomes for Unit VI**	CO1, CO2, CO3, CO5, CO6

Learning Resources

Text Books:

1. Horowitz and Sahani, "Fundamentals of Data Structures in C++", University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9

Reference Books:

1. Steven S S. Skiena, "The Algorithm Design Manual", Springer, 2nd ed. 2008 Edition, ISBN-13: 978-1849967204, ISBN-10: 1849967202.
2. Allen Downey, Jeffery Elkner, Chris Meyers, "How to think like a Computer Scientist: Learning with Python", Dreamtech Press, ISBN: 9789351198147.
3. M. Weiss, "Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.
4. Brassard and Bratley, "Fundamentals of Algorithmic", Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
5. Yashwant Kanetkar & A. Kanetkar, "Let us Python", BPB Publisher, ISBN: 9789389845006

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC Links/Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

Other:

3. Know Thy Complexities! (https://www.bigocheatsheet.com/) (https://github.com/RehanSaeed/.NET-Big-O-Algorithm-Complexity-Cheat-Sheet)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	1	-	1	-	-	-	-	-	-	-	-
CO6	1	1	1	1	1	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210243: Object Oriented Programming(OOP)		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The course is intended to provide the foundations and in-depth understanding of a modern object-oriented language and develop skills in software development, through an algorithmic approach and the application of principles of objected oriented programming.

- To learn the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.
- To learn the syntax and semantics of the C++ programming language.
- To understand the concept of data abstraction and encapsulation, how to design C++ classes for code reuse, how to implement copy constructors and class member functions, to overload functions and operators in C++.
- To learn how inheritance and virtual functions implement dynamic binding with polymorphism.
- To learn how to design and implement generic classes with C++ templates and how to use exception handling in C++ programs.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Apply** constructs- sequence, selection and iteration; classes and objects, inheritance, use of predefined classes from libraries while developing software.
CO2: **Design** object-oriented solutions for small systems involving multiple objects.
CO3: **Use** virtual and pure virtual function and complex programming situations.
CO4: **Apply** object-oriented software principles in problem solving.
CO5: **Analyze** the strengths of object-oriented programming.
CO6: **Develop** the application using object oriented programming language(C++).

Course Contents

Unit I	Fundamentals of Object Oriented Programming	(07 Hours)

Introduction to object-oriented programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, C++ as object oriented programming language.

C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, Access specifiers, separating interface from implementation. **Functions**- Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor, Objects and Memory requirements, Static members: variable and functions, inline function, friend function.

#Exemplar/Case Studies	Story of C++ invention by Bjarne Stroustrup
*Mapping of Course Outcomes for Unit I	CO1, CO5

Unit II	Inheritance and Pointers	(07 Hours)

Inheritance- Base Class and derived Class, protected members, relationship between base Class and

derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class. **Pointers:** declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.		
#Exemplar/Case Studies	Know about Firefox and Thunderbird as one of the popular softwares developed using C++	
*Mapping of Course Outcomes for Unit II	CO2, CO4	
Unit III	**Polymorphism**	**(07 Hours)**
Polymorphism- Introduction to Polymorphism, Types of Polymorphism, Operator Overloading-concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function overloading, **Run Time Polymorphism**- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.		
#Exemplar/Case Studies	Study about use of C++ SDKs wrappers for Java and .Net.	
*Mapping of Course Outcomes for Unit III	CO2, CO3, CO4	
Unit IV	**Files and Streams**	**(07 Hours)**
Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.		
#Exemplar/Case Studies	Study features used for Microsoft Office, Internet Explorer and Visual Studio that are written in Visual C++	
*Mapping of Course Outcomes for Unit IV	CO2, CO4	
Unit V	**Exception Handling and Templates**	**(07 Hours)**
Exception Handling- Fundamentals, other error handling techniques, simple exception handling-Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance. **Templates**- The Power of Templates, Function template, overloading Function templates, and class template, class template and Nontype parameters, template and friends Generic Functions, The type name and export keywords.		
#Exemplar/Case Studies	Study about use of exception handling in Symbian Operating System (discontinued mobile operating system) that was developed using C++.	
*Mapping of Course Outcomes for Unit V	CO2, CO4, CO6	
Unit VI	**Standard Template Library (STL)**	**(07 Hours)**
Introduction to STL, STL Components, Containers- Sequence container and associative containers, container adapters, Application of Container classes: vector, list, **Algorithms**- basic searching and sorting algorithms, min-max algorithm, set operations, heap sort, **Iterators**- input, output, forward, bidirectional and random access. Object Oriented Programming – a road map to future		
#Exemplar/Case Studies	Study MySQL open source C++ code available at GitHub.	
*Mapping of Course Outcomes for Unit VI	CO2, CO4, CO6	

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Learning Resources

Text Books:

1. Deitel,"C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2
2. Robert Lafore, "Object-Oriented Programming in C++‖", fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

Reference Books:

1. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Matt Weisfeld, "The Object-Oriented Thought Process", Third Edition Pearson ISBN-13:075-2063330166
3. E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, Graw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
4. Cox Brad, Andrew J. Novobilski, "Object –Oriented Programming: An Evolutionary Approach"‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

e-Books:

- https://www.springer.com/gp/book/9781852334505
- https://www.ebookphp.com/object-oriented-programming-in-c-epub-pdf/
- https://www.springer.com/gp/book/9781447133780

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/105/106105151/
- https://swayam.gov.in/nd1_noc20_cs07/preview
- https://www.classcentral.com/course/swayam-programming-in-c-6704

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	**1**
CO3	2	1	2	2	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	**1**
CO5	-	1	-	1	-	-	-	-	-	-	-	-
CO6	-	-	1	-	-	-	-	-	-	-	-	**1**

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210244: Computer Graphics		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite : Basic Mathematics

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The Computer Graphics course prepares students for activities involving the design, development, and testing of modeling, rendering, and animation solutions to a broad variety of problems found in entertainment, sciences, and engineering.

- **Remembering:** To acquaint the learner with the basic concepts of Computer Graphics.
- **Understanding:** To learn the various algorithms for generating and rendering graphical figures.
- **Applying:** To get familiar with mathematics behind the graphical transformations.
- **Understanding:** To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting.
- **Creating:** To generate Interactive graphics using OpenGL.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Identify the basic terminologies of Computer Graphics and interpret the mathematical foundation of the concepts of computer graphics.

CO2: Apply mathematics to develop Computer programs for elementary graphic operations.

CO3: Illustrate the concepts of windowing and clipping and **apply** various algorithms to fill and clip polygons.

CO4: Understand and **apply** the core concepts of computer graphics, including transformation in two and three dimensions, viewing and projection.

CO5: Understand the concepts of color models, lighting, shading models and hidden surface elimination.

CO6: Create effective programs using concepts of curves, fractals, animation and gaming.

Course Contents

Unit I	Graphics Primitives and Scan Conversion Algorithms	(07 Hours)

Introduction, graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computer graphics.

Introduction to OpenGL - OpenGL architecture, primitives and attributes, simple modelling and rendering of two- and three-dimensional geometric objects, GLUT, interaction, events and call-backs picking. (**Simple Interaction with the Mouse and Keyboard)**

Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

#Exemplar/Case Studies	Study about OpenGL Architecture Review Board (ARB)
***Mapping of Course Outcomes for Unit I**	CO1, CO2

Unit II	Polygon, Windowing and Clipping	(07 Hours)

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Polygons: Introduction to polygon, types: convex, concave and complex. Inside test. **Polygon Filling:** flood fill, seed fill, scan line fill. **Windowing and clipping:** viewing transformations, 2-D clipping: Cohen – Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman Polygon clipping algorithm, Weiler Atherton Polygon Clipping algorithm.		
#Exemplar/Case Studies	Study Guard-band clipping Technique and it's use in various rendering softwares, Use of 3D pipeline/ polygonal modelling and applications.	
***Mapping of Course Outcomes for Unit II**	CO2, CO3	
Unit III	**2D, 3D Transformations and Projections**	**(07 Hours)**
2-D transformations: introduction, homogeneous coordinates, 2-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary point. **3-D transformations:** introduction, 3-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary axis. **Projections :** Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)		
#Exemplar/Case Studies	Study use of transformations and projections in education and training software.	
***Mapping of Course Outcomes for Unit III**	CO2, CO4	
Unit IV	**Light, Colour, Shading and Hidden Surfaces**	**(07 Hours)**
Colour models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY. **Illumination Models**: Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model, **Shading Algorithms**: Halftone, Gauraud and Phong Shading. **Hidden Surfaces** Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock)		
#Exemplar/Case Studies	Study any popular graphics designing software	
***Mapping of Course Outcomes for Unit IV**	CO5	
Unit V	**Curves and Fractals**	**(07 Hours)**
Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, **Fractals**: Introduction, Classification, Fractal generation: snowflake, Triadic curve, Hilbert curve, Applications.		
#Exemplar/Case Studies	Case study on measuring the length of coastline using fractals	
***Mapping of Course Outcomes for Unit V**	CO2, CO6	
Unit VI	**Introduction to Animation and Gaming**	**(07 Hours)**
Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. **Animation:** Introduction, Conventional and computer based animation, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification. **Gaming:** Introduction, Gaming platform (NVIDIA, i8060), Advances in Gaming.		
#Exemplar/Case Studies	Study of any open source tools- Unity/Maya/Blender	
***Mapping of Course Outcomes for Unit VI**	CO6	

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Learning Resources

Text Books:

1. S. Harrington, "Computer Graphics"‖, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. Donald D. Hearn and Baker, "Computer Graphics with OpenGL", 4th Edition, ISBN-13: 9780136053583.
3. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Reference Books:

1. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice"‖, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
2. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics"‖, 2nd Edition, Tata McGraw Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.

e-Books:

- https://open.umn.edu/opentextbooks/textbooks/introduction-to-computer-graphics
- http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/106/106106090/
- https://nptel.ac.in/courses/106/102/106102065/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	3	-	1	1	-	-	-	-	-	-	-	-
CO3	1	2	-	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	-	1	-	-	-	-	-	-	-	-	-
CO6	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210245: Digital Electronics and Logic Design

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 104010: Basic Electronics Engineering

Companion Course : 210249: Digital Electronics Lab

Course Objectives:

The goal of this course is to impart the fundamentals of digital logic design; starting from learning the basic concepts of the different base number systems, to basic logic elements and deriving logical expressions to further optimize a circuit diagram. Objective is to see that learners are not only able to evaluate different combinational logic designs, but also design their own digital circuits given different parameters.

- To study number systems and develop skills for design and implementation of combinational logic circuits and sequential circuits
- To understand the functionalities, properties and applicability of Logic Families.
- To introduce programmable logic devices and ASM chart and synchronous state machines.
- To introduce students to basics of microprocessor.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Simplify Boolean Expressions using K Map.
CO2: Design and implement combinational circuits.
CO3: Design and implement sequential circuits.
CO4: Develop simple real-world application using ASM and PLD.
CO5: Differentiate and Choose appropriate logic families IC packages as per the given design specifications.
CO6: Explain organization and architecture of computer system

Course Contents

Unit I	Minimization Technique	(07 Hours)
Logic Design Minimization Technique: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.		
#Exemplar/Case Studies	Digital locks using logic gates	
***Mapping of Course Outcomes for Unit I**	CO1	

Unit II	Combinational Logic Design	(07 Hours)
Code converter -: BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX): MUX (IC 74153, 74151), Cascading multiplexers, Demultiplexers (DEMUX)- Decoder (IC 74138, IC 74154), Implementation of SOP and POS using MUX, DMUX, Comparators (2 bit), Parity generators and Checker.		
#Exemplar/Case Studies	Combinational Logic Design of BCD to 7-segment display Controller	
***Mapping of Course Outcomes for Unit II**	CO2	

Unit III	Sequential Logic Design	(07 Hours)
Flip-Flop: SR, JK,D,T, Preset and Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flop-Flop. Registers: SISO, SIPO, PISO, PIPO, Shift Registers, Bidirectional Shift Register, Ring Counter , Universal Shift Register Counters: Asynchronous Counter, Synchronous Counter, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490),Synchronous Sequential Circuit Design :Models- Moore and Mealy, State diagram and State Table ,Design Procedure, Sequence Generator and detector.		
#Exemplar/Case Studies	Electronic Voting Machine (EVM)	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Algorithmic State Machines and Programmable Logic Devices**	**(07 Hours)**
Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits. PLDS:PLD, ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.		
#Exemplar/Case Studies	Wave form generator using MUX controller method	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Logic Families**	**(07 Hours)**
Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Fan-in, Fan-out, Current and voltage parameters, Noise immunity, Propagation Delay, Power Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements. **Transistor**-Transistor Logic: Operation of TTL NAND Gate (Two input), TTL with active pull up, TTL with open collector output, Wired AND Connection, Tristate TTL Devices, TTL characteristics. CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs.		
#Exemplar/Case Studies	To study the various basic gate design using TTL/CMOS logic family	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Introduction to Computer Architecture**	**(07 Hours)**
Introduction to Ideal Microprocessor – Data Bus, Address Bus, Control Bus. Microprocessor based Systems – Basic Operation, Microprocessor operation, Block Diagram of Microprocessor. Functional **Units of Microprocessor** – ALU using IC 74181, Basic Arithmetic operations using ALU IC 74181, 4-bit Multiplier circuit using ALU and shift registers. Memory Organization and Operations, digital circuit using decoder and registers for memory operations.		
#Exemplar/Case Studies	Microprocessor based system in Communication /Instrumentation Control	
*Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. R.P.Jain, " Modern Digital Electronics", Tata McGraw Hill 4th Edition, ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", Pearson , ISBN 978-93-325-4252-5
3. G. K. Kharate, "Digital Electronics", Oxford Press, ISBN-10: 0198061838

Reference Books:

1. John Yarbrough, "Digital Logic applications and Design", Cengage Learning, ISBN – 13: 978-81-315-0058-3

2. D. Leach, Malvino, Saha, "Digital Principles and Applications"‖, Tata McGraw Hill, ISBN – 13:978-0-07-014170-4.
3. Anil Maini, "Digital Electronics: Principles and Integrated Circuits"‖, Wiley India Ltd, ISBN:978-81-265-1466-3.
4. Norman B and Bradley, "Digital Logic Design Principles", Wiley, ISBN:978-81-265-1258

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eBooks:

- https://www.springer.com/gp/book/9783030361952
- https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea

MOOC/ Video Lectures available at:

- Digital Circuits, by Prof. Santanu Chattopadhyay, https://swayam.gov.in/nd1_noc19_ee51/preview (Unit I, II, III, IV)
- Digital Circuits and Systems, Prof. S. Srinivasan https://nptel.ac.in/courses/117/106/117106086/ (Unit I, II, III, IV)
- Microprocessors and Interfacing By Prof. Shaik Rafi Ahamed | IIT Guwahati https://swayam.gov.in/nd1_noc20_ee11/preview (Unit VI)
- Switching Circuits And Logic Design By Prof. Indranil Sengupta w https://swayam.gov.in/nd1_noc20_cs67/preview (Unit V)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	1	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210246: Data Structures Laboratory

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Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 50 Marks

Companion Course : 210242: Fundamentals of Data Structures

Course Objectives:

To understand basic techniques and strategies of algorithm analysis, the memory requirement for various data structures like array, linked list, stack, queue etc using concepts of python and C++ programming language.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Use algorithms on various linear data structure using sequential organization to solve real life problems.

CO2: Analyze problems to **apply** suitable searching and sorting algorithm to various applications.

CO3: Analyze problems to **use variants of** linked list and solve various real life problems.

CO4: Designing and implement data structures and algorithms for solving different kinds of problems.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts

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learned. Instructor may also set one assignment or mini-project that is suitable to respective branch **beyond the scope of syllabus.**

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments (at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E.)

Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Use List data structure of Python as array. Group C, D and E assignments should be implemented in C++ language.

Operating System recommended:- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, G++/GCC.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	In second year computer engineering class, group A student's play cricket, group B students play badminton and group C students play football. Write a Python program using functions to compute following: - a) List of students who play both cricket and badminton b) List of students who play either cricket or badminton but not both c) Number of students who play neither cricket nor badminton d) Number of students who play cricket and football but not badminton. (Note- While realizing the group, duplicate entries should be avoided, Do not use SET built-in functions)
2	Write a Python program to store marks scored in subject "Fundamental of Data Structure" by N students in the class. Write functions to compute following: a) The average score of class b) Highest score and lowest score of class c) Count of students who were absent for the test d) Display mark with highest frequency
3	Write a **Python** program for department library which has N books, write functions for following: a) Delete the duplicate entries b) Display books in ascending order based on cost of books c) Count number of books with cost more than 500. d) Copy books in a new list which has cost less than 500.
4	Write a **Python** program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following: D 100 W 200 (Withdrawal is not allowed if balance is going negative. Write functions for withdraw and deposit) D means deposit while W means withdrawal. Suppose the following input is supplied to the program: D 300, D 300 , W 200, D 100 Then, the output should be: 500

<table>
<tr><td>5</td><td>Write a Python program to compute following operations on String:
a) To display word with the longest length
b) To determines the frequency of occurrence of particular character in the string
c) To check whether given string is palindrome or not
d) To display index of first appearance of the substring
e) To count the occurrences of each word in a given string</td></tr>
<tr><td>6</td><td>It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is to be provided to the authority. Write a Python program to store students PRNs with date and month of birth. Let List_A and List_B be the two list for two SE Computer divisions. Lists are sorted on date and month. Merge these two lists into third list “List_SE_Comp_DOB” resulting in sorted information about Date of Birth of SE Computer students</td></tr>
<tr><td>7</td><td>Write a Python Program for magic square. A magic square is an n * n matrix of the integers 1 to n2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case n=5. In this example, the common sum is 65.
<table>
<tr><td>15</td><td>8</td><td>1</td><td>24</td><td>17</td></tr>
<tr><td>16</td><td>14</td><td>7</td><td>5</td><td>23</td></tr>
<tr><td>22</td><td>20</td><td>13</td><td>6</td><td>4</td></tr>
<tr><td>3</td><td>21</td><td>19</td><td>12</td><td>10</td></tr>
<tr><td>9</td><td>2</td><td>25</td><td>18</td><td>11</td></tr>
</table></td></tr>
<tr><td>8</td><td>Write a Python program that determines the location of a saddle point of matrix if one exists. An m x n matrix is said to have a saddle point if some entry a[i][j] is the smallest value in row i and the largest value in j.</td></tr>
<tr><td>9</td><td>Write a Python program to compute following computation on matrix:
a) Addition of two matrices B) Subtraction of two matrices
c) Multiplication of two matrices d) Transpose of a matrix</td></tr>
<tr><td>10</td><td>Write a Python program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices</td></tr>
<tr><td></td><td>Group B</td></tr>
<tr><td>11</td><td>a) Write a Python program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and Sentinel search.
b) Write a Python program to store roll numbers of student array who attended training program in sorted order. Write function for searching whether particular student attended training program or not, using Binary search and Fibonacci search</td></tr>
<tr><td>12</td><td>a) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using binary search (recursive and non-recursive). Insert friend if not present in phonebook
b) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.</td></tr>
<tr><td>13</td><td>Write a Python program to maintain club members, sort on roll numbers in ascending order. Write function “Ternary_Search” to search whether particular student is member of club or not. Ternary search is modified binary search that divides array into 3 halves instead of two.</td></tr>
<tr><td>14</td><td>Write a Python program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using
a) Selection Sort
b) Bubble sort and display top five scores.</td></tr>
</table>

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15	Write a **Python** program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Insertion sort b) Shell Sort and display top five scores
16	Write a **Python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores.
17	Write a **Python** program to store 12th class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using bucket sort and display top five scores.
18	Write **Python** program to store 10th class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using radix sort and display top five scores
	Group C
19	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member's information using singly linked list. Store student PRN and Name. Write functions to: a) Add and delete the members as well as president or even secretary. b) Compute total number of members of club c) Display members d) Two linked lists exists for two divisions. Concatenate two lists.
20	The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand a) The list of available seats is to be displayed b) The seats are to be booked c) The booking can be cancelled.
21	Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for- A) Display free slots B) Book appointment C) Sort list based on time D) Cancel appointment (check validity, time bounds, availability) E) Sort list based on time using pointer manipulation
22	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display- a) Set of students who like both vanilla and butterscotch b) Set of students who like either vanilla or butterscotch or not both c) Number of students who like neither vanilla nor butterscotch
23	Write C++ program for storing binary number using doubly linked lists. Write functions- a) To compute 1's and 2's complement b) Add two binary numbers
24	Write C++ program to realize Set using Generalized Liked List (GLL) e.g. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation.
	Group D

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25	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions- a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not
26	In any language program mostly syntax error occurs due to unbalancing delimiter such as (),{},[]. Write C++ program using stack to check whether given expression is well parenthesized or not.
27	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions: 1. Operands and operator, both must be single character. 2. Input Postfix expression must be in a desired format. 3. Only '+', '-', '*' and '/ ' operators are expected.
28	A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an 8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem.
	Group E
29	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
30	Write program to implement a priority queue in C++ using an inorder list to store the items in the queue. Create a class that includes the data items (which should be template) and the priority (which should be int). The inorder list should contain these objects, with operator <= overloaded so that the items with highest priority appear at the start of the list (which will make it relatively easy to retrieve the highest item.)
31	A double-ended queue (deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque.
32	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-
CO3	-	2	1	1	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210247: OOP and Computer Graphics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 25Marks

Companion Course : 210243: Object Oriented Programming(OOP), 210244: Computer Graphics

Course Objectives:

To understand basics of Computer Graphics, apply various methods and techniques for implementing line-circle drawing, projections, animation, shading, illumination and lighting using concepts of Object Oriented Programming.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand and **apply** the concepts like inheritance, polymorphism, exception handling and generic structures for implementing reusable programming codes.

CO2: Analyze the concept of file and **apply** it while storing and retrieving the data from secondary storages.

CO3: Analyze and **apply** computer graphics algorithms for line-circle drawing, scan conversion and filling with the help of object oriented programming concepts.

CO4: Understand the concept of windowing and clipping and **apply** various algorithms to fill and clip polygons.

CO5: Apply logic to implement, curves, fractals, animation and gaming programs.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC, OPENGL.

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Part I : Object Oriented Programming

Suggested List of Laboratory Experiments/Assignments

(All assignments are compulsory)

Sr. No.	Group A
1.	Implement a class Complex which represents the Complex Number data type. Implement the following 1. Constructor (including a default constructor which creates the complex number 0+0i). 2. Overload operator+ to add two complex numbers. 3. Overload operator* to multiply two complex numbers. 4. Overload operators << and >> to print and read Complex Numbers.
2.	Develop a program in C++ to create a database of student's information system containing the following information: Name, Roll number, Class, Division, Date of Birth, Blood group, Contact address, Telephone number, Driving license no. and other. Construct the database with suitable member functions. Make use of constructor, default constructor, copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete as well as exception handling.
3.	Imagine a publishing company which does marketing for book and audio cassette versions. Create a class publication that stores the title (a string) and price (type float) of publications. From this class derive two classes: book which adds a page count (type int) and tape which adds a playing time in minutes (type float). Write a program that instantiates the book and tape class, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.
	Group B
4.	Write a C++ program that creates an output file, writes information to it, closes the file, open it again as an input file and read the information from the file.
5.	Write a function template for selection sort that inputs, sorts and outputs an integer array and a float array.
	Group C
6.	Write C++ program using STL for sorting and searching user defined records such as personal records (Name, DOB, Telephone number etc) using vector container. **OR** Write C++ program using STL for sorting and searching user defined records such as Item records (Item code, name, cost, quantity etc) using vector container.

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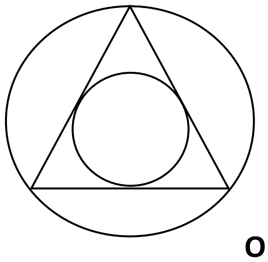
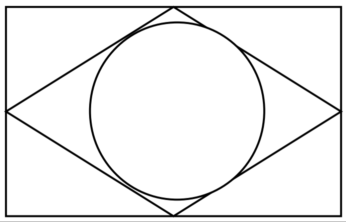
7.	Write a program in C++ to use map associative container. The keys will be the names of states and the values will be the populations of the states. When the program runs, the user is prompted to type the name of a state. The program then looks in the map, using the state name as an index and returns the population of the state.
	Part II : Computer Graphics
	Suggested List of Laboratory Experiments/Assignments **(All assignments are compulsory)**
Sr. No.	**Group A**
1.	Write C++ program to draw a concave polygon and fill it with desired color using scan fill algorithm. Apply the concept of inheritance.
2.	Write C++ program to implement Cohen Southerland line clipping algorithm.
3.	a) Write C++ program to draw the following pattern. Use DDA line and Bresenham‘s circle drawing algorithm. Apply the concept of encapsulation.  **OR** b) Write C++ program to draw the following pattern. Use DDA line and Bresenham‘s circle drawing algorithm. Apply the concept of encapsulation. 
	Group B
4.	a) Write C++ program to draw 2-D object and perform following basic transformations, Scaling b) Translation c) Rotation. Apply the concept of operator overloading. **OR** b) Write C++ program to implement translation, rotation and scaling transformations on equilateral triangle and rhombus. Apply the concept of operator overloading.
5.	a) Write C++ program to generate snowflake using concept of fractals. **OR** b) Write C++ program to generate Hilbert curve using concept of fractals. **OR** c) Write C++ program to generate fractal patterns by using Koch curves.
	Group C
6.	a) Design and simulate any data structure like stack or queue visualization using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL. **OR** b) Write C++ program to draw 3-D cube and perform following transformations on it using OpenGL i) Scaling ii) Translation iii) Rotation about an axis (X/Y/Z). **OR** c) Write OpenGL program to draw Sun Rise and Sunset.

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7.	a) Write a C++ program to control a ball using arrow keys. Apply the concept of polymorphism. **OR** b) Write a C++ program to implement bouncing ball using sine wave form. Apply the concept of polymorphism. **OR** c) Write C++ program to draw man walking in the rain with an umbrella. Apply the concept of polymorphism. **OR** Write a C++ program to implement the game of 8 puzzle. Apply the concept of polymorphism. **OR** d) Write a C++ program to implement the game Tic Tac Toe. Apply the concept of polymorphism.

Mini-Projects/ Case Study

8.	Design and implement game / animation clip / Graphics Editor using open source graphics library. Make use of maximum features of Object Oriented Programming.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	-	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-
CO5	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210248: Digital Electronics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01	Term Work: 25 Marks

Companion Course : 210245: Digital Electronics and Logic Design

Course Objectives:

To understand fundamentals and functionality of electronic circuits, design and implement combinational circuits like MUX, comparator, adder/subtractor, design and implement sequential circuits like flip-flop, registers, and counters using different integrated circuits.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Understand** the working of digital electronic circuits.

CO2: **Apply** the knowledge to appropriate IC as per the design specifications.

CO3: **Design** and **implement** Sequential and Combinational digital circuits as per the specifications.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.

The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Student should perform at least 12 experiments with all experiments from group A and any 5 assignments from group Band one from group C assignments.

Virtual Laboratory:

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- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	To Realize Full Adder/ Subtractor using a) Basic Gates and b) Universal Gates
2	Design and implement Code Converters-Binary to Gray and BCD to Excess-3
3	Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4	Realization of Boolean Expression for suitable combination logic using MUX 74151 /74153, DMUX 74154/74138
5	To Verify the truth table of two bit comparators using logic gates.
6	Design and Implement Parity Generator and checker using EX-OR.
	Group B
7	Design and Realization: Flip Flop conversion
8	Design of 2 bit and 3 bit Ripple Counter using MS JK flip-flop.
9	Design of Synchronous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop
10	Realization of Mod -N counter using (Decade Counter IC 7490) .
11	Design and implement Sequence generator (for Prime Number/odd and even) using MS JK flip-flop.
12	Design and implement Sequence detector using MS JK flip-flop.
	Group C
13	Study of Shift Registers (SISO,SIPO, PISO, PIPO)
14	Design of ASM chart using MUX controller Method.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210249: Business Communication Skills

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01$	Term Work$: 25 Marks

Course Objectives:

- To facilitate Holistic growth ;
- To make the engineering students aware, about the importance, the role and the content of business communication skills ;
- To develop the ability of effective communication through individual and group activities;
- To expose students to right attitudinal and behavioural aspects and to build the same through various activities;

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Express effectively through verbal/oral communication and improve listening skills
CO2: Write precise briefs or reports and technical documents.
CO3: Prepare for group discussion / meetings / interviews and presentations.
CO4: Explore goal/target setting, self-motivation and practicing creative thinking.
CO5: Operate effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership qualities.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about University/program/ institute/ department/foreword/preface), curriculum of course, conduction and Assessment guidelines, topics under consideration concept objectives, outcomes, guidelines, references.

Guidelines for Student's Laboratory Journal and Term Work Assessment

The student must prepare the journal in the form of report elaborating the activities performed. Continuous assessment of laboratory work is to be done based on overall performance and performance of student at each assignments. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion of assignment, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities- SWOT analysis, presentations, team activity, event management, group discussion, Group exercises and interpersonal skills and similar other activities/assignments and Well presented, timely and complete report.

Recommended Assessment and Weightage Parameters:

(Attendance 30%, Assignments/activities-Active participation and proactive learning 50% and report 20%)

Students must submit the report of all conducted activities conducted. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;

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Guidelines for Laboratory Conduction

The instructor may frame assignments to enhance skills supporting career aspects. Multiple set of activity based assignments can be prepared and distributed among batches.
Every student must be given adequate opportunity to participate actively in each activity. An exercise can be designed to allow multiple skills exposure for example a group task encouraging discussions, team building, value sharing, leadership and role play all at the same time.

MOOC at Swayam:[$]

https://swayam.gov.in/nd2_imb19_mg14/preview

Virtual Laboratory:

- https://ve-iitg.vlabs.ac.in/

Sr. No.	Suggested List of Laboratory Experiments/Assignments
1	**SWOT analysis** The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects
2	**Personal and Career Goal setting – Short term and Long term** The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.
3	**Public Speaking** Any one of the following activities may be conducted : **1. Prepared speech (**Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) **2. Extempore speech (**Students deliver speeches spontaneously for 5 minutes each on a given topic) **3. Story telling** (Each student narrates a fictional or real life story for 5 minutes each) **4. Oral review** (Each student orally presents a review on a story or a book read by them)
4	**Reading and Listening skills** The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages asked questions on the article by the readers. Students will get marks on various topics to students for evaluating their reading comprehension.
5	**Group discussion** Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedback.
6	**Letter/Application writing** Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
7	**Report writing** The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal.
8	**Resume writing-** Guide students and instruct them to write resume

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9	**Presentation Skill** Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
10	**Team games for team building -** Students should make to participate in team activity.
11	**Situational games for role playing as leaders**
12	**Faculty may arrange one or more sessions from following:** Yoga and meditation. Stress management, relaxation exercises, and fitness exercises. Time management and personal planning sessions.
13	**Mock interviews-** guide students and conduct mock interviews
14	**Telephonic etiquettes** -To teach students the skills to communicate effectively over the phone. Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call.
15	**Email etiquettes** -To provide students with an in-depth understanding of email skills. Students will be made to send e-mails for different situations such as sending an e-mail to the principal for a leave, inviting a friend for a party, e-mail to enquire about room tariff of a hotel. Students will be assessed on the basis of e-mail such as clarity, purpose and proof reading of e-mail.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	2	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-	1
CO4	-	-	-	-	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	-	3	-	-	2

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210250: Humanity and Social Science		
Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Tutorial: 01 Hours/Week	01$	Term work$: 25 Marks

Course Objectives:

To enable the students to explore aspects of human society and to acquire the intellectual, communication skills and develop characteristics that encourages personal fulfilment, meaningful professional life and responsible citizenship.

- To facilitate Holistic growth;
- To Educate about Contemporary, National and International affairs;
- To bring awareness about the responsibility towards society.
- To give an insight about the emergence of Indian society and the relevance of Economics.

Course Outcomes:

On completion of the course, learner will be–

CO1: **Aware** of the various issues concerning humans and society.

CO2: **Aware** about their responsibilities towards society.

CO3: Sensitized about broader issues regarding the social, cultural, economic and human aspects, involved in social changes.

CO4: **Able** to understand the nature of the individual and the relationship between self and the community.

CO5: **Able** to understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.

Course Contents

Preamble:

As applied sciences, Engineering and Technology are meant to come up with effective solutions to social problems making it imperative that the present generation of engineers and technologists understand the society they live in. Studying the social sciences can provide individuals with crucial answers and observations that could certainly help in understanding of one's life which can alleviate social relations. A broad perspective of nationalistic thinking will provide the students with the ability to be socially conscientious, more resilient and open to building an inclusive society.

Experiencing real-life situations and complex scenarios that arise in each situation will help the budding professions to contribute their skills and knowledge to helping people improve and understand their behaviour or psychological processes. Understanding how the world works begins with an understanding of oneself and gaining hands-on experience and/or thinking about human values and ethics will help trigger a sense of responsibility among the students and lead them to finding effective solutions.

Course Structure: The tutorial sessions to be divided into 2 groups

1. Interactive Sessions to be conducted in classroom
2. Interactive Activities to be conducted Outside Classroom

MOOC/ Video Lectures available at$:

- https://nptel.ac.in/courses/109/103/109103023/
- https://nptel.ac.in/courses/109/107/109107131/

- Teachers will play the role of interventionists and instigating students to apply their thinking abilities on social concepts
- As facilitators and mentors teachers will coax the students to thinking out-of-the-box to come up with creative solutions
- Teachers should focus on instilling a sense of social consciousness through the activities conducted indoors and outdoors.

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Change of Mindset

- Since the course deviates from technical subjects, students will have to be counseled into the importance of social sciences
- A background understanding of the importance of this course in their professional and personal life will have to be enumerated to the students
- Teachers will have to rationalize the course outcomes to get the students invested in the activities being conducted

Designing of Course

- Since students lack prior knowledge, it is imperative that the tutorials conducted be engaging in its activities
- Focus of the sessions should be the learning outcome of each activity conducted either in the class or outside the class
- All activities designed should be as close to real-life making them relatable and applicable
- Student-engagement should be a priority so that the knowledge internalized will be higher
- The activities chosen can be modified to cater to the college location and social context
- The learning should be focused on application of ethics and values during each activity
- The chosen sessions should cater to giving the students the opportunity to be involved and engaged in their role as contributors to society and the nation at large

Basic function of the tutor

- To present a holistic view of the curriculum and the role of this course in it and emphasizing the benefit of the sessions towards developing communications kills, critical thinking and problems solving

Grouping

- The class will be divided into groups of 20 students
- The blend of cultural and social diversity will enhance the learning at the end of each activity
- Teachers will have to be mentored to handle sensitive issues diplomatically while encouraging students to stand up for their beliefs
- The groups will have to have inter-personal sessions so that they get to understand their team members better and work cohesively
- Management support and encouragement to engage students in life-enriching experiences is important

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of each activity
- Assessment of students should be focused on the students' ability to internalize the learning
- Tutors need to understand meaningful ways of assessing students' work to motivate learning

Tutorial Conduction and Term Work guidelines

Interactive Sessions to be conducted during Tutorial (in classroom)

1. PREPARED SPEECH ON CURRENT AFFAIRS
    a. Purpose – Get students to stay abreast and invested in national current affairs
    b. Method – Each student has to read an editorial from any national paper (English), find out more information on the topic and present it to the class; ending the session with his/her opinion on the matter
    c. Outcome – Awareness of national state of affairs. Improve on oratory skills. Instil the thinking and contemplative skills and form non-judgmental opinions about an issue
2. UNDERSTANDING INDIA'S CULTURAL DIVERSITY
    a. Purpose – Expose students to the intricacies of Indian cultural across various states
    b. Method – Each student (or a small group of students in case the number of students is large) has to pick a state and come to the tutorial session prepared with a PPT that will showcase the demographic, sociographic and cultural information of that state
    c. Outcome – Information about the beauty of Indian cultural diversity. Enhance exploratory skill, communication skills and learn to present using technological tools.

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3. WRITING AN ARTICLE ON ANY SOCIAL ISSUE
    a. Purpose – Highlight various social and cultural evil malevolence existing in our country and express one's opinion on how it can be changed
    b. Method – Each student will have to write a 200 word essay on any of existing social malice that is prevalent in society. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
    c. Outcome – Learn to raise one's voice against the wrong doings in communities. Build writing skills, improve language and gain knowledge about how to write an impactful essay
4. GROUP DISCUSSION ON COMMUNAL TOPIC
    a. Purpose – Make students aware of the issues that are pertinent in a society and express a learned opinion about it
    b. Method – Students in groups of 20 each will discuss a relevant and grave issue that is dogging the nation. Alternatively, topics from current affairs (National budget, democratic process, economical strengthening of the country).
    c. Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven arguments making them contributors in any team
5. QUIZ ON SOCIAL BEHAVIOR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills
6. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop
    c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

7. QUIZ ON SOCIAL BEHAVIOR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills
8. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop

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   c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

9. DEBATE ON A TOPIC FROM SOCIAL SCIENCES
   a. Purpose – Educate students about various domains in social sciences and develop an interest towards gaining knowledge about these topics
   b. Method – Various topics from various domains of social sciences can be chosen and students in pairs can pick a topic and present their arguments for or against the topic. Time for each debate will be 10 minutes maximum
   c. Outcome – Recognize the significance of social sciences in our lives. Cultivate the habit to present forceful arguments while respecting the opponents perspective and enhance verbal skills.

Interactive Activities to be conducted during Tutorial (Outside Classroom)

1. WASTE MANAGEMENT and CLEAN CAMPUS
   a. Purpose: Create awareness among students about the significance of a clean environment and social responsibility to deter littering and segregate waste
   b. Method: Students (in groups) will be given charge of areas of campus and will be expected to clean that segment. Also, they will be entrusted with the responsibility to collect, separate waste and hand over to the housekeeping authority
   c. Outcome: Develop the habit to maintain cleanliness at home as well as learn to respect community areas at college or workplace. It will also encourage them become ambassadors among their peers to advocate protection of the environment
2. MAKING A VIDEO ON SOCIAL WASTAGES.
   a. Purpose: Instil among students a sense of responsibility towards judiciously using natural resources like water and electricity
   b. Method: Using their phones / hand-held devices, groups of students will make a 3 – 4 minute short film that will highlight irresponsible behavior in terms of wastage of water, leaving lights, fans and other electrical appliances on when not in use, defacing public and campus property by scribbling on walls and common areas. They will make awareness for the same among students. The creative videos will be posted on the college website and social media as an encouragement
   c. Outcome: Conscientious behavior towards saving public utility resources. Explore the use of audio-visual tools to create more meaningful messages that can effect a change in society
3. RELAY MARATHON (3 – 5 kms)
   a. Purpose: Propagate a social message by way of a sport activity
   b. Method: A group of students will begin the race with banner / placard in hand that contains a social message. The group runs for 500 meters and hands over the banner / placard to the next group of students. This chain of exchange will continue for 3 – 5 kms.
   c. Outcome: Become aware of the need for fitness and encouragement towards healthier lifestyle. Students will also be able to express their creativity in terms of meaningful messages and gain attention towards worthy social causes from the community in and around the campus.
4. TREE PLANTATION ON CAMPUS
   a. Purpose: Involve students to actively participate in environment protection and develop greener surroundings
   b. Method: Each student will plant a sapling and take care of that plant until it is able to sustain itself. Alternatively, students can organize a tree plantation drive in a public area and nurture it
   c. Outcome: Besides increase in plants in the locality, students will feel a sense of empowerment and become social contributors towards protecting the environment.
5. VISIT TO AN OLD AGE HOME / ORPHANAGE
   a. Purpose: Build a sense of responsibility towards the less fortunate in our society and feel privileged to be able to effect real change in the world around us

Home

b. Method: Students have to visit an old age home or orphanage in the vicinity of the college. They can interact with the inmates, probably donate utilities to the charity organization and/or probably stage a few inclusive activities with the residents of the place. After the visit, students can submit a brief report about their experience

c. Outcome: Learn first-hand about the conditions and social situations that the no-so-privileged members of our society have to endure to survive and go beyond their embarrassment to interact with the destitute which will help students appreciate the importance of Indian family values

6. STREET PLAY ACTIVITY

a. Purpose: Create awareness in themselves as well as people in the community on various social evils that need to be eradicated

b. Method: Students will prepare and enact a street play on any pertinent issues in society. The topics suggested can be perils of mobile phones / online fraud / safety for girls / mental and physical health of the youth.

c. Outcome: Allow students to deliberate and think deeply about the looming issues that is dogging our society and the future of the youth. This will also bring out the creative skills among the students and allow them to showcase their talent.

7. BUDDY / BIG BROTHER SYSTEM

a. Purpose: Include and involve the less fortunate children making them feel wanted and cared for as well as use the opportunity to share knowledge among school students.

b. Method: Students have to go to nearby schools after procuring appropriate permissions to teach a particular topic on either technical or non technical domains. Each student can choose to adopt 5 students from the class to be their mentor over a period of 1 year by staying in touch with them and helping them resolve their issues on academic or other matters.

c. Outcome: Appreciation and respect towards the responsibility of teaching. They will learn to be accountable as social contributors and bring about some change in the lives of the young students they mentor as Buddies or Big Brother.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.

The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:

(Attendance 30%, Assignments/Activities-Active participation and proactive learning 50% and report 20%)

Learning Resources

Books:

1. A. Alavudeen, M. Jayakumaran, and R Kalil Rahman, “Professional Ethics and Human Values”
2. Ram Ahuja, “Social Problems in India” (third edition)
3. Shastry, T. S. N., “India and Human rights: Reflections”, Concept Publishing Company India Pvt. Ltd., 2005.
4. Nirmal, C.J., “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford India
5. Rangarajan, “Environmental Issues in India”, Pearson Education.
6. University of Delhi, The Individual and Society, Pearson Education.
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, “Social change in modern India”, 1991, Orient Longman.
9. David Mandelbaum, Society in India, 1990, Popular.
10. Dr. Abha Singh, “Behavioral Science: Achieving Behavioral Excellence for Success”, Wiley.

e-Books:

- https://www.moteoo.org/en/products/social-science-and-humanities-student-book-english
- https://www.springeropen.com/books
  (SpringerOpen open access books; download them free of charge from SpringerLink)
- https://muse.jhu.edu/article/541846/pdf
  (This content has been declared *free* to read by the publisher during the COVID-19)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	2	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	1
CO4	-	-	-	-	-	-	2	2	2	-	-	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210251: Audit Course 3

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 3 Options

Audit Course Code	Audit Course Title
AC3-I	Green Construction and Design
AC3-II	Social Awareness and Governance Program
AC3-III	Environmental Studies
AC3-IV	Smart Cities
AC3-V	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese(Module 1)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

AC3-I: Green Construction and Design

Home

Prerequisites: General awareness of environment and eco system.

Course Objectives:

1. To motivate students for undertaking green construction projects, technical aspects of their design, obstacles to getting them done, and future directions of the field.
2. To increase awareness of green construction issues, so that students will know the range of existing knowledge and issues.
3. Proper use of energy, water and other resources without harming environment.
4. To reduce waste pollution and Environment Degradation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the importance of environment friendly society.
CO2: Apply primary measures to reduce carbon emissions from their surroundings.
CO3: Learn role of IT solutions in design of green buildings.
CO4: Understand the use of software systems to complete statutory compliances involved in the design of a new home or office building through green construction.

Course Contents

1. Introduction to Green Construction, need of green construction, Importance, Government Initiatives, your role in the Green Environment.
2. How to do Green Construction, Project Definition, Team Building, Education and Goal Setting, Documents and Specification.
3. Elements of Green Construction, Materials Construction Waste Management, Indoor Air Quality, Energy Efficiency.
4. Indian Green Building Council (IGBC), Introduction to IGBC, IGBC rating system, Green building projects in India, Benefits of green building, effects on natural resources.

Team Projects:

Students will be formed into groups to research green construction and design in a particular construction context and report their results to the class. What are the particular obstacles and opportunities to integrating green construction techniques into the following sectors? Be sure to consider technical, social, political and economic issues:
Hotels (economy, luxury, resorts), Hospitals, Retail(big box, malls, small scale downtown retail), Office, Government, ,Schools, Universities, Housing, Transportation Stations (Airport Terminals, Train Stations).

References :

1. Kibert, C. (2008) Sustainable Construction: Green Building Design and Delivery, 2nd edition(Hoboken, NJ: John Wiley and Sons.
2. Handbook of Green Building Design and Construction 1st Edition, by Sam Kubba, eBook ISBN:9780123851291.

IGBC Green New Buildings Rating System, Version 3.0, Abridged Reference Guide September 2014. Available:https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	2	-	-	3	3	-	-	-	-	-
CO2	-	-	2	-	-	3	3	-	-	-	-	-
CO3	-	-	-	-	3	-	2	-	-	-	-	-
CO4	-	-	1	-	3	-	2	-	-	-	-	-

AC3-II: Social Awareness and Governance Program

Home

Prerequisites:

Awareness about basic terms in Social Science and Governance

Course Objectives:

1. To Increase community awareness about social issues and to promote the practice of good governance in both private and public institutions, through policy advocacy and awareness creation in order to ensure proper utilization of public resources and good service delivery.
2. Increase community awareness on health, education, and human rights.
3. Transferring costs of social activities to other various segments of society.
4. To enhance youth participation in decision-making, democracy and economic development.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand social issues and responsibilities as member of society.

CO2: Apply social values and ethics in decision making at social or organizational level

CO3:Promote obstacles in national integration and role of youth for National Integration

CO4: Demonstrate basic features of Indian Constitution.

Course Contents

1. Indian Society as Pluralistic, Fundamentals of unity in diversity, diversity and disparity in Indian society, women in mass media, disparities due to disability.
2. The Indian constitution as unifying factor, Introduction Making of Indian Constitution, Basic features of Indian Constitution, Strengths of Indian Constitution, and Fundamental Duties.
3. National Integration: Introduction, The Value of Tolerance, Minority Classes And Constitution, Pre-Requisites of National Integration, Obstacles To National Integration, Promotion of National Integration, Role of Youth In Promoting Communal Harmony.
4. Socialization, Ethics, Values and Prejudices, Meaning of Socialization, Functions of Socialization, Agents of Socialization, Importance of Socialization, Role of Ethics In Individual Development, Role of Basic Human Values In Individual Development, Relative Value System.

Activities:

1. Conducting training/workshops/debates on HIV/AIDS prevention and stigma reduction.
2. Public shows on girls' education and empowerment.
3. Conducting campaigns on adult/disabled education.
4. To support the government to develop policy that encourages youth participation in decision-making through government agencies.

References:

1. Devidas M. Muley , S Chand, " Social Awareness and Personality Development", ISBN: 812193074X.
2. Bhagabati Prosad Banerjee, Durga Das Basu, Shakeel Ahmad Khan, V. R. Manohar, "Introduction to the Constitution of India", ISBN : 9788180385599.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	3	2	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-	-

Home

AC3-III: Environmental Studies

Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
4. Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Comprehend the importance of ecosystem and biodiversity

CO2: Correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention

CO3: Identify different types of environmental pollution and control measures

CO4: Correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents

1. **Natural Resources:** Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
2. **Ecosystems:** Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
3. **Biodiversity:** Genetic, Species and ecological diversity, Bio Geographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
4. **Pollution:** Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution #Exemplar/Case Studies, Disaster management

Reference:

1. Bharucha, E.,–Textbook of "Environmental Studies", Universities Press(2005),ISBN-10:8173715408
2. Mahua Basu, "Environmental Studies", Cambridge University Press, ISBN-978-1-107-5317-3

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	3	3	-	-	-	-	1
CO3	-	2	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-

AC3-IV: Smart Cities

Home

We breathe in a world defined by urbanization and digital ubiquity, where mobile broadband connections outnumber fixed ones, machines dominate a new "internet of things," and more people live in cities than in the countryside. This course enables us to take a broad historical look at the forces that have shaped the planning and design of cities and information technologies from the rise of the great industrial cities of the nineteenth century to the present. This course considers the motivations, aspirations, and shortcomings of them all while offering a new civics to guide our efforts as we build the future together, one click at a time.

Course Objectives

- To identify urban problems
- To study Effective and feasible ways to coordinate urban technologies.
- To study models and methods for effective implementation of Smart Cities.
- To study new technologies for Communication and Dissemination.
- To study new forms of Urban Governance and Organization.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the dynamic behavior of the urban system by going beyond the physical appearance and by focusing on representations, properties and impact factors

CO2: Explore the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows

CO3: Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing

CO4: Knowledge about the latest research results in for the development and management of future cities

CO5: Understand how citizens can benefit from data-informed design to develop smart and responsive cities

Course Contents

Urbanization and Ubiquity - The slow emergence of learning cities in an urbanizing world. Cities as collective learners, what do we know?- Framing a view -A gamut of learning types - Secrets of knowing and accelerating change - Why some cities learn and others do not.

References:

1. Anthony M. Townsend, W. W. Nortonand Company "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", ISBN: 0393082873,9780393082876.
2. Tim Campbell, Routledge, "Beyond Smart Cities: How Cities Network, Learn and Innovate"‖, Routledge, ISBN:9781849714266.
3. StanGeertman, JosephFerreira, Jr.Robert Goodspeed, JohnStillwell, "Planning Support System ms and Smart Cities", Lecture notes in Geo information and Cartography, Springer.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	-	2	2	1	-	-	-	-
CO2	1	2	1	-	-	1	1	-	-	-	-	-
CO3	2	1	3	3	2	-	1	-	1	1	1	
CO4	-	3	2	-	-	-	-	-	-	-	1	2

AC3-V: Foreign Language- Japanese (Module 1)

Home

About course:

With changing times, the competitiveness has gotten into the nerves and "Being the Best"at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best… suited Language!!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market and find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the 'resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it.

The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through anguage.

Course Outcomes:

On completion of the course learner will able to-

CO1: Will have ability of basic communication.

CO2: Will have the knowledge of Japanese script.

CO3: Will get introduced to reading , writing and listening skills

CO4: Will develop interest to pursue professional Japanese Language course.

Course Contents

1. Introduction to Japanese Language. Hiragana basic Script, colors, Days of the week
2. Hiragana : modified Kana, double consonant, Letters combined with ya, yu, yoLong vowels, Greetings and expressions
3. Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating on'sage.

Reference:

1. Minna No Nihongo,"Japanese for Everyone", Elementary Main Text book1-1 (Indian Edition), Goyal Publishers and Distributors Pvt.Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Semester IV

<table>
<tr><td colspan="3">Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
207003: Engineering Mathematics III</td></tr>
<tr><td>Teaching Scheme</td><td>Credit Scheme</td><td>Examination Scheme and Marks</td></tr>
<tr><td>Lecture: 03 Hours/Week
Tutorial: 01 Hour/ Week</td><td>Theory: 03
Tutorial: 01</td><td>Mid_Semester(TH): 30 Marks
End_Semester(TH): 70 Marks
Term Work: 25 Marks</td></tr>
</table>

Home

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification and Representation of data.

Companion Course : ---

Course Objectives:

To make the students familiar with concepts and techniques in Linear differential equations, Fourier transform and Z-transform, Statistical methods, Probability theory and Numerical methods. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes:

On completion of the course learner will able to-

- CO1: Solve Linear differential equations, essential in modelling and design of computer-based systems.
- CO2: Apply concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.
- CO3: Apply Statistical methods like correlation and regression analysis and probability theory for data analysis and predictions in machine learning.
- CO4: Solve Algebraic and Transcendental equations and System of linear equations using numerical techniques.
- CO5: Obtain Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

Course Contents

Unit I	Linear Differential Equations (LDE)	(08 Hours)

LDE of n^{th} order with constant coefficients, Complementary function, Particular integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Unit II	Transforms	(08 Hours)

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine and Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Discrete Fourier Transform.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	(07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV	Probability and Probability Distributions	(07 Hours)

Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergeometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.

Home

Unit V	Numerical Methods	(08 Hours)

Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability.

Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.

Unit VI	Numerical Methods	(08 Hours)

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods.

Learning Resources

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Numerical Methods for Scientific and Engineering Computation, by M. K. Jain, S. R. K. Iyengar And R. K. Jain, 5e, (New Age International Publication)

MOOC Link:

1. NPTEL Course "Transform Calculus And its applications in differential equations" https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course on "Numerical Methods" https://nptel.ac.in/courses/111/107/111107105/

Virtual LAB Link:

1. Numerical Methods: http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/index.php

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in batches (batch size as per norms) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

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Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210252: Data Structures and Algorithms		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses: 110005: Programming and Problem Solving
210242: Fundamentals of Data Structures

Companion Course: 210257: Data Structures and Algorithms Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Identify and articulate** the complexity goals and benefits of a good hashing scheme for real-world applications.
CO2: **Apply** non-linear data structures for solving problems of various domain.
CO3: **Design and specify** the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.
CO4: **Analyze** the algorithmic solutions for resource requirements and optimization
CO5: **Use** efficient indexing methods and multiway search techniques to store and maintain data.
CO6: **Use** appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Course Contents

Unit I	**Hashing**	**(07 Hours)**
Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining. **Skip List-** representation, searching and operations- insertion, removal		
#Exemplar/Case Studies	Book Call Number and Dictionary	
***Mapping of Course Outcomes for Unit I**	CO1, CO4	
Unit II	**Trees**	**(08 Hours)**

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Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree.		
#Exemplar/Case Studies	Use of binary tree in expression tree-evaluation and Huffman's coding	
***Mapping of Course Outcomes for Unit II**	CO2, CO3,CO4	
Unit III	**Graphs**	**(07 Hours)**
Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. **Traversals**-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.		
#Exemplar/Case Studies	Data structure used in Webgraph and Google map	
***Mapping of Course Outcomes for Unit III**	CO2,CO3, CO4	
Unit IV	**Search Trees**	**(08 Hours)**
Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree		
#Exemplar/Case Studies	Keyword search in a document using OBST	
***Mapping of Course Outcomes for Unit IV**	CO2, CO3, CO5	
Unit V	**Indexing and Multiway Trees**	**(07 Hours)**
Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion, B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree.		
#Exemplar/Case Studies	Heap as a Priority Queue	
***Mapping of Course Outcomes for Unit V**	CO2, CO3, CO5	
Unit VI	**File Organization**	**(07 Hours)**
Files: concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.		
#Exemplar/Case Studies	**External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm	
***Mapping of Course Outcomes for Unit VI**	CO4, CO6	
Learning Resources		

Text Books:

1. Horowitz, Sahani, Dinesh Mehata, “Fundamentals of Data Structures in C++”‖, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, “File Structures‖, Pearson Education”, ISBN:81-7758-37-5
3. Peter Brass, “Advanced Data Structures”‖, Cambridge University Press, ISBN: 978-1-107-43982-5

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Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms"‖, Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, "File Structures an Object Oriented Approach with C++‖", Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, "Data Structures, Algorithms and Applications in C++"‖, Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, "Data Structures and Algorithms"‖, McGraw-Hill Companies, ISBN -9780070667266.
5. Goodrich, Tamassia, Goldwasser, "Data Structures and Algorithms in Java"‖, Wiley Publication, ISBN: 9788126551903

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	1	-	-	-	-	-	-	-	-
CO5	1	-	1	1	-	-	-	-	-	-	-	-
CO6	2	1	1	1	-	-	-	-	-	-	-	-

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<table>
<tr><td colspan="6">Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210253: Software Engineering</td></tr>
<tr><td colspan="2">Teaching Scheme</td><td colspan="2">Credit Scheme</td><td colspan="2">Examination Scheme and Marks</td></tr>
<tr><td colspan="2">Lecture: 03 Hours/Week</td><td colspan="2">03</td><td colspan="2">Mid_Semester(TH): 30 Marks
End_Semester(TH): 70 Marks</td></tr>
<tr><td colspan="2">Prerequisite Courses :</td><td colspan="4">110005: Programming and Problem Solving</td></tr>
<tr><td colspan="2">Companion Course :</td><td colspan="4">---</td></tr>
<tr><td colspan="6">Course Objectives:
The main objective of this course is to introduce the students to software engineering- the fundaments of software engineering principles and practices, including project management, configurations management, requirements definition, system analysis, design, testing, and deployment with hands-on experience in a group software development project.
• To learn and understand the principles of Software Engineering.
• To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
• To apply design and testing principles to software project development.
• To understand project management through life cycle of the project.</td></tr>
<tr><td colspan="6">Course Outcomes:
On completion of the course, learner will be able to-
CO1: Analyze software requirements and formulate design solution for a software.
CO2: Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.
CO3: Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.
CO4: Model and design User interface and component-level.
CO5: Identify and handle risk management and software configuration management.
CO6: Utilize knowledge of software testing approaches, approaches to verification and validation.
CO7: Construct software of high quality – software that is reliable, and that is reasonably easy to understand, modify and maintain efficient, reliable, robust and cost-effective software solutions.</td></tr>
<tr><td colspan="6">Course Contents</td></tr>
<tr><td>Unit I</td><td colspan="4">Introduction to Software Engineering and Software Process Models</td><td>(06Hours)</td></tr>
<tr><td colspan="6">Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. Software Process: A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.</td></tr>
<tr><td>#Exemplar/Case Studies</td><td colspan="5">Agile Tools- JIRA</td></tr>
<tr><td>*Mapping of Course Outcomes for Unit I</td><td colspan="5">CO1, CO3, CO7</td></tr>
<tr><td>Unit II</td><td colspan="4">Software Requirements Engineering and Analysis</td><td>(07 Hours)</td></tr>
</table>

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Modeling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements. **Suggested Free Open Source tools:** StarUML, Modelio, SmartDraw.		
#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study Study SRS of Online Voting system (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf), Library management System, Develop use case model for any software applications.	
***Mapping of Course Outcomes for Unit II**	CO1, CO3, CO7	
Unit III	**Estimation and Scheduling**	**(07 Hours)**
Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix **Project Scheduling:** Project Scheduling, Defining a Task for the Software Project, Scheduling. **Suggested Free Open Source Tools:** Gantt Project, Agantty, Project Libre.		
#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study, Study SRS of Online Voting system, Library management System (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf),	
***Mapping of Course Outcomes for Unit III**	CO1, CO3, CO7	
Unit IV	**Design Engineering**	**(07 Hours)**
Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements. **Architectural Design:** Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles. **Suggested Free Open Source Tool:** Smart Draw		
#Exemplar/Case Studies	Study design of Biometric Authentication software	
***Mapping of Course Outcomes for Unit IV**	CO1,CO2 CO3, CO7	
Unit V	**Risks and Configuration Management**	**(07 Hours)**
Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan. **Software Configuration Management**: Software Configuration Management, The SCM Repository The SCM Process, Configuration Management for any suitable software system. Suggested Free Open Source Tools: CF Engine Configuration Tool, Puppet Configuration Tool.		
#Exemplar/Case Studies	Risk management in Food delivery software	

*Mapping of Course Outcomes for Unit V	CO1,CO2 CO3, CO7	
Unit VI	**Software Testing**	**(07 Hours)**
A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies forWebApps, Validation Testing, Validation-Test Criteria, Configuration Review. **Suggested Free Open Source Tools:** Selenium, JUnit.		
#Exemplar/Case Studies	Selemium Testing with any online application	
*Mapping of Course Outcomes for Unit VI	CO1,CO2 CO3, CO6	

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Learning Resources

Text Books:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach"‖, McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, "Software Engineering"‖, Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", PHI, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering"‖, PHI, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering"‖, Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering"‖, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, "Handbook of Software Engineering", Clanye International ISBN-10: 1632402939

e-books:

- https://ebookpdf.com/roger-s-pressman-software-engineering

MOOC/ Video Lectures available at:

- https://swayam.gov.in/nd1_noc19_cs69/preview
- https://swayam.gov.in/nd2_cec20_cs07/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	2	2	2	-	-	-	-
CO3	-	-	2	-	-	2	-	-	-	-	-	-
CO4	-	2	2	-	-	-	-	-	-	-	-	
CO5	-	2	2	-	-	-	-	-	-	-	-	-
CO6	-	2	2	-	-	-	-	-	-	-	-	-
CO7	1	-	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210254: Microprocessor		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 210248: Digital Electronics and Logic Design

Companion Course : 210258: Microprocessor Laboratory

Course Objectives:

The course is intended to provide practical exposure to the students on microprocessors, design and coding knowledge on 80386 and introduction to microcontrollers.

- To learn and distinguish the architecture and programmer‘s model of advanced processor.
- To identify the system level features and processes of advanced processors.
- To acquaint the learner with application instruction set and logic to build assembly language programs.

Course Outcomes:

After successful completion of the course, the learner will be able to-

CO1: Exhibit skill of assembly language programming for the application.

CO2: **Classify** Processor architectures.

CO3: **Illustrate** advanced features of 80386 Microprocessor.

CO4: **Compare** and **contrast** different processor modes.

CO5: **Use** interrupts mechanism in applications

CO6: **Differentiate** between Microprocessors and Microcontrollers.

CO7: **Identify** and **analyze** the tools and techniques used to design, implement, and debug microprocessor-based systems.

Course Contents

Unit I	Introduction to 80386	(07 Hours)

Brief History of Intel Processors, 80386 DX Features and Architecture, Programmers Model, Operating modes, Addressing modes and data types.

Applications Instruction Set: Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.

#Exemplar/Case Studies	Study-Evolution of Microprocessor
*Mapping of Course Outcomes for Unit I	CO1,CO2

Unit II	Bus Cycles and System Architecture	(07 Hours)

Initialization- Processor State after Reset. Functional pin Diagram, functionality of various pins, I/O Organization, Memory Organization (Memory banks), Basic memory read and writes cycles with timing diagram.

Systems Architecture- Systems Registers (Systems flags, Memory Management registers, Control registers, Debug registers, Test registers), System Instructions.

#Exemplar/Case Studies	Study-Motherboard of Computer and it’s components.
*Mapping of Course Outcomes for Unit II	CO3

Unit III	Memory Management	(08 Hours)

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Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, GDTR, LDTR, IDTR. Formats of Descriptors and Selector, Segment Translation, Page Translation, Combining Segment and Page Translation.		
#Exemplar/Case Studies	Try creating an animation by using any of /Study of the tools to create and access all the type of possible segments in 80386DX.	
***Mapping of Course Outcomes for Unit III**	CO1,CO2	
Unit IV	**Protection**	**(08 Hours)**
Need of Protection, Overview of 80386DX Protection Mechanisms: Protection rings and levels, Privileged Instructions, Concept of DPL, CPL, RPL, EPL. Inter privilege level transfers using Call gates, Conforming code segment, Privilege levels and stacks. Page Level Protection, Combining Segment and Page Level Protection.		
#Exemplar/Case Studies	Study about- can the security of the system be compromised using CALL gates?	
***Mapping of Course Outcomes for Unit IV**	CO4, , CO6	
Unit V	**Multitasking and Virtual 8086 Mode**	**(08Hours)**
Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space. **Virtual Mode** – Features, Memory management in Virtual Mode , Entering and leaving Virtual mode.		
#Exemplar/Case Studies	Study about multitasking implemented by using timing interrupt generated by internal clock of the system. Consider three different tasks: One displaying a string at first row accessing VRAM directly; Second Blinking the string with certain time interval and; Third clearing the screen.	
***Mapping of Course Outcomes for Unit V**	CO4, CO5, CO6	
Unit VI	**Interrupts, Exceptions, and Introduction to Microcontrollers**	**(07 Hours)**
Interrupts and Exceptions: Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions. **Introduction to Microcontrollers**: Architecture of typical Microcontroller, Difference between Microprocessor and Microcontroller, Characteristics of microcontrollers, Application of Microcontrollers.		
#Exemplar/Case Studies	Try building a Minimum System using 8051 microcontroller (Provide complete architecture and component selection with rationale). Indicate Memory Map explicitly.	
***Mapping of Course Outcomes for Unit VI**	CO4,CO6, CO7	
Learning Resources		

Text Books:

1. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 2 Edition, 2006 ISBN 0-07-100462-9
2. A.Ray, K.Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill,2004 ISBN 0-07-463841-6
3. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.
4. Intel 80386 Hardware Reference Manual 1986, Intel Corporation, Order no.: 231732-001, 1986.
5. James Turley- "Advanced 80386 Programming Techniques", McGraw-Hill,
ISBN: 10:0078813425, 13: 978-0078813429.

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Reference Books:

1. Chris H. Pappas, William H. Murray, "80386 Microprocessor Handbooks", McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
2. Walter A. Triebel, "The 80386Dx Microprocessor: Hardware", Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
3. Brey, Barry B, "8086/8088, 80286, 80386 and 80486 Assembly Language Programming", Prentice Hall, ISBN: 13: 9780023142475.
4. Mohammad Rafiquzzaman, "Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
5. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.
6. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

Intel 80386 Programmer's Reference Manual:

- http://intel80386.com/386htm/toc.htm
- https://css.csail.mit.edu/6.858/2014/readings/i386.pdf

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/108/106108100/
- https://nptel.ac.in/courses/108/107/108107029/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-
CO7	2	1	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210255: Principles of Programming Languages

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving, 210253: Object Oriented Programming

Companion Course : 210257: Data Structures and Algorithms Laboratory

Course Objectives:

- To learn basic principles of programming languages and programming paradigms.
- To learn structuring the data and manipulation of data, computation and program structure.
- To learn Object Oriented Programming (OOP) principles using Java Programming Language.
- To learn basic concepts of logical and functional programming language.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Make** use of basic principles of programming languages.
CO2: **Develop** a program with Data representation and Computations.
CO3: **Develop** programs using Object Oriented Programming language : Java.
CO4: **Develop** application using inheritance, encapsulation, and polymorphism.
CO5: **Demonstrate** Multithreading for robust application development.
CO6: **Develop** a simple program using basic concepts of Functional and Logical programming paradigm.

Course Contents

Unit I	Fundamentals of Programming	(06Hours)

Importance of Studying Programming Languages, History of Programming Languages, Impact of Programming Paradigms, Role of Programming Languages, Programming Environments. Impact of Machine Architectures: The operation of a computer, Virtual Computers and Binding Times.
Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic and rule based.

#Exemplar/Case Studies	A case study: Retail Sales application
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Structuring the Data, Computations and Program	(07 Hours)

Elementary Data Types : Primitive data Types, Character String types, User Defined Ordinal Types, Array types, Associative Arrays, Record Types, Union Types, Pointer and reference Type.
Expression and Assignment Statements: Arithmetic expression, Overloaded Operators, Type conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed mode Assignment. **Statement level Control Statements:** Selection Statements, Iterative Statements, Unconditional Branching. **Subprograms:** Fundamentals of Sub Programs, Design Issues for Subprograms, Local referencing Environments, Parameter passing methods.
Abstract Data Types and Encapsulation Construct: Design issues for Abstraction, Parameterized Abstract Data types, Encapsulation Constructs, Naming Encapsulations.

#Exemplar/Case Studies	Data representation and computations in Retail Sales
*Mapping of Course Outcomes for Unit II	CO2

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Unit III	Java as Object Oriented Programming Language- Overview	(07 Hours)
Fundamentals of JAVA, Arrays: one dimensional array, multi-dimensional array, alternative array declaration statements, **String Handling:** String class methods, **Classes and Methods**: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable - length arguments.		
#Exemplar/Case Studies	Demonstrate classes , objects, data, methods for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Inheritance, Packages and Exception Handling using Java**	**(07 Hours)**
Inheritances: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator. fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class.		
#Exemplar/Case Studies	Demonstrate inheritance, Packages and interface for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Multithreading in Java**	**(07 Hours)**
Concurrency and Synchronization, Java Thread Model: Thread priorities, Synchronization, Messaging, Main Thread, Creating thread: Implementing Thread using thread class and Runnable interface. Creating multiple threads using is Alive() and join(). **Web Based Application in Java:** Use of JavaScript for creating web based applications in Java, Introduction to Java script frameworks- ReactJS, VueJS, AngularJS (open source).		
#Exemplar/Case Studies	Demonstrate Multithreading for Gaming.	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Logical and Functional Programming**	**(07 Hours)**
Functional Programming Paradigm: Understanding symbol manipulation, Basic LISP functions, definitions, predicates, conditionals and scoping, Recursion and iteration, Properties List array and access functions, Using lambda definitions, printing, reading and atom manipulation. **Logic Programming Paradigm:** An Overview of Prolog, Syntax and Meaning of Prolog Programs, Lists, Operators, Arithmetic, Using Structures.		
#Exemplar/Case Studies	Demonstrate Functional and Logic Programming for Software Project Management.	
*Mapping of Course Outcomes for Unit VI	CO6	

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Learning Resources

Text Books:

1. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation‖, 4th Ed, PHI, ISBN 81-203-2035-2.
2. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
3. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9.

Reference Books:

1. Deugo, ―Java Gems‖, Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
2. Carl Townsend ,"Programming in turbo PROLOG", Tata-McGraw Hill
3. Ivan Bratko, " Prolog Programming for Artificial Intelligence", Wesley Publishers Limited
4. Winston P., Klaus B., Horn P., "LISP", 3rd Edition, Pearson Education, 81 - 7808 -155-5
5. Carlo Ghezzi, Mehdi Jazayeri, ―Programming Language Concepts‖,3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.

eBooks:

- https://www.springer.com/gp/book/9781848820319
- https://www.springer.com/gp/book/9781848829138

eBooks:

- https://nptel.ac.in/courses/106/102/106102067/
- https://swayam.gov.in/nd1_noc20_cs08/preview
- https://swayam.gov.in/nd2_aic20_sp13/preview
- https://swayam.gov.in/nd1_noc19_cs84/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210256: Data Structures and Algorithms Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 25 Marks

Companion Course : 210252: Data Structures and Algorithms, 210255:Priciples of Programming Languages

Course Objectives:

- To **understand** practical implementation and usage of non linear data structures for solving problems of different domain.
- To strengthen the ability to identify and **apply** the suitable data structure for the given real world problems.
- To **analyze** advanced data structures including hash table, dictionary, trees, graphs, sorting algorithms and file organization.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the ADT/libraries, hash tables and dictionary to design algorithms for a specific problem.

CO2: Choose most appropriate data structures and **apply** algorithms for graphical solutions of the problems.

CO3: Apply and **analyze** non linear data structures to solve real world complex problems.

CO4: Apply and **analyze** algorithm design techniques for indexing, sorting, multi-way searching, file organization and compression.

CO5: Analyze the efficiency of most appropriate data structure for creating efficient solutions for engineering design situations.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory / Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, C, D, E, F and G. Each student must perform at least 12 assignments(at least 02 from group A, 03 from group B, 02 from group C, 2 from group D, 01 from group E, 02 from group F.)

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python - Group A assignments, C++ Programming tool like G++/GCC

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Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. Consequently encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. Therefore adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No	Group A
1	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number. Make use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers
2	Implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key)
3	For given set of elements create skip list. Find the element in the set that is closest to some given value. (note: Decide the level of element in the list Randomly with some upper limit)
4	To create ADT that implement the "set" concept. a. Add (new Element) -Place a value into the set , b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection, d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection, e. Intersection of two sets , f. Union of two sets, g. Difference between two sets, h. Subset
	Group B
5	A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method.
6	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - i. Insert new node, ii. Find number of nodes in longest path from root, iii. Minimum data value found in the tree, iv. Change a tree so that the roles of the left and right pointers are swapped at every node, v. Search a value

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7	Construct an expression tree from the given prefix expression eg. +--a*bc/def and traverse it using post order traversal (non recursive) and then delete the entire tree.
8	Read for the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function?
9	Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm.
10	Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity. _
11	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.
12	Implement a file compression algorithm that uses binary tree. Your program should allow the user to compress and decompress messages containing alphabets using the standard Huffman algorithm for encoding and decoding.
	Group C
13	Represent a given graph using adjacency matrix/list to perform DFS and using adjacency list to perform BFS. Use the map of the area around the college as the graph. Identify the prominent land marks as nodes and perform DFS and BFS on that.
14	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight take to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Check whether the graph is connected or not. Justify the storage representation used.
15	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.
16	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
17	Consider the scheduling problem. n tasks to be scheduled on single processor. Let t1, ...,tn be durations required to execute on single processor is known. The tasks can be executed in any order but one task at a time. Design a greedy algorithm for this problem and find a schedule that minimizes the total time spent by all the tasks in the system. (The time spent by one is the sum of the waiting time of task and the time spent on its execution.)
	Group D
18	Given sequence k = k1 <k2 < … <kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key?

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19	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
	Group E
20	Consider a scenario for Hospital to cater services to different kinds of patients as Serious (top priority), b) non-serious (medium priority), c) General Checkup (Least priority). Implement the priority queue to cater services to the patients.
21	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language
22	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyze the algorithm.
	Group F
23	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to main the data.
24	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.
25	Implementation of a direct access file -Insertion and deletion of a record from a direct access file
26	Assume we have two input and two output tapes to perform the sorting. The internal memory can hold and sort m records at a time. Write a program in java for external sorting. Find out time complexity.
	Mini-Projects/ Case Study
27	Design a mini project using JAVA which will use the different data structure with or without Java collection library and show the use of specific data structure on the efficiency (performance) of the code.
28	Design a mini project to implement Snake and Ladders Game using Python.
29	Design a mini project to implement a Smart text editor.
30	Design a mini project for automated Term work assessment of student based on parameters like daily attendance, Unit Test / Prelim performance, Students achievements if any, Mock Practical.

@The CO-PO Mapping Matrix

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	-	2	2	1	-	-	-	-	-	-	-	-
CO4	1	2	1	1	-	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210257: Microprocessor Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01	**Term Work:** 25 Marks **Oral:** 25 Marks

Companion Course : 210254: Microprocessor

Course Objectives:

- To understand assembly language programming instruction set
- To understand different assembler directives with example
- To apply instruction set for implementing X86/64 bit assembly language programs

Course Outcomes:

On completion of the course, learner will be able to–

CO1. **Understand** and **apply** various addressing modes and instruction set to implement assembly language programs

CO2. **Apply** logic to **implement** code conversion

CO3. **Analyze** and **apply** logic to **demonstrate** processor mode of operation

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System: 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM/TASM/NASM/FASM.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student’s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://209.211.220.205/vlabiitece/mi/MI3.php

Suggested List of Laboratory Experiments/Assignments(any 10)

Sr. No.	Assignments

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1	Write an X86/64 ALP to accept five 64 bit Hexadecimal numbers from user and store them in an array and display the accepted numbers.
2	Write an X86/64 ALP to accept a string and to display its length.
3	Write an X86/64 ALP to find the largest of given Byte/Word/Dword/64-bit numbers.
4	Write a switch case driven X86/64 ALP to perform 64-bit hexadecimal arithmetic operations (+,-,*, /) using suitable macros. Define procedure for each operation.
5	Write an X86/64 ALP to count number of positive and negative numbers from the array.
6	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for: (a) HEX to BCD b) BCD to HEX (c) EXIT. Display proper strings to prompt the user while accepting the input and displaying the result. (Wherever necessary, use 64-bit registers).
7	Write X86/64 ALP to detect protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers also identify CPU type using CPUID instruction.
8	Write X86/64 ALP to perform non-overlapped block transfer without string specific instructions. Block containing data can be defined in the data segment.
9	Write X86/64 ALP to perform overlapped block transfer with string specific instructions Block containing data can be defined in the data segment.
10	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition and add and shift method. (use of 64-bit registers is expected).
11	Write X86 Assembly Language Program (ALP) to implement following OS commands i) COPY, ii) TYPE Using file operations. User is supposed to provide command line arguments
12	Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file. The text file has to be accessed during Program_1 execution and write FAR PROCEDURES in Program_2 for the rest of the processing. Use of PUBLIC and EXTERN directives is mandatory.
13	Write x86 ALP to find the factorial of a given integer number on a command line by using recursion. Explicit stack manipulation is expected in the code.
14	Write an X86/64 ALP password program that operates as follows: a. Do not display what is actually typed instead display asterisk ("*"). If the password is correct display, "access is granted" else display "Access not Granted"
15	Study Assignment: Motherboards are complex. Break them down, component by component, and Understand how they work. Choosing a motherboard is a hugely important part of building a PC. Study- Block diagram, Processor Socket, Expansion Slots, SATA, RAM, Form Factor, BIOS, Internal Connectors, External Ports, Peripherals and Data Transfer, Display, Audio, Networking, Overclocking, and Cooling. 4. https://www.intel.in/content/www/in/en/support/articles/000006014/boards-and-kits/desktop-boards.html

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	-	1	-	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210258: Project Based Learning II

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 50 Marks

Course Objectives:

- To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem.
- To Evaluate alternative approaches, and justify the use of selected tools and methods.
- To emphasizes learning activities that are long-term, inter-disciplinary and student-centric.
- To engages students in rich and authentic learning experiences.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
- To develop an ecosystem that promotes entrepreneurship and research culture among the students.

Course Outcomes:

CO1: Identify the real life problem from societal need point of view
CO2: Choose and compare alternative approaches to select most feasible one
CO3: Analyze and synthesize the identified problem from technological perspective
CO4: Design the reliable and scalable solution to meet challenges
CO5: Evaluate the solution based on the criteria specified
CO6: Inculcate long life learning attitude towards the societal problems

Course Contents

Preamble:

Project-based learning is an instructional approach designed to give students the opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. PBL, is more than just projects. With PBL students "investigate and respond to an authentic, engaging, and complex problem, or challenge" with deep and sustained attention. PBL is "learning by doing." The truth is, many in education are recognizing we live in a modern world sustained and advanced through the successful completion of projects. In short, If students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Project based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development. The PBL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It Brings what students should academically know, understand, and be able to do and requires students to present their problems, research process, methods, and results.[1]

Project based learning (PBL) requires regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per batch. For the faculty involved in PBL , teaching workload of 4 Hrs/week/batch needs to be considered. The Batch should be divided into sub-groups of 4 to 5 students. Idea implementation /Real life problem/Complex assignments / activities / projects. under project based learning is to be carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester

Group Structure:

Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.

1. There should be team/group of 4-5 students
2. A supervisor/mentor teacher assigned to individual groups

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Selection of Project/Problem:

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated interdisciplinary or subject frame.

A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and structure of the activity.

A few hands-on activities that may or may not be multidisciplinary.

Use of technology in meaningful ways to help them investigate, collaborate, analyse, synthesize, and present their learning.

Activities may include- Solving real life problem, investigation, /study and Writing reports of in depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.

Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation of the individual and the team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
3. Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at college end by both students as well as mentor (PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment/evaluation and weightage:

1. Idea Inception and Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (10%)
2. Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (Individual assessment and team assessment) (40%)
3. Documentation (Gathering requirements, design and modelling, implementation/execution, use of technology and final report, other documents) (15%)
4. Demonstration (Presentation, User Interface, Usability) (20%)

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5. Contest Participation/ publication (15%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. It will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

Note :

- While planning for the assessment, choose a valid method based on your context. It should be able to understand by both the students as well as the faculty.
- The student group must follow the principles of Software Engineering (Scoping out the problem, the solution implementation and related documentation).
- Researching the problem and outlining various approaches is key here and should be emphasized by the tutor and the mentor.
- Aspects of design thinking (from the point of view of the person facing the problem) are very important. Students should not jump into the technology aspects first.
- The team can follow the principles of Agile Software Development. The weekly meetings could be used as a Scrum meeting.
- The tutor and mentor should actively help the students to scope the work and the approach. They must validate the technology choices.
- If the implementation code is well documented, the project can be continued by subsequent batch – which will help solve a bigger problem.

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3. Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Capraro, Mary Margaret Capraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2. Gopalan," Project management core text book", 2 Indian Edition
3. James Shore and Shane Warden, " The Art of Agile Development"

Tutors Role in Project Based Learning

- The fundamentals of problem based learning, lies with the Tutors role.
- Tutors are not the source of solutions rather they act as the facilitator and mentor.
- The facilitator skills of the Tutors / Teacher are central to the success of PBL.

Change of Mindset

- Students are not used to the constructivist approach to learning, it is important that they are carefully told what to expect in PBL.
- Tutors need to explain the differences between PBL and traditional learning.
- Tutors need to explain the principals involved and role of the students in PBL learning.

Designing Problem

- Considering the prior knowledge of the students, their ability and creativity, problem statement should be designed.
- For 2nd year PBL students the tutor should place more emphasis on getting the students to perform higher-level tasks.
- It is important for tutors to design problems that are anchored in authentic contexts only
- Students should take ownership of the problem.
- Problems should not be over simplified or well defiled
- Learning should not be the sequencing of instructional events, but the application of principles for responding to the needs of the situation.
- The problems given to students in PBL should be realistic, complex, and should reflect, as

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much as possible, the actual problems that students would encounter in real life.

Basic function of the tutor

- A good understanding of the overall curriculum the students have to study, the principles of problems solving, critical thinking and meta-cognitive skills.

Grouping

- Study the background and profile of each student.
- Make sure that students of different backgrounds and experience are assigned in a group
- It is useful to group students of different abilities, gender, and nationalities together.
- Tutors must have the commitment to devote the time to the tutorial process.
- A good tutor is always interested in helping students to learn better.
- Sufficient resources should be made available for students to take part the PBL tutorial.
- Time management is important.

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of the groups in PBL
- Assessment of students should not be focused only on the final leaning product.
- PBL tutors need to understand meaningful ways of assessing students' work to motivate learning.
- For assessment to be implemented properly there should be well designed and clearly defined goals and objectives and well thought out strategies, techniques, criteria, and marking schemes.

Student's Role in PBL

- Prepare students for PBL before starting the sessions.
- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PBL must be responsible for their own learning.
- Throughout the PBL process, students have to define and analyze the problem, generate learning issues and apply what they have learned to solve the problem and act for them-selves and be free.
- Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
- Students in PBL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PBL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Inquiry Skills

- Students in PBL are expected to develop critical thinking abilities by constantly relating:
- What they read to do?
- What they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Formative and summative questions for evaluation:
- How effective is …….?
- How strong is the evidence for ………?
- How clear is ……?
- What are the justifications for thinking?
- Why is the method chosen?
- What is the evidence given to justify the solution?

Home

Information Literacy

- Information literacy is an integral part of self- directed learning

Information literacy involves the ability to:

- Know when there is a need for information
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
- How to prepare the search , How to carry out the research,
- Sorting and assessing of information in general

Collaborative learning

- It is an educational approach to teaching and learning that involves
- groups of students working together to solve a problem or complete a project
- In collaborative learning, learners have the opportunity to talk with peers, exchange diverse beliefs present and defend ideas, as well as questioning other ideas.

Interpersonal Skills

- Interpersonal skills relating to group process are essential for effective problem solving and learning.
- It is important that students are made aware of these inter personal skills.
- Consensual decision making skills, Dialogue and discussion skills, Team maintenance skills
- Conflict management skills and Team leadership skills.
  Students who have these skills have a better opportunity to learn than students who do not have these skills and Time Management

Resources

- Students need to have the ability to evaluate the resources used

Students have to evaluate the source of the resources used by asking the following questions:

- How current is it?, Is there any reason to suspect bias in the source?
- How credible and accurate is it?

Meta-cognitive Skills

- Students need to reflect on the processes they are using during the learning process,
- Compare one strategy with another, and evaluate the effectiveness of the strategy used

Reflection Skills

- Reflection helps students refine and strengthen their high-level thinking skills and abilities through self-assessment.
- Reflection gives students opportunities to think about how they answered a question, made a decision, or solved a problem.
- What strategies were successful or unsuccessful? ,What issues need to be remembered for next time? , What could or should be done differently in the future?

Follow the practices learned in Software Engineering course- Requirement Analysis, Designing and Modeling.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	2

Home

Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210259: Code of Conduct

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Tutorial: 01 Hours/Week	01$	Term work$: 25 Marks

Preamble:

Engineering is one of the important and cultured professions. With respect to any engineering profession, engineers are expected to exhibit the reasonable standards of integrity and honesty. Engineering is directly or indirectly responsible to create a vital impact on the quality of life for the society. Acceptably, the services provided by engineers require impartiality, honesty, equity and fairness and must give paramount importance to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the principles of ethical conduct.

Prime aim is to recognize and evaluate ethical challenges that they will face in their professional careers through knowledge and exercises that deeply challenge their decision making processes and ethics.

Course Objectives:

- To promote ethics, honesty and professionalism.
- To set standards that are expected to follow and to be aware that If one acts unethically what are the consequences.
- To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
- To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the basic perception of profession, professional ethics, various moral and social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO2: Aware of professional rights and responsibilities of an engineer, responsibilities of an engineer for safety and risk benefit analysis.

CO3: Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CO4: Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Contents

The following are the certain guidelines as far as ethics and code of conduct are concerned to be clearly and elaborately explained to the students,

Fundamental norms Engineers, in the fulfillment of their professional duties, should include paying utmost attention to the safety, health, and welfare of the society. Along with that engineers should execute the services only in their areas of competence. Whenever there is a need to issue public statements then such statements should be expressed in objective and truthful manner. Engineer should extend high sense of integrity by acting for each employer or client as faithful agents or trustees. Whatever may be the working scope engineer should conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

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As far as ethical practices are concerned engineers should not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or Code. Engineers should not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise moreover he/she should not aid or abet the unlawful practice of engineering by a person or firm.

Engineers having knowledge of any alleged violation of the Code should report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required. Engineers should disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services. Engineers should not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties. Engineers should not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

Engineers should never falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures, or past accomplishments.

Engineers should not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They should not offer any gift or other valuable consideration in order to secure work. They should not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

There are certain obligations accompanied with engineering profession. Engineers should acknowledge their errors and should not distort or alter the facts. Candid advises in special cases are always welcome. Engineers should not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

Engineers should not promote their own interest at the expense of the dignity and integrity of the profession furthermore they should treat all persons with dignity, respect, fairness, and without discrimination. Engineers should at all times strive to serve the public interest. Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community. Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminar.

Engineers should not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice. They should not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action. "Sustainable development" is the challenge for the engineers meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

Following are contents to be covered in tutorial session-

Home

1. **Introduction to Ethical Reasoning and Engineer Ethics:** Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.
2. **Professional Practice in Engineering :** Global Issues -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct
3. **Ethics as Design** - Doing Justice to Moral Problems : Engineer's Responsibility for Safety - Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk
4. **Workplace Responsibilities and Rights** - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination
5. **Computers, Software, and Digital Information**
6. **Responsibility for the Environment**

#Exemplar/Case Studies :

General Motors ignition switch recalls (2014), Space Shuttle Columbia disaster (2003), Space Shuttle Challenger disaster (1986), Therac-25 accidents (1985 to 1987), Chernobyl disaster (1986), Bhopal disaster (1984), Kansas City Hyatt Regency walkway collapse (1981)

Guidelines for Conduction:

The course will exemplify the budding engineers the Code of Conduct and ethics pertaining to their area and scope of their work. The Instructor/Teacher shall explain the students the importance and impact of the ethics and code of conduct.

Confined to various courses and project/mini-project development the possible vulnerabilities and threats need to be elaborated and the students' participation need to be encouraged in designing such document explicitly mentioning Code of Conduct and Disclaimers.

Suggested set of Activities

1. **Purpose**-Introduce the concept of Professional Code of Conduct
   Method – Using Group Discussion as a platform, ask students to share one practice in their family / home that everyone has to follow. For ex. not wearing footwear in the house, taking a bath first thing in the morning, seeking blessings from elders, etc. Connect this Code of Conduct in their family to one that exists in the professional world
   Outcome – Awareness of profession-specific code of conduct and importance of adherence of that code specified. Ability to express opinions verbally and be empathetic to diverse backgrounds and values
2. **Purpose**-Impress upon the students, the significance of morality
   Method – Role play a professional situation where an engineer is not competent and is trying to copy the work of a colleague and claim credit for that work. Ask observing students to react to that situation. Alternatively, a short video that clearly shows unethical behavior can be played and ask viewers their opinion about the situation. Note to teachers – read about Kohlber's theory and Gilligan's theory to understand levels of moral behavior
   Outcome – Incite students to contemplate their own immoral behavior in public space or academic environment (like copying homework or assignment). Will coax students to introspect their own values and encourage them to choose the right path
3. **Purpose**-Highlight the importance of professional ideals like conflict management, ambition, ethical manners and accountability
   Method – Each student will have to write a 200 word essay on any of above mentioned virtues of being a good professional. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
   Outcome – Learn to express one's ideas and identify and relate to good virtues. Build writing skills, improve language and gain knowledge about how to write an impactful essay

Home

4. **Purpose**-Make students aware of proper and globally accepted ethical way to handle work, colleagues and clients
   Method – Teacher can form groups of 6 – 7 students and assign them different cases (these can be accessed online from copyright free websites of B-school content)
   Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven analytical arguments making them contributors in any team.
5. **Purpose** – Make students aware that technology can be harmful if not used wisely and ethically
   Method – Conduct a quiz on various ethical dilemmas that are relevant in today's world pertaining to privacy right, stalking, plagiarism, hacking, weaponizing technology, AI, electronic garbage creating environmental hazard etc
   Outcome – Make students aware of various adverse consequences of technology development and allow them to introspect on how to use technology responsibly.
6. **Purpose** – Expose students to professional situations where engineers must use their skills ethically and for the betterment of society and nation
   Method – Students in groups of 4 can be given an assignment in the earlier session to present in front of the class one specific case where they felt unethical treatment has been meted out to a person by an engineer – either as a witness, advisor, dishonesty, improper skills testimony etc. The group has to make a short presentation and also suggested plausible solutions to that situation. Q&A from other students must encouraged to allow healthy discussion
   Outcome – Become aware of unethical code of conduct in the professional world and how to follow a moral compass especially when one reaches positions of power.
7. **Purpose** – Provide an insight into rights and ethical behavior.
   Method – Movies like The Social Network can be played and students can be asked to discuss their opinion about collegiality, intellectual property, friendship and professional relationships
   Outcome – help them look at success stories from an ethical point of view. Develop critical thinking and evaluation of circumstances.
8. **Purpose** – Make students contemplate about ideal and safe professional environment and decide on making right decisions based on codes of conduct
   Method – Students can be asked to write down 5 most important codes of conduct that they feel that every computer engineer should follow. After evaluation by teacher / experts, the collection of codes can be converted into a handbook to be given to every student as a memoir to help them in their professional life.
   Outcome – Introspection and think about how to shape the professional environment. Also, when they carry back with them their own codes of conduct, they could feel bound to adhere to these ethics.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

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Recommended Assessment and Weightage Parameters:
(Attendance 30%, Assignments/Activities- Active participation and proactive learning 50% and report 20%)

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.
The brief guidelines for report preparations are as follows:
1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
- General information about the activity;
- Define the purpose of the activity;
- Detail out the activities carried out during the visit in chronological order;
- Summarize the operations / process (methods) during the activities;
- Describe what you learned (outcomes) during the activities as a student;
- Add photos of the activity;(optional)
- Add a title page to the beginning of your report;
- Write in clear and objective language; and
- Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:
(Attendance 30%, Active participation and proactive learning 50% and report 20%)

Web Links:
- https://www.ieee.org/about/compliance.html
- https://www.cs.cmu.edu/~bmclaren/ethics/caseframes/91-7.html
- https://www.nspe.org/
- http://www.ewh.ieee.org/soc/pes/switchgear/presentations/tp_files/2017-1_Thurs_Shiffbauer_Singer_Engineering_Ethics.pdf

MOOC/ Video lectures available at:
- https://swayam.gov.in/nd1_noc20_mg44/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	-	-	-	-
CO2	-	-	-	-	-	-	2	2	-	-	-	-
CO3	-	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	-	2	3	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210260: Audit Course 4

In addition to credits, it is recommended that there should be audit course in preferably in each semester starting from second year in order to supplement student's knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credits [1] and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 4 Options

Audit Course Code	Audit Course Title
AC4-I	Water Management
AC4-II	Intellectual Property Rights and Patents
AC4-III	The Science of Happiness
AC4-IV	Stress Relief: Yoga and Meditation
AC4-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier. [1]
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

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AC4-I: Water Management

Water is a vital resource for all life on the planet. Only three percent of the water resources on Earth are fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. One fifth of the remaining one percent is in remote, inaccessible areas. As time advances, water is becoming scarcer and having access to clean, safe, drinking water is limited among countries. Pure water supply and disinfected water treatment are prerequisites for the well-being of communities all over the world. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. This course will provide students a unique opportunity to study water management activities like planning, developing, distributing and optimum use of water resources. This course covers the topics that management of water treatment of drinking water, industrial water, sewage or Wastewater, management of water resources, management of flood protection.

Course Objectives

- To develop understanding of water recourses.
- To study global water cycle and factors that affect this cycle.
- To analyze the process for water resources and management.
- To study the research and development areas necessary for efficient utilization and management of water recourses.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the global water cycle and its various processes

CO2: Understand climate change and their effects on water systems

CO3: Understand Drinking treatment and quality of groundwater and surface water

CO4: Understand the Physical, chemical, and biological processes involved in water treatment and distribution.

Course Contents

1. Understanding 'water'-Climate change and the global water cycle, understanding global hydrology
2. Water resources planning and management-Water law and the search for sustainability: a comparative analysis, Risk and uncertainty in water resources planning and management
3. Agricultural water use -The role of research and development for agriculture water use
4. Urban water supply and management - The urban water challenge, Water sensitive urban design

References:

1. R. Quentin Graft, Karen Hussey, Quentin Graft, Karen Hussey, Publisher, "Water Resources Planning and Management", Cambridge University Press, ISBN: 9780511974304, 9780521762588.
2. P. C. Basil, "Water Management in India", ISBN: 8180690970, 2004.
3. C.A. Brebbia, "Water Resources Management", ISBN: 978-1-84564-960-9, 978-1-84564-961-6.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	
CO4	-	-	-	-	-	2	2	-	-	-	-	2

AC4-II: Intellectual Property Rights and Patents

Home

Intellectual property is the area of law that deals with protecting the rights of those who create original works. It covers everything from original plays and novels to inventions and company identification marks. The purpose of intellectual property laws is to encourage new technologies, artistic expressions and inventions while promoting economic growth.

Innovation and originality have great potential value. Whatever line of activity you are engaged in, future success depends on them. The last few years have seen intellectual property rights become an issue of general interest: the smart phone "patent wars", the introduction of Digital Rights management (DRM) and the rise of generic pharmaceuticals and open-source software are just some examples that have been in the public eye. Protecting your intellectual rights appropriately should be at a priority. Yet too many people embark on their chosen professions without even a basic awareness of intellectual property.

Course Objectives:

- To encourage research, scholarship, and a spirit of inquiry
- To encourage students at all levels to develop patentable technologies.
- To provide environment to the students of the Institute for creation, protection, and commercialization of intellectual property and to stimulate innovation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition

CO2: Identify, apply and **assess** principles of law relating to each of these areas of intellectual property

CO3: Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents

1. **IntroductiontoIntellectualPropertyLaw–**TheEvolutionaryPast-TheIPRToolKit-Para-Legal Tasks in Intellectual Property Law
2. **Introduction to Trade mark –** Trade mark Registration Process – Post registration Procedures -Trade mark maintenance - Transfer of Rights – Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark
3. **Introduction to Copyrights –** Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works
4. **IntroductiontoTradeSecret–**MaintainingTradeSecret–PhysicalSecurity–EmployeeLimitation - Employee confidentiality agreement

Reference:

1. Debirag E. Bouchoux, "Intellectual Property" Cengage learning, New Delhi, ISBN-10:1111648573
2. Ferrera, Reder, Bird, Darrow, "Cyber Law. Texts and Cases", South-Western's Special Topics Collections,ISBN:0-324-39972-3
3. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw–Hill, NewDelhi,ISBN-10:0070077177

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	-	-	-	1
CO2	-	-	-	-	-	-	-	2	-	-	-	1
CO3	-	-	-	-	-	-	-	1	-	-	-	1

Home

AC4-III: The Science of Happiness

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That's where this course comes in. The subject "Science of Happiness" aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives

- To understand the feeling of happiness
- To study the sources of positive feelings
- To analyze the anatomy of the happiness system
- To study the effect of thoughts and emotions on the happiness system

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand what happiness is and why it matters to you

CO2: Learn how to increase your own happiness

CO3: Understand of the power of social connections and the science of empathy

CO4: Understand what is mindfulness and its real world applications

Course Contents

1. Happiness: what is it? , 2. The secret of smiling
3. The autonomy of positive feelings
4. Positive feelings as a compass
5. The happiness system
6. Foundations: Emotions, Motivation and nature of Wellbeing
7. Subjective well being
8. Love and well being
9. Optimal well being
10. Religion, Spirituality and wellbeing

References:

1. Happier, Stefan Klein, "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get", Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing", William, Cengage Learning, 2012, ISBN10: 1111834121.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	1	-	-	-	-	-	-	-	1
CO2	-	-	-	1	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	1	-	1	-	-	2
CO4	-	-	-	-	-	-	-	-	-	-	-	2

AC4-IV: Yoga and Meditation

Home

The concepts and practices of Yoga originated in India about several thousand years ago. Its founders were great Saints and Sages. The great Yogis presented rational interpretation of their experiences of Yoga and brought about a practical and scientifically sound method within every one's reach. Yoga today, is no longer restricted to hermits, saints, and sages; it has entered into our everyday lives and has aroused a worldwide awakening and acceptance in the last few decades. The science of Yoga and its techniques have now been reoriented to suit modern sociological needs and lifestyles.

Yoga is one of the six systems of Vedic philosophy. The Yoga advocates certain restraints and observances, physical discipline, breathe regulations, restraining the sense organs, contemplation, meditation and Samadhi. The practice of Yoga prevents psychosomatic disorders and improves an individual's resistance and ability to endure stressful situations.

Course Objectives:

- To impart knowledge about the basic technique and practice of yoga, including instruction in breath control, meditation, and physical postures
- To gain an intellectual and theoretical understanding of the principles embodied in the Yoga Sutras, the Bhagavad-Gita, and other important texts and doctrines
- Relaxation and stress reduction ,Personal insight and self understanding, Personal empowerment, Gaining wisdom and spiritual discernment
- Awakening the abilities or powers of the Super conscious mind

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand philosophy and religion as well as daily life issues will be challenged and enhanced.

CO2: Enhances the immune system.

CO3: Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.

CO4: Powers of concentration, focus, and awareness will be heightened.

Course Contents

1. Meaning and definition of yoga – Scope of Yoga - Aims and Objectives of Yoga – Misconception about yoga.
2. Ayurveda: an introduction to this system of health care derived from the Vedic tradition Anatomy and Physiology as they relate to Yoga
3. Yoga Philosophy and Psychology

References:

1. B.K.S. Iyengar, "BKS Iyengar Yoga The Path to Holistic Health" , DK publisher, ISBN-13: 978-1409343479
2. Osho, "The Essence of Yoga", Osho International Foundation, ISBN: 9780918963093

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	2	-	-	2	-	-	-
CO2	-	-	-	-	-	2	1	-	-	-	-	-
CO3	-	2	-	-	-	2	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	-	-

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AC4-V: Foreign Language (Japanese) Module 2

W ith changing times, the competitiveness has gotten into the nerves and 'Being the Best' at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best… suited Language!!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course learner will-

1. have ability of basic communication.
2. have the knowledge of Japanese script.
3. get introduced to reading , writing and listening skills
4. develop interest to pursue professional Japanese Language course

Course Contents

1. Katakana basic Script, Denoting things (nominal and pre nominal demonstratives), Purchasing at the Market / in a shop / mall (asking and stating price)
2. Katakana : Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting and finishing time (kara ~ made), Point in time (denoting the time when any action or the movement occurs)
3. Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle.

References:

1. Minna No Nihongo, "Japanese for Everyone", (Indian Edition), Goyal Publishers and Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates- Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

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Acknowledgement

It is with great pleasure and honor that I share the curriculum for Second Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all inclusive curriculum for Second Year of Computer Engineering.

Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Rajesh Prasad (SITS), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

Special thanks are due to Dr. Parikshit Mahalle, Dr. Swati Bhavsar and Dr. Jayashri Prasad for helping with the formatting and crisp presentation of this draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

I am thankful to Dr. Nuzhat Shaikh, for the time she has spent in critically reading the draft and giving the final touches. I appreciate her initiative and thank her for her time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that's what makes the team stronger! You took the meaning of teamwork to a whole new level.

Thank you for all your efforts!

Professor (Mrs) Varsha H. Patil

Chairman, Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University.

BoS Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

Task Force at Curriculum Design

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1. Advisors, the Team of Board of Studies-

Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

2. Team Leader- **Dr. Rajesh Prasad**

3. Teams, Course Design-

Name of Course	Team Leaders	Team Members	
Discrete Mathematics	Dr. Nihar Ranjan Dr. Mrs. Archana Chaugule	Dr. S. K. Pathan Dr. Mrs. Snehal Kamlapur Dr. Mrs. Shital Sonawane	Dr. V. S. Pawar Dr. Kailash Shaw Prof. Ravindra Rathore
Fundamental of Data Structure & Lab	Dr. S R Dhore Dr. Prashant Dhotre	Dr. Mrs. Gitanjali Shinde Dr. Mrs. A. P. Kale Prof. Anupama Phakatkar	Dr. Vinayak Kottawar Prof. Ajitkumar Shitole Prof. Ms. Snehal Kulkarni
Object Oriented Programming	Dr. Amol Dhumane Dr. Mrs. S. K. Wagh	Prof. D. D. Sapkal Prof. Ms. Poojashree Vidap Prof. K. M. Sanghavi	Dr. Mrs. R. A. Satao Dr. Mrs. Swati Bhavsar Dr. Mrs. Chiwhane
Computer Graphics & Lab	Dr. Mrs. N. F. Shaikh	Prof. P. P. Vaidya Prof. Dr. Aparna Junnarkar	Dr. Shabnam Farook Sayyad Prof. Mrs. Laxmi Sisode
Digital Electronics and Logic Design & Lab	Dr. Mrs. C. R. Jadhav Dr. V. V. Kimbahune	Prof. M. B. Lonare Prof. Mrs. M.S. Pokale Dr A. R. Buchade	Dr. Nilesh Sabale Prof. Ms. Ila Sawant
Humanities and Social Studies & Code of Conduct	Dr. Mrs. R. A. Khan	Prof. Mrs. Vaidehi Banerjee Prof. N. L. Bhale	Prof. S. P. Pingat Mr. Ranjeet Gawande
Data Structures and Algorithms & Lab	Dr. Mrs. G. S Navale Dr. S. D. Babar	Dr. K. C. Nalavade Dr Mrs. A. R. Deshpande Prof. Ms. Pallavi Baviskar	Prof. Mrs. S. M. Bhadkumbhe Prof. Ms. Neha Patil
Software Engineering	Dr. Mrs. J. R. Prasad	Dr. Mrs. Manjusha Joshi Prof. Ms. Deipali Gore	Dr. Hanchate D.B. Prof. Sachin Shinde Ms. Poonam Dholi
Microprocessor & Lab	Dr. Sunil M. Sangve Dr. Sable Nilesh P.	Prof. Mrs. S.A. Joshi Dr. K. N. Honwadkar Prof. Mahendra Salunke	Prof. Nitin M. Shahane Prof. N. L. Bhale Prof. Uday C. Patkar
Principles of Programming Languages	Dr. Mrs. Jyoti Rao	Dr. J. R. Pansare Prof. Mrs. P. P. Joshi Prof. Mrs. Sonali Lunavat Prof. Ms. Geeta R Gupta Prof. Mrs. Snehal Patil	Prof. Mrs. Vaishali Latke Prof. Santosh Nagargoje Prof. Vaibhav Muddebihalkar Prof. Phadtare Tushar T
Project Based Learning	Dr. Mrs. Manisha Bhende Dr. Chaudhari Manohar	Dr. Saumitra Das Dr. D. T. Mane Dr. Swati Bhavsar	Prof. Subhash Rathod Prof. Mrs. Swati Shinde Prof. Kushal P. Birla Mr. Pravin Andhale

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Curriculum
for

Third Year of Computer Engineering
(2019 Course)

(With effect from 2021-22)

http://unipune.ac.in

Faculty of Science and Technology

Savitribai Phule Pune University
Maharashtra, India

Third Year of Computer Engineering
(2019 Course)
(With effect from 2021-22)

Prologue

It is with great pleasure and honor that I share the syllabi for Third Year of Computer Engineering (2019 Course) on behalf of Board of Studies, Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BoS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks,

Dr. Varsha H. Patil
Chairman, Board of Studies (Computer Engineering), SPPU, Pune

links for First and Second Year Computer Engineering Curriculum 2019:

1. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
2. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf
3. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt_03.072020.pdf

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

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Savitribai Phule Pune University
Bachelor of Computer Engineering

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Program Outcomes (POs)

Learners are expected to know and be able to

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1	**Professional Skills**-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

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Semester V

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
310241	Database Management Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
310242	Theory of Computation	03	-	-	30	70	-	-	-	100	03	-	-	03
310243	Systems Programming and Operating System	03	-	-	30	70	-	-	-	100	03	-	-	03
310244	Computer Networks and Security	03	-	-	30	70	-	-	-	100	03	-	-	03
310245	Elective I	03	-	-	30	70	-	-	-	100	03	-	-	03
310246	Database Management Systems Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
310247	Computer Networks and Security Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310248	Laboratory Practice I	-	04	-	-	-	25	25	-	50	-	02	-	02
310249	Seminar and Technical Communication	-	-	01	-	-	50	-	-	50	-	-	01	01
	Total	**15**	**10**	**01**	**150**	**350**	**125**	**50**	**25**	**700**	**15**	**05**	**01**	**21**
310250	Audit Course 5												**Grade**	
										Total Credit	**15**	**05**	**01**	**21**

310245 **Elective I Options:**

310245(A) Internet of Things and Embedded Systems
310245(B) Human Computer Interface
310245(C) Distributed Systems
310245(D) Software Project Management

310250 Audit Course 5 Options:

310250 (A) Cyber Security
310250 (B) Professional Ethics and Etiquettes
310250 (C) Learn New Skills
310250 (D) Engineering Economics
310250 (E) Foreign Language

Laboratory Practice I

Assignments from **Systems Programming and Operating System** and **Elective I**

Savitribai Phule Pune University

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Semester VI

Course Code	Course Name	Teaching Scheme (Hours/week) $$			Examination Scheme and Marks						Credit Scheme			
		$$ Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
310251	Data Science and Big Data Analytics	04	-	-	30	70	-	-	-	100	03	-	-	03
310252	Web Technology	04	-	-	30	70	-	-	-	100	03	-	-	03
310253	Artificial Intelligence	04	-	-	30	70	-	-	-	100	03	-	-	03
310254	Elective II	04	-	-	30	70	-	-	-	100	03	-	-	03
310255	Internship**	-	-	-	-	-	100 **	-	-	100	-	-	-	04 **
310256	Data Science and Big Data Analytics Laboratory	-	04	-	-	-	50	25	-	75	-	02	-	02
310257	Web Technology Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310258	Laboratory Practice II	-	04	-	-	-	50	25	-	75	-	02	-	02
Total		**12**	**10**	**-**	**120**	**280**	**225**	**50**	**25**	**700**	**12**	**09**	**-**	**21**
310259	Audit Course 6												**Grade**	
Total											**12**	**09**	**-**	**21**

310254 Elective II Options:

310254(A) Information Security
310254(B) Augmented and Virtual Reality
310254(C) Cloud Computing
310254(D) Software Modeling and Architectures

310259 Audit Course 6 Options:

310259(A) Digital and Social Media Marketing
310259(B) Sustainable Energy Systems
310259(C) Leadership and Personality Development
310259(D) Foreign Language
310259(E) Learn New Skills

Laboratory Practice II:

Assignments from **Artificial Intelligence** and **Elective II**.

**** Internship:**

Internship guidelines are provided in course curriculum sheet.

$$ Hours/Week for Theory Course in Third Year of Engineering, Semester VI:

As per the apex bodies' recommendations and guidelines, it is need of the day to train the pre-final year students for the industrial readiness through internship. As per the guidelines of AICTE, the duration of internship is 4-6 weeks after completion of semester V and before commencement of semester VI, so it is apparent that the contact hours of the TE students need to be managed meticulously. It becomes mandatory as per the structure that 4 credits for internship must earned by the students. **Per semester, 15 weeks duration that is suggested ideally by the affiliated university will eventually reduce to fruitful 12 weeks after the implementation of the revised curriculum (2019 Course). With the evaluatory introduction of internship in the structure, we are left with the choice of 4 theory courses in the sixth semester with 12 weeks instead of traditional 15 weeks.** To balance the credits and to achieve the minimum required contact hours, it is the reasonable choice to allot 4 hours / week for each theory course of the sixth semester of Third year of Engineering. The additional one lecture/ week will definitely be instrumental in achieving the largest of minimum contact hours. As such there is no correspondence of weekly load and credits earned, the credit allotted per course remain intact despite of the change. **So it is almost imperative that the commencement of VI Semester need to be approx. 3 weeks beyond the schedule.**

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General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. The **Program Outcomes (POs)** for Engineering are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @: **CO and PO Mapping Matrix**(Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-'indicates that there is no correlation between the respective CO and PO.

3. **#: Elaborated examples/Case Studies**- For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *: For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.

5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.

6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.

8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed. Use of open source software is appreciated.

9. **Term Work** [1]–Term work is continuous assessment that evaluates a student's progress throughout the semester [1]. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been

achieved. It is recommended to conduct internal monthly mock practical test as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

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10. **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

11. **Tutorial** [1] - Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. **Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.**

12. **Audit Course** [1]-The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP'/'PP'' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.
13. UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer[2].

    SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity, and quality. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.[2]

    For more rules, pattern and assessment of semester examination refer[1]
14. ****Internship**:

    Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

[1]http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf

[2] https://swayam.gov.in/about

Abbreviations		
TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**TUT: Tutorial**	**Sem: Semester**

Semester V

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310241: Database Management Systems

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Teaching Scheme: Theory: 03 Hours/Week	Credit: 03	Examination Scheme: Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Data Structures and Algorithms (210252)

Companion Course: Database Management Systems Laboratory (310246)

Course Objectives:

- To understand the fundamental concepts of Database Management Systems
- To acquire the knowledge of database query languages and transaction processing
- To understand systematic database design approaches
- To acquire the skills to use a powerful, flexible, and scalable general-purpose databases to handle Big Data
- To be familiar with advances in databases and applications

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze and design Database Management System using ER model
CO2: Implement database queries using database languages
CO3: Normalize the database design using normal forms
CO4: Apply Transaction Management concepts in real-time situations
CO5: Use NoSQL databases for processing unstructured data
CO6: Differentiate between Complex Data Types and analyze the use of appropriate data types

Course Contents

Unit I	Introduction to Database Management Systems and ER Model	06 Hours

Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models. **Database Design and ER Model**: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagram into tables.

#Exemplar/Case Studies	Analyze and design database using ER Model for any real-time application and convert the same into tables.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	SQL and PL/SQL	07 Hours

SQL: Characteristics and Advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators. **Tables**: Creating, Modifying, Deleting, Updating.**SQL DML Queries**: SELECT Query and clauses, Index and Sequence in SQL. **Views**: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries.**PL/SQL**: Concept of Stored Procedures and Functions, Cursors, Triggers, Assertions, Roles and Privileges.

#Exemplar/Case Studies	Implementation of Unit 1 case study using SQL and PL/SQL.

***Mapping of Course Outcomes for Unit II**	CO1, CO2	
Unit III	**Relational Database Design**	**06 Hours**
Relational Model: Basic concepts, Attributes and Domains, CODD's Rules. **Relational Integrity**: Domain, Referential Integrities, Enterprise Constraints. **Database Design**: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.		
#Exemplar/Case Studies	Normalize relational database designed in Unit I.	
***Mapping of Course Outcomes for Unit III**	CO1, CO3	
Unit IV	**Database Transaction Management**	**07 Hours**
Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. **Serializability**: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules. **Concurrency Control**: Lock-based, Time-stamp based Deadlock handling. **Recovery methods**: Shadow-Paging and Log-Based Recovery, Checkpoints. **Log-Based Recovery**: Deferred Database Modifications and Immediate Database Modifications.		
#Exemplar/Case Studies	Study of Transaction Management in Postgre SQL	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**NoSQL Databases**	**07 Hours**
Introduction to Distributed Database System, Advantages, Disadvantages, CAP Theorem. **Types of Data:** Structured, Unstructured Data and Semi-Structured Data. **NoSQL Database:** Introduction, Need, Features. **Types of NoSQL Databases:** Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL. **MongoDB** (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.		
#Exemplar/Case Studies	Use of NoSQL databases for processing unstructured data from social media.	
***Mapping of Course Outcomes for Unit V**	CO5, CO6	
Unit VI	**Advances in Databases**	**07 Hours**
Emerging Databases: Active and Deductive Databases, Main Memory Databases, Semantic Databases. **Complex Data Types:** Semi-Structured Data, Features of Semi-Structured Data Models. **Nested Data Types**: JSON, XML. **Object Orientation:** Object-Relational Database System, Table Inheritance, Object-Relational Mapping. **Spatial Data:** Geographic Data, Geometric Data.		
#Exemplar/Case Studies	Applications of advanced databases in real time environment.	

***Mapping of Course Outcomes for Unit VI**	CO5, CO6

Learning Resources

Text Books :

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled”, Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626

Reference Books :

1. C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, “Database Systems: Concepts, Design and Application”, Pearson Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dierolf, “MongoDB: The Definitive Guide”, O‘Reilly Publications, ISBN: 978-1-449-34468-9
4. Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, “Storing and Managing Big Data - NoSQL, HADOOP and More”, Emereopty Limited, ISBN: 1743045743, 9781743045749
6. Joy A. Kreibich, “Using SQLite”, O'REILLY, ISBN: 13:978-93-5110-934-1
7. Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, BPB Publications ISBN: 9788176569644, 9788176569644
8. Seema Acharya, “Demystifying NoSQL”, Wiley Publications, ISBN: 9788126579969

e-Books :

1. SQL and Relational Theory
   a. (How to Write Accurate SQL code), C.J. Date, O’REILLY Publication
2. SQL A Beginner’s Guide, Andy Oppel, Robert Sheldon, McGraw Hill Publication

MOOCs Courses Links:

- http://www.nptelvideos.com/lecture.php?id=6518

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	2	3	1	-	-	-	1	-	-	-	3
CO2	-	2	3	-	-	2	-	-	-	-	-	3
CO3	-	2	3	-	1	-	-	-	-	-	-	3
CO4	2	2	2	2	-	-	-	-	-	1	-	3
CO5	-	2	3	-	-	-	-	-	-	-	1	3
CO6	2	2	-	-	-	-	1	-	2	-	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310242: Theory of Computation

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: --

Course Objectives:

- To introduce the students to basics of Theory of Computation
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

Course Outcomes:

After completion of the course, learners should be able to

CO1: Understand formal language, translation logic, essentials of translation, alphabets, language representation and apply it to design Finite Automata and its variants

CO2: Construct regular expression to present regular language and understand pumping lemma for RE

CO3: Design Context Free Grammars and learn to simplify the grammar

CO4: Construct Pushdown Automaton model for the Context Free Language

CO5: Devise Turing Machine for the different requirements outlined by theoretical computer science

CO6: Analyze different classes of problems, and study concepts of NP completeness

Course Contents

Unit I	Formal Language Theory and Finite Automata	07 Hours

Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.
FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion. Minimization of DFAs.
FA with output: Moore and Mealy machines -Definition, models, inter-conversion.

#Exemplar/Case Studies	FSM for vending machine, spell checker
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Regular Expressions (RE)	07 Hours

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs. **Conversions**: RE to NFA, DFA, DFA to RE using Arden’s theorem, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages. Myhill-Nerode theorem.

#Exemplar/Case Studies	RE in text search and replace

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Context Free Grammar (CFG) and Context Free Language(CFL)**	**07 Hours**
Basic Elements of Grammar, Formal Definition of Context Free Grammar, Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL), Ambiguous Grammar, writing grammar for language. **Simplification of CFG**: Eliminating Є-productions, unit productions, useless production, and useless symbols. **Normal Forms:** Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, Cock-Younger-Kasami Algorithm.		
#Exemplar/Case Studies	Parser, CFG for Palindromes, Parenthesis Match	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Pushdown Automata (PDA)**	**07 Hours**
Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs CFLs. Deterministic CFLs.		
#Exemplar/Case Studies	Parsing and PDA: Top-Down Parsing, Bottom-up Parsing simulation showing use of PDA	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Turing Machines (TM)**	**07 Hours**
Turing Machine Model, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Computing function with Turing Machine, Variants of Turing Machines, Halting Problem of TM, Halting vs Looping, A Turing-unrecognizable language, Reducibility, Recursion Theorem. The Model of Linear Bounded Automata.		
#Exemplar/Case Studies	Algorithms using Turing Machine	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Computability and Complexity Theory**	**07 Hours**
Computability Theory: Decidable Problems and Un-decidable Problems, Church-Turing Thesis. **Reducibility**: Undecidable Problems that is recursively enumerable, A Simple Un-decidable problem. **Complexity Classes**: Time and Space Measures, The Class P, Examples of problems in P, The Class NP, Examples of problems in NP, P Problem Versus NP Problem, NP-completeness and NP-hard Problems.		
#Exemplar/Case Studies	Traveling salesman problem, Post Correspondence Problem (PCP)	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languagesand Computation", Addison-Wesley,ISBN 0-201-44124-1
2. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454

Reference Books:

1. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, ISBN: 0521424267 97805214242643
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGrawHill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
3. J.Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-45
4. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN1081265331106
5. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 97811331878137
6. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

e-Books :

- https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
- https://www.cs.virginia.edu/~robins/Sipser_2006_Second_Edition_Problems.pdf
- http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Automata/John%20E.%20Hopcroft,%20Rajeev%20Motwani,%20Jeffrey%20D.%20Ullman-Introduction%20to%20Automata%20Theory,%20Languages,%20and%20Computations-Prentice%20Hall%20(2006).pdf

MOOCs Courses Links:

- https://nptel.ac.in/courses/106/104/106104148/
- https://nptel.ac.in/courses/106/104/106104028/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	1	-	-	-	-	-	-	2
CO2	3	3	2	2	1	-	-	-	-	-	-	1
CO3	3	3	2	2	1	-	-	-	-	-	-	1
CO4	3	3	2	2	1	-	-	-	-	-	-	1
CO5	3	3	3	2	1	-	-	-	-	-	-	2
CO6	3	3	3	3	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310243: Systems Programming and Operating System

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Programming and Problem Solving (110005), Data Structures and Algorithms (210252), Principles of Programming Languages (210255), Microprocessor (210254)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To get acquainted with the basics of System Programming
- To acquire knowledge of data structures used in the design of System Software
- To be familiar with the format of object modules, the functions of linking, relocation, and loading
- To comprehend the structures and functions of Operating Systems and process management.
- To deal with concurrency and deadlock in the Operating System
- To learn and understand memory management of Operating System

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze and synthesize basic System Software and its functionality.
CO2: Identify suitable data structures and Design & Implement various System Software
CO3: Compare different loading schemes and analyze the performance of linker and loader
CO4: Implement and Analyze the performance of process scheduling algorithms
CO5: Identify the mechanism to deal with deadlock and concurrency issues
CO6: Demonstrate memory organization and memory management policies

Course Contents

Unit I	Introduction	08 Hours

Introduction to Systems Programming, Need of Systems Programming, Software Hierarchy, Types of software: system software and application software, Machine structure.
Evolution of components of Systems Programming: Text Editors, Assembler, Macros, Compiler, Interpreter, Loader, Linker, Debugger, Device Drivers, Operating System. **Elements of Assembly Language Programming**: Assembly Language statements, Benefits of Assembly Language, A simple Assembly scheme, Pass Structure of Assembler.
Design of two pass Assembler: Processing of declaration statements, Assembler Directives and imperative statements, Advanced Assembler Directives, Intermediate code forms, Pass I and Pass II of two pass Assembler.

#Exemplar/Case Studies	Study of Debugging tools like GDB
***Mapping of Course Outcomes for Unit I**	CO1, CO2, CO3

Unit II	Macro Processor and Compilers	06 Hours

Introduction, **Features of a Macro facility**: Macro instruction arguments, Conditional Macro expansion, Macro calls within Macros, Macro instructions, Defining Macro, Design of two pass Macro processor, Concept of single pass Macro processor.
Introduction to Compilers: Phases of Compiler with one example, Comparison of Compiler and Interpreter.

#Exemplar/Case Studies	GNU M4 Macro Processor	
***Mapping of Course Outcomes for Unit II**	CO1, CO2, CO3	
Unit III	**Linkers and Loaders**	**07 Hours**

Introduction, **Loader schemes**: Compile and Go, General Loader Scheme, Absolute Loaders, Subroutine Linkages, Relocating Loaders, Direct linking Loaders, Overlay structure, Design of an Absolute Loader, Design of Direct linking Loader, Self-relocating programs, Static and Dynamic linking.

#Exemplar/Case Studies	Study the concepts of Class loading in Java.
***Mapping of Course Outcomes for Unit III**	CO1, CO2, CO3

Unit IV	**Operating System (OS)**	**07 Hours**

Introduction: Evolution of OS, Operating System Services, Functions of Operating System.

Process Management: Process, Process States: 5 and 7 state model, Process control block, Threads, Thread lifecycle, Multithreading Model, Process control system calls.

Process Scheduling: Uni-processor Scheduling, Scheduling: Preemptive, Non-preemptive, Long-term, Medium-term, Short term scheduling. **Scheduling Algorithms**: FCFS, SJF, RR, and Priority.

#Exemplar/Case Studies	Process management in Linux /Windows/Android Readers-Writers problem
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Synchronization and Concurrency Control**	**07 Hours**

Concurrency: Principle and issues with Concurrency, Mutual Exclusion, Hardware approach, Software approach, Semaphore, Mutex and monitor, Reader writer problem, Producer Consumer problem, Dining Philosopher problem.

Deadlocks: Principle of Deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, Deadlock recovery.

#Exemplar/Case Studies	Concurrency Mechanism: Unix/Linux/Windows.
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Memory Management**	**07 Hours**

Introduction: Memory Management concepts**,** Memory Management requirements.

Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Buddy Systems Fragmentation, Paging, Segmentation, Address translation.

Placement Strategies: First Fit, Best Fit, Next Fit and Worst Fit.

Virtual Memory (VM): Concepts, Swapping, VM with Paging, Page Table Structure, Inverted Page Table, Translation Look aside Buffer, Page Size, VM with Segmentation, VM with Combined paging and segmentation.

Page Replacement Policies: First In First Out (FIFO), Last Recently Used(LRU), Optimal, Thrashing.

#Exemplar/Case Studies	Memory management in Linux /Windows/Android

***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. John Donovan, "Systems Programming", McGraw Hill, ISBN 978-0--07-460482-3
2. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
3. Silberschatz, Galvin, Gagne, "Operating System Principles", 9th Edition, Wiley, ISBN 978- 1-118-06333-0

Reference Books:

1. Leland Beck, "System Software: An Introduction to Systems Programming", Pearson
2. John R. Levine, Tony Mason, Doug Brown, "Lex & Yacc", 1st Edition, O'REILLY, ISBN 81-7366-062-X
3. Alfred V. Aho, Ravi Sethi, Reffrey D. Ullman, "Compilers Principles, Techniques, and Tools", Addison Wesley, ISBN 981-235-885-4

e-Books :

- https://www.elsevier.com/books/systems-programming/anthony/978-0-12-800729-7
- https://www.kobo.com/us/en/ebook/linux-system-programming-1
- https://www.ebooks.com/en-us/subjects/computers-operating-systems-ebooks/279/
- https://www.e-booksdirectory.com/details.php?ebook=9907

MOOCs Courses Links:

- https://www.udacity.com/course/introduction-to-operating-systems--ud923
- nptel video lecture link: https://nptel.ac.in/courses/106/105/106105214/
- https://www.edx.org/course/computer-hardware-and-operating-systems
- https://onlinecourses.nptel.ac.in/noc19_cs50/preview
- https://www.udemy.com/course/system-programming/

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	-	-	-	-	-	-	-	-
CO2	2	2	1	2	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	1
CO5	2	2	1	2	-	-	-	-	-	-	-	1
CO6	2	1	2	1	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310244: Computer Networks and Security

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: Computer Networks and Security Laboratory (310247)

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies
- To learn different techniques for framing, error control, flow control and routing
- To learn different layer protocols in the protocol stacks
- To understand modern network architectures with respect to design and performance
- To learn the fundamental concepts of Network Security

Course Outcomes:

On completion of the course, learners should be able to

CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies

CO2: Illustrate the working and functions of data link layer

CO3: Analyze the working of different routing protocols and mechanisms

CO4: Implement client-server applications using sockets

CO5: Illustrate role of application layer with its protocols, client-server architectures

CO6: Comprehend the basics of Network Security

Course Contents

Unit I	Introduction To Computer Networks	06 Hours

Definition, **Types of Networks**: Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Networks Software, Protocol, Design issues for the Network layers. **Network Models**: The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium. **Network Architectures**: Client-Server, Peer To Peer, Hybrid. **Network Devices**: Bridge, Switch, Router, Gateway, Access Point. **Line Coding Schemes**: Manchester and Differential Manchester Encodings, Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

#Exemplar/Case Studies	Study of Campus wide networking.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Data Link Layer	08 Hours

Introduction, functions. **Design Issues**: Services to Network Layer, Framing.**ARQ strategies**: Error detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. **Flow Control Protocols**: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.**WAN Connectivity**: PPP and HDLC. **MAC Sub layer**: Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Binary Exponential Back-off algorithm, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.

#Exemplar/Case Studies	Demonstration of DLL protocols on Simulator

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Network Layer**	**08 Hours**
Introduction: Functions of Network layer. **Switching Techniques**: Circuit switching, Message Switching, Packet Switching. **IP Protocol**: Classes of IP (Network addressing), IPv4, IPv6,Network Address Translation, Sub-netting, CIDR. **Network layer Protocols**: ARP, RARP, ICMP, IGMP. **Network Routing and Algorithms**: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. **Routing Protocols**: RIP, OSPF, BGP, MPLS. **Routing in MANET**: AODV, DSR, Mobile IP.		
#Exemplar/Case Studies	Demonstration of Routing Protocols on simulator.	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Transport Layer**	**07 Hours**
Process to Process Delivery, Services, Socket Programming. **Elements of Transport Layer Protocols**: Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control. **Transport Layer Protocols**: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.		
#Exemplar/Case Studies	Demonstration of Transport layer protocols on Simulator.	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Application Layer**	**06 Hours**
Introduction, Web and HTTP, Web Caching, DNS, Email: SMTP, MIME,POP3, Webmail, FTP, TELNET, DHCP, SNMP.		
#Exemplar/Case Studies	Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Security**	**07 Hours**
Introduction, Security services, Need of Security, Key Principles of Security, Threats and Vulnerabilities, Types of Attacks, ITU-T X.800 Security Architecture for OSI, Security Policy and mechanisms, Operational Model of Network Security, Symmetric and Asymmetric Key Cryptography. Security in Network, Transport and Application: Introduction of IPSec, SSL, HTTPS, S/MIME, Overview of IDS and Firewalls.		
#Exemplar/Case Studies	Study of security protocols in Network, Transport and Application Layer using network protocol analyzer. Wireshark	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books :

1. Fourauzan B.,"Data Communications and Networking",5th Edition,TataMcGraw-Hill,Publications, ISBN:0–07 – 058408 – 7
2. Andrew S. Tanenbaum, “Computer Networks”, 5th Edition, Pearson India, 2012.

Reference Books :

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
3. Douglas E. Comer & M.S Narayanan, "Computer Network & Internet", Pearson Education
4. William Stallings, "Cryptography and Network Security: Principles and Practice", 4th Edition
5. Pachghare V. K., "Cryptography and Information Security", 3rd Edition, PHI,

e-Books :

- https://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf
- http://eti2506.elimu.net/Introduction/Books/Data_Communications_and_Networking_By_Behrouz_A.Forouzan.pdf
- http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
- https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf

Case Study:

- https://slideplayer.com/slide/6106945
- http://www.worldcolleges.info/sites/default/files/Cisco_-_Ccie_Fundamental_-Network_Design_And_Case_Studies.PDF
- http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php

MOOCs Courses link:

- nptel.ac.in/courses/106/105/106105183
- nptel.ac.in/courses/106/105/106105080
- nptel.ac.in/courses/106/105/106105081
- nptel.ac.in/courses/106/106/106106091
- nptel.ac.in/courses/106/105/106105031
- https://www.mooc-list.com/tags/computer-networking
- https://www.coursera.org/courses?query=computer%20network

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	2	2	1	-	-	-	-	1	1
CO2	1	1	1	1	1	-	1	-	-	1	-	-
CO3	3	1	2	1	2	-	-	-	-	-	-	1
CO4	1	2	1	2	2	-	-	-	1	-	1	1
CO5	1	3	-	-	1	-	1	1	-	-	-	-
CO6	1	-	2	1	-	1	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(A): Internet of Things and Embedded Systems

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Digital Electronics and Logic Design (210245)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To learn advances in Embedded Systems and IoT
- To learn methodologies for IoT application development
- To learn the IoT protocols, cloud platforms and security issues in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the fundamentals and need of Embedded Systems for the Internet of Things
CO2: Apply IoT enabling technologies for developing IoT systems
CO3: Apply design methodology for designing and implementing IoT applications
CO4: Analyze IoT protocols for making IoT devices communication
CO5: Design cloud based IoT systems
CO6: Design and Develop secured IoT applications

Course Contents

Unit I	Introduction to Embedded Systems	07 Hours

Definition, Characteristics of Embedded System, Real time systems, Real time tasks. **Processor basics**: General Processors in Computer Vs Embedded Processors, Microcontrollers, Microcontroller Properties, Components of Microcontrollers, System-On-Chip and its examples, Components of Embedded Systems, Introduction to embedded processor.

#Exemplar/Case Studies	Installation of Real Time Operating System
***Mapping of Course Outcomes for Unit I**	CO1,CO2

Unit II	Internet of Things : Concepts	07 Hours

Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. **Physical Design of IoT**: Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog / Digital Conversion. **Logical Design of IoT**: IoT functional blocks, IoT enabling technologies, IoT levels and deployment templates, Applications in IoT.

#Exemplar/Case Studies	Exemplary device: Raspberry Pi / Arduino: Programming: Arduino IDE/ Python, Interfacing. Other IoT Devices.
***Mapping of Course Outcomes for Unit II**	CO1,CO2

Unit III	IoT: Design Methodology	07 Hours

IoT Design Methodology: Steps, Basics of IoT Networking, Networking Components, Internet

Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.		
#Exemplar/Case Studies	Home Automation using IoT communication models and IoT Communication APIs.	
***Mapping of Course Outcomes for Unit III**	CO3,CO4	
Unit IV	**IoT Protocols**	**07 Hours**
Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. **IP based Protocols**: MQTT (Secure), 6LoWPAN, LoRa.		
#Exemplar/Case Studies	LoRa based Smart Irrigation System.	
***Mapping of Course Outcomes for Unit IV**	CO4,CO5	
Unit V	**Cloud Platforms for IoT**	**07 Hours**
Software Defined Networking, Introduction to Cloud Storage Models, Communication API. **WAMP**: Auto Bahn for IoT, Xively Cloud for IoT. **Python Web Application Framework**: Django Architecture and application development with Django, Amazon Web Services for IoT, Sky Net IoT Messaging Platform, RESTful Web Service, GRPC,SOAP.		
#Exemplar/Case Studies	Smart parking, Forest fire detection	
***Mapping of Course Outcomes for Unit V**	CO4, CO5	
Unit VI	**Security in IoT**	**07 Hours**
Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. **Key elements of IoT Security**: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT, Challenges in designing IOT applications, Lightweight cryptography.		
#Exemplar/Case Studies	Home Intrusion Detection	
***Mapping of Course Outcomes for Unit VI**	CO2, CO6	
Learning Resources		

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on Approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, “Microcontroller and Smart Home Networks”, ISBN: 9788770221566, e-ISBN: 9788770221559
2. Charles Crowell, “IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT”,ISBN-13 : 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press,ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5
4. David Etter, “IoT Security: Practical guide book”, amazon kindle Page numbers, source ISBN: 1540335011.
5. Brian Russell, Drew Van Duren, “Practical Internet of Things Security”, Second Edition,

Packt Publishing, ISBN: 9781788625821

6. Dr. Shriram K Vasudevan,Abhishek S Nagarajan, RMD Sundaram, "Internet of Things", Wiley publication, 2nd Edition, ISBN: 9789388991018

e-Books :

- https://www.iotforall.com/ebooks/an-introduction-to-iot
- https://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105166/
- https://www.udemy.com/course/a-complete-course-on-an-iot-system-design-and-development/
- https://www.coursera.org/learn/iot
- https://nptel.ac.in/courses/108/108/108108098/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	-	-	-	-	1	-	1	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-
CO3	2	3	3	3	2	3	-	-	2	-	1	-
CO4	1	2	2	2	3	3	-	-	2	1	2	2
CO5	2	2	2	3	3	3	-	-	2	1	2	2
CO6	2	2	1	2	2	2	-	1	1	-	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(B): Human Computer Interface

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Graphics (210244), Software Engineering (210253)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand the importance of HCI design process in software development
- To learn fundamental aspects of designing and implementing user interfaces
- To study HCI with technical, cognitive and functional perspectives
- To acquire knowledge about variety of effective human-computer-interactions
- To co-evaluate the technology with respect to adapting changing user requirements in interacting with computer

Course Outcomes:

On completion of the course, learners should be able to

CO1: Design effective Human-Computer-Interfaces for all kinds of users

CO2: Apply and analyze the user-interface with respect to golden rules of interface

CO3: Analyze and evaluate the effectiveness of a user-interface design

CO4: Implement the interactive designs for feasible data search and retrieval

CO5: Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual reality ,multi-media, World wide web related environments

CO6: Analyze and identify user models, user support, and stakeholder requirements of HCI systems

Course Contents

Unit I	Introduction and Foundation of HCI	07 Hours

Foundation: Human Memory. **Thinking**: Reasoning and Problem Solving, Emotion, Individual Difference, Psychology and design of Interactive systems, The Computer-Text Entry Device, Positioning, Pointing, Display devices, Devices for virtual reality and 3D Interaction, The Interactions-Models of Interaction, Frameworks and HCI, Ergonomics, Interaction styles, Ergonomics, Elements of WIMP Interface, Interactivity, Measurable Human Factors, The context of Interaction. **Importance of User Interface**: Defining user Interface, Brief History of Human-Computer Interface, Good and Poor Design- Importance of good design.

#Exemplar/Case Studies	Paper prototype – Design elements of GUI
***Mapping of Course Outcomes for Unit I**	CO1,CO6

Unit II	Human Perspective in Interaction Design Process	07 Hours

Know your user/client: Understanding how people interact with computers, Important human characteristics in Design, Human considerations in design of Business systems, Human Interaction speeds, Performance versus Preference, Methods of gaining an understanding of users, Miller's Law.

Design Guidelines: Navigating the interface, Organizing the display, Getting user's attention, Facilitating data entry. **Principles**: Determine user's skill level, Identify the tasks, Choose an

interaction style, Natural Language, Eight Golden rules of Interface design, Prevent errors, Ensuring Human control while increasing automation. **Theories**: Design-by-level, Stages of action, Consistency, Contextual Theories, Dynamic theories.		
#Exemplar/Case Studies	Registration form design.	
***Mapping of Course Outcomes for Unit II**	CO1,CO2	
Unit III	**Interaction Styles and HCI in Software Process**	**07 Hours**
Design, Process of Interaction Design. **Interaction styles**: Command line, Menu Selection, Form fill-in, Direct Manipulation. **Graphical User Interface:** Popularity of Graphics, Concept of direct manipulation, Advantages, Disadvantages and characteristics of Graphical user interface. **Web User Interface**: Popularity and Characteristics, Merging of Graphical business systems and the Web- Characteristics of Intranet versus Internet, Web page versus application design, Principles for user interface design, Software life cycle, Usability Engineering, Iterative design and prototyping, Design Rationale.		
#Exemplar/Case Studies	Comparison - GUI and Web design with a real time example.	
***Mapping of Course Outcomes for Unit III**	CO1,CO3,CO5	
Unit IV	**Usability Evaluation and Universal Design**	**07 Hours**
User interface design process: Designing for People: Seven commandments, Usability Assessment in the Design process, Common Usability problems, Practical and Objective measures of Usability, Formative and Summative evaluation, Usability specifications for evaluation, Analytic methods, Model based analysis, GOMS model, Empirical methods, Field studies, Usability testing in Laboratory, Controlled experiments, Heuristic Evaluation, Cognitive Walkthrough. **Evaluation framework**: Paradigms and techniques, DECIDE: a framework to guide evaluation, Universal design principles, Multi-modal interaction, Designing for diversity.		
#Exemplar/Case Studies	GOMS model - Adding items to a cart of e-shopping website.	
***Mapping of Course Outcomes for Unit IV**	CO1,CO3	
Unit V	**HCI Paradigms**	**07 Hours**
Paradigms for Interaction: Time sharing, Video display units, Programming toolkits, Personal computing, The metaphor, Direct manipulation, Hypertext, Computer-supported cooperative work, Agent based interfaces. **Ubiquitous Computing**: Sensor-based and context-aware interaction, Data Integrity versus Data immunity, Handling missing data, Data entry and fudge ability, Auditing versus Editing, Retrieval in Physical World, Retrieval in Digital world, Constrained Natural Language output, Five stage search framework, Dynamic queries and faceted search, The social aspects of search. **Pattern Recognition**: Introduction, Examples, Role of Machine Learning, Pattern Recognition Process, Pattern Recognition in HCI.		
#Exemplar/Case Studies	Interface Design- Pattern gesture recognition	
***Mapping of Course Outcomes for Unit V**	CO1,CO3,CO4	
Unit VI	**HCI for Mobile and Handheld devices**	**07 Hours**
Designing for Mobile and other devices: Anatomy of a Mobile app, Mobile form factors, Handheld format apps, Tablet format apps, Mini-tablet format apps, Mobile Navigation, Content, and control idioms- browse controls, Navigation and toolbars, Drawers, Tap-to-reveal and direct manipulation, Searching, Sorting and Filtering, Welcome and help screens, Multi-touch gestures,		

Inter-app integration, Android Accessibility Guidelines.

Other devices: Designing for kiosks, Designing for 10-foot interfaces, Designing for automotive interfaces, Designing for audible interfaces.

#Exemplar/Case Studies	GUI in Python Enlist and evaluate handled devices
***Mapping of Course Outcomes for Unit VI**	CO3,CO5,CO6

Learning Resources

Text Books:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9
3. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, "Designing the User Interface: Strategies for Effective Human- Computer Interaction", 6th Edition, Pearson Education Limited, ISBN 987-1-292-03701-1.

Reference Books :

1. Alan Cooper, Robert Reiman, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th edition, WILEY, ISBN 978-1-118-76658-3
2. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann Publishers, ISBN 978-1-558-60712-5
3. Wibert O. Galitz,"The Essential Guide to user Interface Design", WILEY India, ISBN: 978-1-265-0280-6
4. Jenifer Tidwell, "Designing Interfaces", O'REILLY, ISBN: 978-1-449-37970-4
5. Julie A. Jacko (Ed), "The Human-Computer Interaction Handbook", 3rd edition, CRC Press, 2012
6. Zou J., Nagy G. (2006) "Human-Computer Interaction for Complex Pattern Recognition Problems"
7. Basu M., Ho T.K. (eds) "Data Complexity in Pattern Recognition. Advanced Information and Knowledge Processing", Springer, London

e-Books :

- http://www.37steps.com/data/pdf/PRIntro_medium.pdf
- https://www.ecse.rpi.edu/~nagy/PDF_chrono/2005_Zou_Nagy_complexity_05.pdf
- https://www.raywenderlich.com/240-android-accessibility-tutorial-getting-started

MOOCs Courses link

- https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p
- https://www.edx.org/course/human-computer-interaction-ii-cognition-context-cu

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	1	1	1	-	-	1	1	3	1
CO2	2	2	-	1	-	-	-	2	1	-	-	-
CO3	-	1	2	3	-	1	-	1	-	-	1	-
CO4	-	-	-	2	3	1	-	-	1	-	-	-
CO5	3	2	2	-	2	2	2	-	-	2	2	3
CO6	-	1	2	1	2	3	-	1	-	-	-	2

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(C): Distributed Systems

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To learn the fundamentals of Distributed Systems
- To learn types of communication and synchronization in Distributed Systems
- To acquaint with the Distributed File Systems
- To understand consistency and replication in Distributed Systems
- To understand the fault tolerance based Distributed Systems

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze Distributed Systems types and architectural styles
CO2: Implement communication mechanism in Distributed Systems
CO3: Implement the synchronization algorithms in Distributed System applications
CO4: Develop the components of Distributed File System
CO5: Apply replication techniques and consistency model in Distributed Systems
CO6: Build fault tolerant Distributed Systems

Course Contents

Unit I	Introduction	07 Hours

Defining Distributed Systems, Characteristics, Middleware and Distributed Systems. **Design goals**: Supporting resource sharing, Making distribution transparent, Open, Scalable, Pitfalls. **Types of Distributed Systems**: High Performance Distributed Computing, Distributed Information Systems, Pervasive Systems. **Architectural styles**: Layered architectures, Object based architectures, Publish Subscribe architectures. **Middleware organization**: Wrappers, Interceptors, Modifiable middleware. **System architecture**: Centralized, Decentralized, Hybrid, Example architectures – Network File System, Web.

#Exemplar/Case Studies	Case Study of Middleware System that includes Design, Architecture and Application.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Communication	07 Hours

Introduction: Layered Protocols, Types of Communication, Remote Procedural Call- Basic RPC Operation, Parameter Passing, RPC-based application support, Variations on RPC, Example: DCE RPC, Remote Method Invocation. **Message Oriented Communication**: Simple Transient Messaging with Sockets, Advanced Transient Messaging, Message Oriented Persistent Communication, Examples. **Multicast Communication**: Application Level Tree-Based Multicasting, Flooding-Based Multicasting, Gossip-Based Data Dissemination.

#Exemplar/Case Studies	Apache Kafka Distributed Event Streaming Platform, gRPC Open Source RPC Framework
***Mapping of Course**	CO2

Outcomes for Unit II		
Unit III	**Synchronization**	**07 Hours**
Clock Synchronization: Physical Clocks, Clock Synchronization Algorithms. **Logical Clocks** – Lamport's Logical clocks, Vector Clocks. **Mutual Exclusion**: Overview, Centralized Algorithm, Distributed Algorithm, Token-Ring Algorithm, Decentralized Algorithm .**Election Algorithms**: Bully Algorithm, Ring Algorithm. **Location Systems**: GPS, Logical Positioning of nodes, Distributed Event Matching. **Gossip-Based Contribution**: Aggregation, A Peer-Sampling Service, Gossip-Based Overlay Construction.		
#Exemplar/Case Studies	Design Time Synchronization Mechanism in Distributed Gaming	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Naming and Distributed File Systems**	**07 Hours**
Names, Identifiers, Addresses, Flat Naming, Structured Naming, Attributed Based Naming, Introduction to Distributed File Systems, File Service Architecture. **Case study**: Suns Network file System, Andrew File System.		
#Exemplar/Case Studies	Study of Google File System	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Consistency and Replication**	**07 Hours**
Introduction: Reasons for Replication, Replication as Scaling Technique. **Data-Centric Consistency Models**: Continuous Consistency, Consistent Ordering of Operations. **Client-Centric Consistency Models**: Eventual Consistency, Monotonic Reads, Monotonic Writes, Read Your Writes, Writes Follow Reads. **Replica Management**: Finding the best server location, Content Replication and Placement, Content Distribution, Managing Replicated Objects. **Consistency Protocols**: Continuous Consistency, Sequential Consistency, Cache Coherence Protocols, Example: Caching, and Replication in the web.		
#Exemplar/Case Studies	Study of HDFS Architecture for Data Replication	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Fault Tolerance**	**07 Hours**
Introduction to Fault Tolerance: Basic Concepts, Failure Models, Failure Masking by Redundancy. **Process Resilience**: Resilience by Process Groups, Failure Masking and Replication, Example: Paxos, Consensus in faulty systems with crash failures, some limitations on realizing Fault Tolerant tolerance, Failure Detection. **Reliable Client Server Communication:** Point to Point Communication, RPC Semantics in the Presence of Failures. **Reliable Group Communication:** Atomic multicast, Distributed commit. **Recovery:** Introduction, Check pointing, Message Logging, Recovery Oriented Computing.		
#Exemplar/Case Studies	Study of any Open Source Tool for Building Fault-Tolerant System such as Circuit Breaker/Nginx/HaProxy/Akka	
***Mapping of Course**	CO6	

Outcomes for Unit VI	

Learning Resources

Text Books:

1. Maarten van Steen, Andrew S. Tanenbaum, "Distributed System", Third edition, version 3
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Fifth edition

Reference Books:

1. Christian Cachin, Rachid Guerraoui, Luís Rodrigues, "Introduction to Reliable and Secure Distributed Programming", Springer; 2nd ed. 2011 edition
2. Vijay K. Garg, "Elements of Distributed Computing", Wiley
3. Maarten Van Steen and Andrew S. Tanenbaum, "Distributed Systems", Amazon Digital Services; 3rd edition

e-Books :

- Martin Kleppmann, "Designing Data-Intensive Applications", Oreilly

MOOC Courses links:

- Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/106/106106168/#
- Prof. Rajiv Misra, Cloud computing and Distributed System
- Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/104/106104182/

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	1	-	-	-	-	-	1
CO2	3	2	2	2	1	-	-	-	-	1	-	1
CO3	3	2	2	2	1	-	-	-	-	1	-	1
CO4	3	1	2	2	1	-	-	-	-	1	-	1
CO5	3	1	1	1	-	-	-	-	-	-	-	1
CO6	1	1	1	1	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(D): Software Project Management

Home

Teaching Scheme:	Credit:	Examination Scheme:
Theory: 03 Hours/Week	03	Mid-Sem (TH) : 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses: Software Engineering(210253)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand the fundamentals of Software Project Management
- To investigate software project planning and management tools
- To learn software project scheduling and tracking
- To discuss about the agile project management
- To know people management in software project

Course Outcomes:

On completion of the course, learners should be able to

CO1: Comprehend Project Management Concepts
CO2: Use various tools of Software Project Management
CO3: Schedule various activities in software projects
CO4: Track a project and manage changes
CO5: Apply Agile Project Management
CO6: Analyse staffing process for team building and decision making in Software Projects and Management

Course Contents

Unit I	Introduction to Software Project Management	07 Hours

Project Definition, Project versus Flow type work, Project Lifecycle, Processes and Knowledge Areas in Project Management (PM), Build or Buy decision, Work Breakdown Structure (WBS) and its types, Introduction to PMBOK, Program and Portfolio Management.

#Exemplar/Case Studies	Analysis of a project using PMBOK concepts
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Project Planning and Project Management Tools	07 Hours

Project Planning: Steps for Project Planning, PERT and Gantt Charts, Gantt Project, Microsoft Project and Primavera Project Management Software, Objectives of Activity planning, Project Schedules, Activities, Sequencing and Scheduling, Network Planning Models, Formulating Network Model.

#Exemplar/Case Studies	Create software project plan using any tool.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Activity based Scheduling	07 Hours

Introduction, Objectives of Activity Planning, Project Schedules. **Activities**: Sequencing and Scheduling, Network Planning Models, Formulating Network Model, Activity relationships (FS,SF,SS,FF), Forward Pass and Backward Pass techniques, Critical Path concept and remedies.

#Exemplar/Case Studies	Apply the critical path technique to the project
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	Project Tracking and Control	07 Hours

Introduction, Collection of Project data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, Change Control, Software Configuration Management, Managing contracts, Contract Management.	
#Exemplar/Case Studies	Analyze the effect of a major requirement change on the schedule
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Agile Project Management**	**07 Hours**
Predictive versus Empirical Management, Comparison between Non-Agile and Agile Project, Three stages of Agile Project, Estimation, Scope Management, Roles and Responsibilities, Scheduling and Tracking.		
#Exemplar/Case Studies	Analyse the same project using Agile. Create the three stages of the project.	
***Mapping of Course Outcomes for Unit V**	CO5	

Unit VI	**Staffing in Software Projects**	**07 Hours**
Managing People, Organizational behaviour, Best methods of Staff Selection, Motivation, The Oldham, Hackman job characteristic Model, Stress, Health and Safety, Ethical and Professional concerns, Working in Teams, Decision Making, Organizational structures, Dispersed and Virtual Teams, Communications Genres, Communication Plans.		
#Exemplar/Case Studies	Analyse a case study for a distributed team and comment	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Bob Hughes, Mike Cotterell and Rajib Mall, “Software Project Management”, Sixth Edition, Tata McGraw Hill, New Delhi, 2017
2. Robert K. Wysocki, “Effective Software Project Management”, Wiley Publication, 2011

Reference Books :

1. Ken Schwaber, “Agile Project Management”, Microsoft Press, 2004
2. Walker Royce, “Software Project Management”, Addison-Wesley, 1998
3. Jalote Pankaj, “Software Project Management in Practice”, Addison-Wesley Professional,2002
4. PMBOK Guide

e-Books :

- https://www.kornev-online.net/ITIL/Mcgraw.Hill.Software_Project_Management_2nd_Edition.pdf
- http://library.lol/main/B96E3B122326F8D2C6FBD35A5E978422

MOOCs Courses Links:

- https://onlinecourses.nptel.ac.in/noc19_cs70/preview
- Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur
- Agilealliance.org, Scrum.org, Scrumalliance.org

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	-	-	-	1	-	3	-
CO2	-	-	-	2	2	-	-	-	1	-	3	-
CO3	-	-	-	-	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	-	1	-	3	-
CO5	-	-	2	1	1	-	-	1	2	-	3	-
CO6	-	-	-	-	1	-	-	-	3	1	3	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310246:Database Management Systems Laboratory

Home

Teaching Scheme Practical: 04 Hours/Week	Credit:02	Examination Scheme and Marks Term work: 25 Marks Practical: 25 Marks

Companion Course: Database Management Systems(310241)

Course Objectives:

- To develop Database programming skills
- To develop basic Database administration skills
- To develop skills to handle NoSQL database
- To learn, understand and execute process of software application development

Course Outcomes:

On completion of the course, learners will be able to

CO1: Design E-R Model for given requirements and convert the same into database tables

CO2: Design schema in appropriate normal form considering actual requirements

CO3: Implement SQL queries for given requirements, using different SQL concepts

CO4: Implement PL/SQL Code block for given requirements

CO5: Implement NoSQL queries using MongoDB

CO6: Design and develop application considering actual requirements and using database concepts

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student’s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/index.php

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Sr. No.	Group A: SQL and PL/SQL
1.	**ER Modeling and Normalization:** Decide a case study related to real time application in group of 2-3 students and formulate a problem statement for application to be developed. Propose a Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize Relational data model. Note: Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part Mini Project. Further assignments will be useful for students to develop a backend for system. To design front end interface students should use the different concepts learnt in the other subjects also.
2.	**SQL Queries:** a. Design and Develop SQLDDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc. b. Write at least 10 SQL queries on the suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like Insert, Select, Update, Delete with operators, functions, and set operator etc.
3.	**SQL Queries – all types of Join, Sub-Query and View:** Write at least10 SQL queries for suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like all types of Join ,Sub-Query and View
4.	**Unnamed PL/SQLcode block: Use of Control structure and Exception handling is mandatory.** Suggested Problem statement: Consider Tables: 1. Borrower(Roll_no, Name, Date of Issue, Name of Book, Status) 2. Fine(Roll_no, Date, Amt) • Accept Roll_no and Name of Book from user. • Check the number of days (from date of issue). • If days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day and for days less than 30, Rs. 5 per day.

5.	• After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. • Also handles the exception by named exception handler or user define exception handler. **OR** Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 5 to 9. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns, radius and area. Note: Instructor will frame the problem statement for writing PL/SQL block in line with above statement.
6.	**Named PL/SQL Block: PL/SQL Stored Procedure and Stored Function.** Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks899and 825 category is Higher Second Class. Write a PL/SQLblock to use procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class) Note: Instructor will frame the problem statement for writing stored procedure and Function in line with above statement.
7.	**Cursors:(All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)** Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_Roll Call with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped. Note: Instructor will frame the problem statement for writing PL/SQL block using all types of Cursors in line with above statement.
8.	**Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers).** Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. Note: Instructor will Frame the problem statement for writing PL/SQLblock for all types of Triggers in line with above statement.
9.	**Database Connectivity:** Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)
	Group B: NoSQL Databases
1.	**MongoDB Queries:** DesignandDevelopMongoDBQueriesusingCRUDoperations.(UseCRUDoperations, SAVE method, logical operators etc.).
2.	**MongoDB – Aggregation and Indexing:** Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB.
3.	**MongoDB – Map-reduces operations:** Implement Map reduces operation with suitable example using MongoDB.
4.	**Database Connectivity:** Write a program to implement Mongo DB database connectivity with any front end language to implement Database navigation operations(add, delete, edit etc.)

	Group C: Mini Project
1.	Using the **database concepts covered in Group A and Group B**, develop an application with following details: 1. Follow the same problem statement decided in Assignment -1 of Group A. 2. Follow the Software Development Life cycle and other concepts learnt in **Software Engineering Course** throughout the implementation. 3. Develop application considering: • Front End: Java/Perl/PHP/Python/Ruby/.net/any other language • Backend : MongoDB/ MySQL/Oracle 4. Test and validate application using Manual/Automation testing. 5. Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle: • Title of the Project, Abstract, Introduction • Software Requirement Specification • Conceptual Design using ER features, Relational Model in appropriate Normalize form • Graphical User Interface, Source Code • Testing document • Conclusion. **Note:** • Instructor should maintain progress report of mini project through out the semester from project group. • Practical examination will be on assignments given above in Group A and Group B only • Mini Project in this course should facilitate the Project Based Learning among students

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	3	-	3	1	1	1	3	1	-	1
CO2	2	2	3	-	2	-	1	-	3	-	1	-
CO3	-	1	2	-	2	1	-	1	3	-	-	2
CO4	-	1	2	-	2	-	-	-	3	2	1	-
CO5	-	1	2	-	2	-	2	-	3	1	-	1
CO6	2	2	3	-	3	1	-	-	3	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310247:Computer Networks and Security Laboratory

Home

Teaching Scheme	Credit:	Examination Scheme and Marks
Practical: 02 Hours/Week	01	Term work: 25 Marks Oral: 25 Marks

Companion Course: Computer Network and Security(310244)

Course Objectives:

- To learn computer network hardware and software components
- To learn computer network topologies and types of network
- To develop an understanding of various protocols, modern technologies and applications
- To learn modern tools for network traffic analysis
- To learn network programming

Course Outcomes:

On completion of the course, learners will be able to

CO1: Analyze the requirements of network types, topology and transmission media

CO2: Demonstrate error control, flow control techniques and protocols and analyze them

CO3: Demonstrate the subnet formation with IP allocation mechanism and apply various routing algorithms

CO4: Develop Client-Server architectures and prototypes

CO5: Implement web applications and services using application layer protocols

CO6: Use network security services and mechanisms

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Oral Examination

Oral examination should be jointly conducted by the internal examiner and external examiner. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementations in term work. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended: -64-bit Open-source Linux or its derivative

Programming tools recommended: - Open-Source/C/C++/JAVA

Programming tool like G++/GCC, Wireshark/Ethereal and Packet Tracer

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlab/

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Sr. No.	Group A (Unit I and II): Attempt any two assignments from Sr.No. 1 to 3. Assignments 4 and 5 are compulsory.
1.	Setup a wired LAN using Layer 2 Switch. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrating the PING packets captured traces using Wireshark Packet Analyzer Tool.
2.	Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.
3.	Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN).
4.	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.
5.	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.
	Group B (Unit III and IV)
6.	Write a program to demonstrate Sub-netting and find subnet masks.
7.	Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission.
8.	Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP.
9.	Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator
10.	Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.
	Group C (Unit V and VI): Assignment Sr. No. 11 is Compulsory and attempt any four from Assignments Sr. No 12 to 17.
11.	Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa.
12.	InstallingandconfigureDHCPserverandwriteaprogramtoinstallthesoftwareonremotemachine.

13.	Capture packets using Wireshark, write the exact packet capture filter expressions to accomplish the following and save the output in file: 1. Capture all TCP traffic to/from Facebook, during the time when you log in to your Facebook account 2. Capture all HTTP traffic to/from Facebook, when you log in to your Facebook account 3. Write a DISPLAY filter expression to count all TCP packets (captured under item #1) that have the flags SYN, PSH, and RST set. Show the fraction of packets that had each flag set. 4. Count how many TCP packets you received from / sent to Face book, and how many of each were also HTTP packets.
14.	Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool.
15.	To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).
16.	Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
17.	To study the IPsec (ESP and AH) protocol by capturing the packets using Wireshark tool.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	2	-	2	1	1	-	-	1	-	1
CO2	-	3	-	1	1	-	-	1	-	-	-	-
CO3	3	2	1	1	-	-	-	1	-	-	1	1
CO4	-	1	2	1	1	1	-	-	-	-	-	1
CO5	2	3	-	-	1	-	-	-	1	-	-	-
CO6	-	1	3	1	1	-	1	-	2	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310248: Laboratory Practice I

Home

Teaching Scheme	Credit:02	Examination Scheme and Marks
Practical: 04 Hours/Week		Term work: 25 Marks Practical: 25 Marks

Companion Course: Systems Programming and Operating System (310243), Elective I(310245)

Course Objectives:

- To learn system programming tools
- To learn modern operating system
- To learn various techniques, tools, applications in IoT and Embedded Systems /Human Computer Interface/Distributed Systems/ Software Project Management

Course Outcomes:

On completion of the course, learners will be able to

- **Systems Programming and Operating System**
  - **CO1:** Implement language translators
  - **CO2**: Use tools like LEX and YACC
  - **CO3**: Implement internals and functionalities of Operating System
- **Internet of Things and Embedded Systems**
  - **CO4:** Design IoT and Embedded Systems based application
  - **CO5:** Develop smart applications using IoT
  - **CO6:** Develop IoT applications based on cloud environment

OR

- **Human Computer Interface**
  - **CO4:**Implement the interactive designs for feasible data search and retrieval
  - **CO5:**Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual Reality and ,multi-media, World wide web related environments
  - **CO6:**Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems

OR

- **Distributed Systems**
  - **CO4:** Demonstrate knowledge of the core concepts and techniques in Distributed Systems
  - **CO5**: Apply the principles of state-of-the-Art Distributed Systems in real time applications
  - **CO6**: Design, build and test application programs on Distributed Systems

OR

- **Software Project Management**
  - **CO4:**Apply Software Project Management tools
  - **CO5:**Implement software project planning and scheduling
  - **CO6:**Analyse staffing in software project

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus. For the elective subjects students should form group of 3-4 students. The faculty coordinator will take care that all the assignment should be assigned to class and minimum two assignments are compulsory for each group.

Programming tools recommended: -

Human computer Interface-GUI in python

Internet of Things and Embedded System- Raspberry Pi/Arduino Programming; Arduino IDE/Python Interfacing. Other IoT devices

Software project management-MS project/Gantt Project/Primavera

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Part I: Systems Programming and Operating System	
Sr. No.	**Group A (Any Two Assignments from Sr. No. 1 to 3)**
1.	Design suitable Data structures and implement Pass-I and Pass-II of a two-pass assembler for pseudo-machine. Implementation should consist of a few instructions from each category and few assembler directives. The output of Pass-I (intermediate code file and symbol table) should be input for Pass-II.

2.	Design suitable data structures and implement Pass-I and Pass-II of a two-pass macro-processor. The output of Pass-I (MNT, MDT and intermediate code file without any macro definitions) should be input for Pass-II.
3.	Write a program to create a Dynamic Link Library for any mathematical operation and writean application program to test it. (Java Native Interface / Use VB or VC++)
	Group B(Any Two Assignments from Sr. No. 4 to 7)
4.	Write a program to solve Classical Problems of Synchronization using Mutexand Semaphore.
5.	Write a program to simulate CPU Scheduling Algorithms: FCFS, SJF (Preemptive), Priority (Non-Preemptive) and Round Robin (Preemptive).
6.	Write a program to simulate Memory placement strategies – best fit, first fit, next fit and worst fit.
7.	Write a program to simulate Page replacement algorithm.
Part II : Elective I	
	Suggested List of Laboratory Experiments/Assignments **(Any Two assignments from each elective subject are compulsory andInstructor will take care that all the assignments should be covered among different batch students)**
	Internet of Things and Embedded Systems
1.	Understanding the connectivity of Raspberry-Pi / Adriano with IR sensor. Write an application to detect obstacle and notify user using LEDs.
2.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, generate alerts using LEDs.
3.	Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.
4.	Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
	Human Computer Interface
1.	Design a paper prototype for selected Graphical User Interface.
2.	Implement GOMS (Goals, Operators, Methods and Selection rules) modeling technique to model user's behavior in given scenario.
3.	Design a User Interface in Python.
4.	To redesign existing Graphical User Interface with screen complexity.
	Distributed System
1.	Implementation of Inter-process communication using socket programming: implementing multithreaded echo server.
2.	Implementation of RPC Mechanism.
3.	Simulation of election algorithms (Ring and Bully).
4.	Implementation of Clock Synchronization: a) NTP b) Lamports clock.
	Software Project Management
1.	**Create Project Plan** ▪ Specify project name and start (or finish) date. ▪ Identify and define project tasks. ▪ Define duration for each project task. ▪ Define milestones in the plan ▪ Define dependency between tasks ▪ Define project calendar. ▪ Define project resources and specify resource type ▪ Assign resources against each task and baseline the project plan

2.	**Execute and Monitor Project Plan** ▪ Update % Complete with current task status. ▪ Review the status of each task. ▪ Compare Planned vs Actual Status ▪ Review the status of Critical Path ▪ Review resources assignation status
3.	**Generate Dashboard and Reports** • **Dashboard** o Project Overview o Cost Overview o Upcoming Tasks • **Resource Reports** o Over-allocated Resources o Resource Overview • **Cost Reports** o Earned Value Report o Resource Cost Overview o Task Cost Overview • **Progress Reports** o Critical Tasks o Milestone Report o Slipping Tasks

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	3	-	-	-	-	-	-	1
CO2	1	2	2	2	2	-	-	-	-	-	-	1
CO3	1	2	2	2	2	-	-	-	-	-	-	1
CO4	1	2	3	2	-	2	-	-	2	1	2	-
CO5	1	2	2	1	-	2	-	-	3	2	1	-
CO6	2	2	2	1	-	2	-	-	2	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310249: Seminar and Technical Communication

Home

Teaching Scheme	Credit: 01	Examination Scheme and Marks
Tutorial: 01 Hour/Week		Term Work: 50 Marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques
- To explore the latest technologies
- To enhance the communication skills
- To develop problem analysis skills

Course Outcomes:

On completion of the course, learners will be able to

CO1: Analyze a latest topic of professional interest
CO2: Enhance technical writing skills
CO3: Identify an engineering problem, analyze it and propose a work plan to solve it
CO4: Communicate with professional technical presentation skills

Guidelines

- Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.
- The topic must be selected in consultation with the Institute guide.
- Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only.
- Active participation at classmate seminars is essential.
- BoS has circulated the Seminar Log book and it is recommended to use it.

Guidelines for Assessment

Panel of staff members along with a guide would be assessing the seminar work based on these parameters-Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Recommended Format of the Seminar Report

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year and University
- Seminar Approval Sheet/Certificate,
- Abstract and Keywords
- Acknowledgements
- Table of Contents, List of Figures, List of Tables and Nomenclature
- Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/ …..,Discussions and Conclusions ,Bibliography/References
- Plagiarism Check report
- Report Documentation page

Reference Books :

1. Rebecca Stott, Cordelia Bryan, Tory Young, "Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)", Longman, ISBN-13: 978-0582382435
2. Johnson-Sheehan, Richard, "Technical Communication", Longman. ISBN 0-321-11764-6
3.Vikas Shirodka, "Fundamental skills for building Professionals", SPD, ISBN 978-93-5213-146-5

@The CO-PO Mapping Matrix												
PO/CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	-	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
310250: Audit Course 5

Home

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
310250(A)	Cyber Security
310250(B)	Professional Ethics and Etiquette
310250(C)	Learn New Skills -Full Stack Developer
310250(D)	Engineering Economics
310250(E)	Foreign Language (one of Japanese/ Spanish/ French/ German). Course contents for **Japanese (Module 3)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(A): Cyber Security

Home

Prerequisites: Computer Network and Security (310244)

Course Objectives:

- To motivate students for understanding the various scenarios of cybercrimes
- To increase awareness about the cybercrimes and ways to be more secure in online activities
- To learn about various methods and tools used in cybercrimes
- To analyze the system for various vulnerabilities

Course Outcomes : On completion of the course, learners will be able to

CO 1: Understand and classify various cybercrimes
CO 2: Understand how criminals plan for the cybercrimes
CO 3: Apply tools and methods used in cybercrime
CO 4: Analyze the examples of few case studies of cybercrimes

Course Contents

1. **Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective.
2. **Cyber offenses: How Criminals Plan Them:** Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.
3. **Tools and Methods Used in Cybercrime :** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks **(Expected to cover the introduction to all these terms).**
4. **Cybercrime: Illustrations, Examples and Mini-Cases** :Introduction, Real-Life Examples, Mini-Cases, Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Digital Forensics Case Illustrations, Online Scams.

Text Books :

1. Nina Godbole, Sunit Belapure , “Cyber Security- Understanding Cyber Crimes”, Computer Forensics and Legal Perspectives, Wiely India Pvt. Ltd, ISBN- 978-81-265-2179-1
2. William Stallings, “Computer Security: Principles and Practices”, Pearson 6thEd, ISBN 978-0-13-335469-0

Reference Books :

1. Berouz Forouzan, “Cryptography and Network Security”, TMH, 2 edition, ISBN -978-00-707-0208-0. 5.
2. Mark Merkow, “Information Security-Principles and Practices”, Pearson Ed., ISBN- 978-81-317-1288-7
3. CK Shyamala et el., “Cryptography and Security”, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	1	1	2	1	-	3	-	1	-	2
CO2	1	1	1	1	1	1	-	3	-	1	-	2
CO3	1	1	1	1	1	1	-	3	-	1	-	2
CO4	1	1	1	1	1	1	-	3	-	1	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(B): Professional Ethics and Etiquettes

Home

Prerequisites: Business Communication Skill

Course Objectives:

- To learn importance of ethics and the rules of good behavior for today's most common social and business situations.
- To acquire basic knowledge of ethics to make informed ethical decisions when confronted with problems in the working environment.
- To develop an understanding towards business etiquettes and the proper etiquette practices for different business scenarios.
- To learn the etiquette requirements for meetings, entertaining, telephone, email and Internet business interaction scenario.

Course Outcomes:

On completion of the course, learners will be able to

CO1: Summarize the principles of proper courtesy as they are practiced in the workplace.

CO2: Apply proper courtesy in different professional situations.

CO3: Practice and apply appropriate etiquettes in the working environment and day to day life.

CO4: Build proper practices personal and business communications of Ethics and Etiquettes.

Course Contents

1. **Introduction to Ethics**: Basics, Difference Between Morals, Ethics, and Laws, Engineering Ethics: Purpose of Engineering Ethics-Professional and Professionalism, Professional Roles to be played by an Engineer, Uses of Ethical Theories, Professional Ethics, Development of Ethics.
2. **Professional Ethics:** IT Professional Ethics, Ethics in the Business World, Corporate Social Responsibility, Improving Corporate Ethics, Creating an Ethical Work Environment, Including Ethical Considerations in Decision Making, Ethics in Information Technology, Common Ethical issues for IT Users, Supporting the Ethical Practices of IT users.
3. **Business Etiquette**: ABC's of Etiquette, Developing a Culture of Excellence, The Role of Good Manners in Business, Enduring Words Making Introductions and Greeting People: Greeting Components, The Protocol of Shaking Hands, Introductions, Introductory Scenarios, Addressing Individuals Meeting and Board Room Protocol: Guidelines for Planning a Meeting, Guidelines for Attending a Meeting.
4. **Professional Etiquette**: Etiquette at Dining, Involuntary Awkward Actions, How to Network, Networking Etiquette, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, interview Etiquette, Dressing Etiquettes : for interview, offices and social functions.

References Books:

1. Ghillyer, "Business Ethics Now", 3rd Edition, McGraw-Hill.
2. George Reynolds, "Ethics in information Technology", Cengage Learning, ISBN- 10:1285197151.
3. Charles E Harris, Micheat J. Rabins, "Engineering Ethics", Cengage Learning, ISBN- 13:978-1133934684,4th Edition.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	3	1	2	-	2
CO2	-	-	-	-	-	1	1	3	1	2	-	2
CO3	-	-	-	-	-	1	1	3	1	2	-	2
CO4	-	-	-	-	-	1	1	3	1	2	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(C): Learn New Skills- Full Stack Developer

Home

Prerequisites: Programming Skills

Course Objectives:

- To understand the fundamental concepts in designing web based applications and applying frontend and backend technologies
- To understand the fundamental concepts in applying database techniques in application
- To progress the student towards term "industry ready engineer"

Course Outcomes:

On completion of the course, learners will be able to

CO1: Design and develop web application using frontend and backend technologies.
CO2: Design and develop dynamic and scalable web applications
CO3: Develop server side scripts
CO4: Design and develop projects applying various database techniques

Course Contents

Full stack Developer

1. HTML5
2. CSS3
3. Bootstrap
4. Vanilla JS (ES6+)
5. Flask or Django
6. Wagtail CMS
7. Node.js
8. MySQL
9. jQuery

Team Projects: Design and develop an e-commerce a dynamic, scalable and responsive web application. (Sample Project similar problem statements and be formulated).

Reference Books:

1. Laura Lemay, Rafe Colburn and Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing", SAMS, BPB Publications
2. DT Editorial Services " HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)" 2Ed , Dreamtech Press.

Note: **This is sample contents for Software Development Using Agility Approach, however the course instructor may design suitable course giving opportunity to the students for learning new skills.**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	3	3	1	1	1	1	1	1	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1	1	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(D): Engineering Economics

Engineering economics is one of the most practical subject matters in the engineering curriculum, but it is an always challenging, ever-changing discipline. Engineers are planners and builders. They are also problem solvers, manager, decision makers. Engineering economics touches of these activities.

Course Objectives:

Home

- To understand engineering economics and money management
- To understand financial project analysis
- To estimate project cost and apply for business
- To understand making financial decisions when acting as team member or manager in the engineering project

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand economics, the cost money and management in engineering

CO2: Analyze business economics and engineering assets evaluation

CO3: Evaluate project cost and its elements for business

CO4: Develop financial statements and make business decisions

Course Contents

1. **Understanding money and its management**: Engineering Economic Decisions, Time value of money, Money management, Equivalence calculations.
2. **Evaluating business and engineering assets**: Present worth analysis, Annual equivalence Analysis, Rate of Return Analysis, Benefit Cost Analysis.
3. **Development project cash flow**: Accounting of Income Taxes, Project cash flow Analysis, Handling Project Uncertainty.
4. **Special topics in Engineering Economics**: Replacement decisions, understanding financial statements.

Reference Books :

1. Chan S Park, "Fundamentals of Engineering Economics", Pearson, ISBN-13: 9780134870076
2. James Riggs, "Engineering Economics", Tata McGraw-Hill, ISBN – 13: 9780070586703

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	1	-	-	-	-	-	2	2	3	1
CO2	1	1	1	-	-	-	-	-	2	2	3	1
CO3	1	1	1	-	-	-	-	-	2	2	3	1
CO4	1	1	1	-	-	-	-	-	2	2	3	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(E): Foreign Language (Japanese)-Module 3

Home

Prerequisites: We recommend that candidates should have previously completed AC3-V(210251) and AC4-V (210260)

Course Objectives:

- To open up more doors and job opportunities
- To introduce to Japanese society, culture and entertainment

Course Outcomes:

On completion of the course, learners will be able to

CO1: Apply language to communicate confidently and clearly in the Japanese language
CO2: Understand and use Japanese script to read and write
CO3: Apply knowledge for next advance level reading, writing and listening skills
CO4: Develop interest to pursue further study, work and leisure

Course Contents

1. The Kanji: Brief Historical Outline, Introduction to Kanji, From Pictures to characters
2. Read and Write 58 Kanji Characters, talk about yourself/family/others, things, time, events, and activities-in the present, future, and past tense; shop at stores and order food at restaurants;
3. Lessons: Karate, Park(Playground), The Grandpa's Inaka, The Sun and the Moon, My little sister, Rice Fields, My Teacher, People who Exit and People who Enter.

Reference Books :

1. Japanese Kanji and Kana, “A complete guide to the Japanese writing system”, Wolfgang Hadamitzky & Mark Spahn, Tuttle Publishing, Third edition ISBN: 978-1-4629-1018-2(eBook)
2. Banno, Eri, Yoko Ikeda, et al. Genki I, “An Integrated Course in Elementary Japanese”, 2nd ed. Japan Times/Tsai Fong Books, 2011. ISBN: 9784789014403.
3. Anna Sato and Eriko Sato, “My First Japanese Kanji Book, Learning kanji the fun and easy way”, TUTTLE PUBLISHING, First Edition ISBN: 978-1-4629-1369-5 (eBook)

@The CO-PO Mapping Matrix

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Semester VI

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310251: Data Science and Big Data Analytics

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Database Management Systems (310341)

Companion Course: Data Science and Big Data Analytics Laboratory (310256)

Course Objectives:

- To understand the need of Data Science and Big Data
- To understand computational statistics in Data Science
- To study and understand the different technologies used for Big Data processing
- To understand and apply data modeling strategies
- To learn Data Analytics using Python programming
- To be conversant with advances in analytics

Course Outcomes:

After completion of the course, learners should be able to

CO1: Analyze needs and challenges for Data Science Big Data Analytics
CO2: Apply statistics for Big Data Analytics
CO3: Apply the lifecycle of Big Data analytics to real world problems
CO4: Implement Big Data Analytics using Python programming
CO5: Implement data visualization using visualization tools in Python programming
CO6: Design and implement Big Databases using the Hadoop ecosystem

Course Contents

Unit I	Introduction to Data Science and Big Data	07 Hours

Basics and need of Data Science and Big Data, Applications of Data Science, Data explosion, 5 V's of Big Data, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data Science Life Cycle, Data: Data Types, Data Collection. Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, Data Discretization.

#Exemplar/Case Studies	Create academic performance dataset of students and perform data pre-processing using techniques of data cleaning and data transformation.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Statistical Inference	07 Hours

Need of statistics in Data Science and Big Data Analytics**, Measures of Central Tendency**: Mean, Median, Mode, Mid-range. **Measures of Dispersion**: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.

#Exemplar/Case Studies	For an employee dataset, create measure of central tendency and its measure of dispersion for statistical analysis of given data.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Big Data Analytics Life Cycle	07 Hours

Introduction to Big Data, sources of Big Data, **Data Analytic Lifecycle**: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operation alize.

Home

#Exemplar/Case Studies	Case study: Global Innovation Social Network and Analysis (GINA).	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Predictive Big Data Analytics with Python**	**07 Hours**
Introduction, Essential Python Libraries, Basic examples. **Data Preprocessing**: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data. Analytics Types: Predictive, Descriptive and Prescriptive. **Association Rules**: Apriori Algorithm, FP growth. **Regression**: Linear Regression, Logistic Regression. **Classification**: Naïve Bayes, Decision Trees. **Introduction to Scikit-learn**, Installations, Dataset, mat plotlib, filling missing values, Regression and Classification using Scikit-learn.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply data preprocessing methods	
***Mapping of Course Outcomes for Unit IV**	CO4,CO2	
Unit V	**Big Data Analytics and Model Evaluation**	**07 Hours**
Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis. **Introduction to Text Analysis**: Text-preprocessing, Bag of words, TF-IDF and topics. Need and Introduction to social network analysis, Introduction to business analysis. **Model Evaluation and Selection**: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Clustering and Time-series analysis using Scikit-learn, sklearn. metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply K-means clustering methods	
***Mapping of Course Outcomes for Unit V**	CO4, CO2	
Unit VI	**Data Visualization and Hadoop**	**07 Hours**
Introduction to Data Visualization, Challenges to Big data visualization, Types of data visualization, Data Visualization Techniques, Visualizing Big Data, Tools used in Data Visualization, Hadoop ecosystem, Map Reduce, Pig, Hive, Analytical techniques used in Big data visualization. **Data Visualization using Python:** Line plot, Scatter plot, Histogram, Density plot, Box- plot.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and plot 2D views of the dataset	
***Mapping of Course Outcomes for Unit VI**	CO5, CO6	

Learning Resources

Text Books:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publication, 2012, ISBN0-07-120413-X
2. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807

Reference Books :

1. EMC Education Services, "Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data"
2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition
3. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press, (2020), ISBN : ISBN 978-1-108-47244-9
4. Wes McKinney, "Python for Data Analysis ", O' Reilly media, ISBN: 978-1-449-31979-3
5. Trent Hauk, "Scikit-learn Cookbook", Packt Publishing, ISBN: 9781787286382

6. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", OReilly Media, Inc., ISBN: 9781491913703
7. Venkat Ankam,"Big Data Analytics", Packt Publishing, ISBN: 9781785884696
8. Seema Acharya, Subhashini Chellappan, "Big Data And Analytics", Wiley publi ISBN: 9788126579518

Home

e-Books :

- An Introduction to Statistical Learning by Gareth James
  https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
- Python Data Science Handbook by Jake VanderPlas
  https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
- Introducing Data Science by Davy Ciele, Manning Publications
- Introducing Data Science [PDF]
- Handbook for visualizing : a handbook for data driven design by Andy krik
- A Handbook for Data Driven Design
- An introduction to data Science :
  https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1
- Hadoop Tutorial :
  https://www.tutorialspoint.com/hadoop/hadoop_tutorial.pdf?utm_source=7_&utm_medium=affiliate&utm_content=5f34cd37cdf1050001b09537&utm_campaign=Admitad&utm_term=761c575424fc4a6b48d02f72157eb578
- Learning with Python; How to think like a computer scientist:
  http://openbookproject.net/thinkcs/python/english3e/
- Python for everybody:
  http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
- Scikit Learn Tutorial
  https://scikit-learn.org/stable/

MOOCs Courses links:

- Computer Science and Engineering - NOC:Data Science for Engineers
- Computer Science and Engineering - NOC:Python for Data Science
- Computer Science and Engineering - NOC:Data Mining
- Computer Science and Engineering - NOC:Big Data Computing
- Big Data Computing - Course

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	1	-	-	-	-	1	-	-	1
CO2	1	2	1	2	-	1	-	-	1	-	-	1
CO3	2	1	2	1	-	1	-	-	1	-	-	1
CO4	1	2	2	2	2	-	-	-	1	-	-	1
CO5	1	2	2	1	2	-	-	-	1	-	-	1
CO6	1	2	1	2	2	-	-	-	1	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310252: Web Technology

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory : 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Database Management Systems (310341), Computer Networks and Security (310244)

Companion Course: Web Technology Laboratory (310257)

Course Objectives:

- To learn the fundamentals of web essentials and markup languages
- To use the Client side technologies in web development
- To use the Server side technologies in web development
- To understand the web services and frameworks

Course Outcomes:

On completion of the course, learners should be able to

CO1: Implement and analyze behavior of web pages using HTML and CSS
CO2: Apply the client side technologies for web development
CO3: Analyze the concepts of Servlet and JSP
CO4: Analyze the Web services and frameworks
CO5: Apply the server side technologies for web development
CO6: Create the effective web applications for business functionalities using latest web development platforms

Course Contents

Unit I	Web Essentials and Mark-up language- HTML	07 Hours

The Internet, basic internet protocols, the World Wide Web, HTTP Request message, HTTP response message, web clients, web servers.**HTML**: Introduction, history and versions.**HTML elements**: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. **CSS**: Introduction to Style Sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap.

#Exemplar/Case Studies	Create a style sheet suitable for blogging application using HTML and using style sheet
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Client Side Technologies: JavaScript and DOM	07 Hours

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. **DOM**: Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

#Exemplar/Case Studies	Enhancement in created blogging application using JavaScript (Add Entry feature)
*Mapping of Course Outcomes for Unit II	CO2

Unit III	Java Servlets and XML	07 Hours
Servlet: Servlet architecture overview, A "Hello World" servlet, Servlets generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. **XML**: XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. **AJAX**: Introduction, Working of AJAX.		
#Exemplar/Case Studies	Develop server-side code for blogging application	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**JSP and Web Services**	**07 Hours**
JSP: Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. **Web Services**: Web Service concepts, Writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. **Struts**: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.		
#Exemplar/Case Studies	Transform the blogging application from a loose collection of various resources (servlets, HTML documents, etc.) to an integrated web application that follows the MVC paradigm	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**Server Side Scripting Languages**	**07 Hours**
PHP: Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. **Introduction to ASP.NET**: Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS.		
#Exemplar/Case Studies	Use of PHP in developing blogging application.	
***Mapping of Course Outcomes for Unit V**	CO5, CO6	
Unit VI	**Ruby and Rails**	**07 Hours**
Introduction to Ruby: Origins & uses of Ruby, scalar types and their operations, simple input and output, control statements, fundamentals of arrays, hashes, methods, classes, code blocks and iterators, pattern matching. **Introduction to Rails**: Overview of Rails, Document Requests, Processing Forms, Rails Applications and Databases, Layouts, Rails with Ajax. Introduction to EJB.		
#Exemplar/Case Studies	Study of dynamic web product development using ruby and rails	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035

2. Robert W. Sebesta,“ Programming the World Wide Web”, 4th Edition, Pearson education, 2008

Reference Books :

1. Marty Hall, Larry Brown, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, “The web Warrior Guide to Web Programming”, Thomson, 2003.

e-Books :

- https://www.w3.org/html/
- HTML, The Complete Reference http://www.htmlref.com/
- http://w3schools.org/
- http://php.net/
- https://jquery.com/
- https://developer.mozilla.org/en-US/docs/AJAX
- http://www.tutorialspoint.com/css/

MOOCs Courses link:

- http://www.nptelvideos.in/2012/11/internet-technologies.html
- https://freevideolectures.com/course/2308/internet-technology/25video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
- https://www.digimat.in/nptel/courses/video/106105191/L01.html
- http://www.nptelvideos.com/php/php_video_tutorials.php

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	1	1	2	1	1	-	-	-	-	-	-	-
CO2	-	2	1	3	1	-	-	-	1	-	-	-
CO3	2	-	2	1	-	1	-	-	-	-	1	-
CO4	1	3	1	2	2	1	-	1	-	-	-	1
CO5	1	1	2	-	3	-	1	1	-	1	-	-
CO6	2	1	-	2	1	1	-	1	-	-	-	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310253: Artificial Intelligence

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week[$$]		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Programming and Problem solving (110005),
Data Structures and Algorithms (210252)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks
- To understand Problem Solving using various peculiar search strategies for AI
- To understand multi-agent environment in competitive environment
- To acquaint with the fundamentals of knowledge and reasoning
- To devise plan of action to achieve goals as a critical part of AI
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

After completion of the course, students should be able to

CO1: Identify and apply suitable Intelligent agents for various AI applications

CO2: Build smart system using different informed search / uninformed search or heuristic approaches

CO3: Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem

CO4: Apply the suitable algorithms to solve AI problems

CO5: Implement ideas underlying modern logical inference systems

CO6: Represent complex problems with expressive yet carefully constrained language of representation

Course Contents

Unit I	Introduction	07 Hours
Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents.		
#Exemplar/Case Studies	Kroger: How This U.S. Retail Giant Is Using AI And Robots To Prepare For The 4th Industrial Revolution	
*Mapping of Course Outcomes for Unit I	CO1, CO4	
Unit II	**Problem-solving**	**07 Hours**
Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.		
#Exemplar/Case Studies	4th Industrial Revolution Using AI, Big Data And Robotics	
*Mapping of Course Outcomes for Unit II	CO2, CO4	

Unit III	Adversarial Search and Games	07 Hours
Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs.		
#Exemplar/Case Studies	Machine Learning At Google: The Amazing Use Case Of Becoming A Fully Sustainable Business	
***Mapping of Course Outcomes for Unit III**	CO3, CO4	
Unit IV	**Knowledge**	**07 Hours**
Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.		
#Exemplar/Case Studies	BBC To Launch AI - Enabled Interactive Radio Show For Amazon Echo And Google Home Chat bots	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**Reasoning**	**07 Hours**
Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information		
#Exemplar/Case Studies	The Amazing Ways How Wikipedia Uses Artificial Intelligence	
***Mapping of Course Outcomes for Unit V**	CO4, CO5	
Unit VI	**Planning**	**07 Hours**
Automated Planning, Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches, Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.		
#Exemplar/Case Studies	The Amazing Ways Samsung Is Using Big Data, Artificial Intelligence And Robots To Drive Performance	
***Mapping of Course Outcomes for Unit VI**	CO4, CO6	

Learning Resources

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, "Artificial Intelligence, As per AICTE: Making a System Intelligent", Wiley publication, ISBN: 9788126579945

e-Books :

- https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf
- https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf
- http://aima.cs.berkeley.edu/

MOOCs Courses link:

- https://nptel.ac.in/courses/106/102/106102220/
- https://nptel.ac.in/courses/106/105/106105077/
- https://nptel.ac.in/courses/106/105/106105078/
- https://nptel.ac.in/courses/106/105/106105079/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	-	-	1	3	-	2	-	-
CO2	1	3	3	2	3	1	-	3	1	2	-	-
CO3	3	2	2	2	1	1	1	-	-	2	-	-
CO4	1	2	2	1	-	-	1	3	1	2	-	-
CO5	1	2	2	1	-	-	1	3	1	2	-	-
CO6	1	2	2	1	-	-	1	3	1	2	-	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(A): Information Security

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: --Computer Networks and Security (310244)

Companion Course: --Laboratory Practice II (310258)

Course Objectives:

- To understand the fundamental approaches, principles and apply these concepts in Information Security
- To acquire the knowledge of mathematics for cryptography, understand the concepts of basic cryptography
- To learn standard algorithms and protocols employed to provide confidentiality, integrity and authenticity
- To acquire the knowledge of security protocol deployed in web security
- To study Information Security tools

Course Outcomes:

On completion of the course, learners should be able to

CO1: Model the cyber security threats and apply formal procedures to defend the attacks

CO2: Apply appropriate cryptographic techniques by learning symmetric and asymmetric key cryptography

CO3: Design and analyze web security solutions by deploying various cryptographic techniques along with data integrity algorithms

CO4: Identify and Evaluate Information Security threats and vulnerabilities in Information systems and apply security measures to real time scenarios

CO5: Demonstrate the use of standards and cyber laws to enhance Information Security in the development process and infrastructure protection

Course Contents

Unit I	Introduction to Information Security	05 Hours

Foundations of Security, Computer Security Concepts, The OSI Security Architecture, Security attacks, Security services, Security mechanism, A Model for Network Security.

#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: Clam AV antivirus engine, Anti Phishing, Anti Spyware, Wireshark
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Symmetric Key Cryptography	07 Hours

Classical Encryption Techniques: Stream Ciphers, Substitution Techniques: Caesar Cipher, Mono alphabetic Ciphers, Play fair Cipher, Hill Cipher, Poly alphabetic Ciphers, Transposition Techniques, Block Ciphers and Data Encryption standards, 3DES, Advanced Encryption standard

#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: crypt tool
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Asymmetric Key Cryptography	07 Hours

Number theory: Prime number, Fermat and Euler theorems , Testing for primality, Chinese reminder theorem, discrete logarithm, Public Key Cryptography and RSA, Key Management, Diffie-Hellman key exchange, El Gamal algorithm, Elliptic Curve Cryptography		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: crypt tool	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**Data Integrity Algorithms And Web Security**	**09 Hours**
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, MD4, MD5. **Message Authentication Codes**: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs. **Digital Signatures**: Digital Signatures, Schemes, Digital Signature standard, PKI X.509 Certificate. Web Security issues, HTTPS, SSH, Email security: PGP, S/MIME, IP Security : IPSec		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: Open SSL, Hash Calculator Tool : MD5, SHA1, SHA256, SHA 512	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Network and System Security**	**07 Hours**
The OSI Security architecture, Access Control, Flooding attacks, DOS, Distributed DOS attacks Intrusion detection, Host based and network based Honeypot, Firewall and Intrusion prevention system, Need of firewall, Firewall characteristics and access policy, Types of Firewall, DMZ networks, **Intrusion prevention system:** Host based, Network based, Hybrid. Operating system Security, Application Security, Security maintenance, Multilevel Security, Multilevel Security for role based access control, Concepts of trusted system, Trusted computing.		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: DOS Attacks, DDOS attacks, Wireshark, Cain and Abel, iptables/ Windows Firewall, Suricata, fail2ban, Snort.	
***Mapping of Course Outcomes for Unit V**	CO4	
Unit VI	**Cyber Security and Tools**	**07 Hours**
Introduction, Cybercrime and Information Security, Classification of Cybercrimes, The legal perspectives-Indian perspective, Global perspective, Categories of Cybercrime, Social Engineering, Cyber stalking, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and Cybercrime Scenario in India, Indian IT Act.		
#Exemplar/Case Studies	Study of any two network security scanners: Nmap, Metasploit, Open VAS, Aircrack,Nikito,Samurai,Safe3etc.	
***Mapping of Course Outcomes for Unit VI**	CO5	
Learning Resources		

Text Books :

1. William Stallings, “Cryptography and Network Security Principals and Practice”, Seventh edition, Pearson , ISBN : 978-1-292-15858
2. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, 3rd_Edition, Pearson , ISBN : 978-0-13-3777392-7
3. Nina Godbole, Sumit Belapure, “Cyber Security”, Wiley, ISBN: 978-81-265-2179-1

Reference Books :

1. Atul Kahate, “Cryptography and Network Security”, 3e, McGraw Hill Education
2. V.K. Pachghare, “Cryptography and Information Security”, PHI Learning
3. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning India, 2014, ISBN No.: 8131513491
4. JoshephKizza, “Computer Network Security and Cyber Ethics”, McFarland & Company, Inc., Publishers , Fourth Edition
5. Michael Whitman and Herbert Matford, “Principles of Information Security”, Course Technnology Ink, 7th edition
6. Neena Godbole, “Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices” , Wiley publication, ISBN: 9788126564057

e-Books :

- Introduction to Cyber Security, “http://www.uou.ac.in/sites/default/files/slm/FCS.pdf “, by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani
- “Information Security, The complete reference”, Second Edition, Mark Rhodes-Ousley, McGrawHill

MOOCs Courses link:

- NPTEL course on https://nptel.ac.in/courses/106/106/106106129/(IIT Madras, Prof. V.Kamakoti)
- Introduction to cyber security, “https://swayam.gov.in/nd2_nou19_cs08/preview” by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	2	-	1	-	-	-	1
CO2	3	3	2	3	-	2	-	-	-	-	-	-
CO3	3	3	2	3	-	2	-	-	-	1	-	-
CO4	3	3	2	2	-	-	1	-	-	-		-
CO5	3	2	1	2	-	2	1	2	-	1	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(B): Augmented and Virtual Reality

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Graphics (210244)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand fundamentals of augmented and virtual reality
- To describe various elements and components used in AR/VR Hardware and Software
- To understand the methods used for representing and rendering the virtual world
- To create Augmented Reality application that allows users to interact with the immersive 3D world

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the basics of Augmented and Virtual reality systems and list their applications

CO2: Describe interface to the Virtual World with the help of input and output devices

CO3: Explain representation and rendering system in the context of Virtual Reality

CO4: Analyze manipulation, navigation and interaction of elements in the virtual world

CO5: Summarize the basic concepts and hardware of Augmented Reality system

CO6: Create Mobile Augmented Reality using Augmented Reality techniques and software

Course Contents

Unit I	Introduction	06 Hours

Virtual Reality (VR): Introduction, Key Elements of VR, Experience, History, Applications. **Augmented Reality (AR)**: Introduction, History, Key Aspects, and Applications.

#Exemplar/Case Studies	Timeline of evolution of AR from VR and Case study of a single application using both VR and AR technologies
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Interface to the Virtual World	08 Hours

Input: User Monitoring, Position Tracking, Body Tracking, Physical input Devices, Speech Recognition (Audio Input) and World Monitoring: Persistent Virtual Worlds, Bringing the Real World into the Virtual World.

Output:

Visual Displays: Properties of Visual Displays, Monitor-basedor Fishtank-VR, Projection-based VR, Head-based VR, See-through Head-based Displays, Handheld VR.

Aural Displays: Properties of Aural Displays, Head-based Aural Displays- Headphones, Stationary Aural Displays-Speakers.

Haptic Displays: Properties of Haptic Displays, Tactile Haptic Displays, End-effector Displays, Robotically Operated Shape Displays, Vestibular and Other Senses.

#Exemplar/Case Studies	Study the use of Virtual Reality at NASA

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Representing and Rendering the Virtual World**	**08 Hours**

Representation of the Virtual World: Visual Representation in Virtual Reality, Aural Representation and Haptic Representation in Virtual Reality.
Rendering Systems:
Visual Rendering Systems: Visual Rendering Methods, Geometrically Based Rendering Systems, Non-geometric Rendering Systems, Rendering Complex Visual Scenes, Computer Graphics System Requirements.
Aural Rendering Systems: Visual Rendering Methods, Rendering Complex Sounds, Sound-Generation Hardware, Internal Computer Representation.
Haptic Rendering Systems : Haptic Rendering Methods, Rendering Complex Haptic Scenes with Force Displays, Haptic Rendering Techniques.

#Exemplar/Case Studies	GHOST (General Haptics Open Software Toolkit) software development toolkit.
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Interacting with the Virtual World and Virtual Reality Experience**	**07 Hours**

User Interface Metaphors, Manipulating a Virtual World, Properties of Manipulation, Manipulation Operations, Navigating in a Virtual World-Way finding and Travelling, Classes of Travel Methods Interacting with Others-Shared Experience, Collaborative Interaction, Interacting with the VR System, Immersion, Rules of the Virtual World: Physics, Substance of the Virtual World.

#Exemplar/Case Studies	Side effects of using VR systems/ VR sickness and Study of Iterative design of any VR game.
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Augmented Reality**	**06 Hours**

Concepts: Computer Graphics, Dimensionality, Depth Cues, Registration and Latency, Working of Augmented Reality, Augmented Reality Hardware (Sensors, Processors, Displays), Ingredients of an AR Experience.

#Exemplar/Case Studies	Augmented Reality (AR) and Virtual Reality (VR) headsets mainly find applications in gaming, movies, and other forms of entertainment. French startup Lynx has manufactured a standalone Mixed Reality (MR) headset for entertainment, medical, industrial, and defense applications. Analyze the technical specifications of Lynx – Mixed Reality Headset
***Mapping of Course Outcomes for Unit V**	CO1, CO5

Unit VI	**Augmented Reality Software and Mobile Augmented Reality**	**07 Hours**

Augmented Reality Systems, Software Components, Software Tools for Content Creation, Interaction in Augmented Reality, **Augmented Reality Techniques**: Marker based and Marker less tracking, Mobile Augmented Reality.

#Exemplar/Case Studies	Case study of Google Maps AR navigation and its use
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics), Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086

Reference Books:

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
4. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

e-Books :

- http://lavalle.pl/vr/book.html
- https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf

MOOC Courses link:

- https://nptel.ac.in/courses/106/106/106106138/
- https://www.coursera.org/learn/introduction-virtual-reality
- https://www.coursera.org/learn/ar

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	1	2	-	-	-	-	-	-	1
CO4	1	2	2	-	2	-	-	-	-	-	-	1
CO5	1	1	2	2	1	-	-	-	-	-	-	2
CO6	1	2	2	2	3	-	-	-	-	-	-	2

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(C): Cloud Computing

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks and Security(310244), Distributed Systems (310245C)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To study fundamental concepts of cloud computing
- To learn various data storage methods on cloud
- To understand the implementation of Virtualization in Cloud Computing
- To learn the application and security on cloud computing
- To study risk management in cloud computing
- To understand the advanced technologies in cloud computing

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the different Cloud Computing environment
CO2: Use appropriate data storage technique on Cloud, based on Cloud application
CO3: Analyze virtualization technology and install virtualization software
CO4: Develop and deploy applications on Cloud
CO5: Apply security in cloud applications
CO6: Use advance techniques in Cloud Computing

Course Contents

Unit I	Introduction to Cloud Computing	07 Hours

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. **Cloud Service Models**: SaaS, PaaS, IaaS, Storage. **Cloud Architecture**: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.

#Exemplar/Case Studies	Cloud Computing Model of IBM
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Data Storage and Cloud Computing	07 Hours

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. **Cloud Storage**: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. **Cloud Storage from LANs to WANs**: Cloud Characteristics, Distributed Data Storage.

#Exemplar/Case Studies	Online Book Marketing Service, Online Photo Editing Service

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Virtualization in Cloud Computing**	**07 Hours**
Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. **Grid, Cloud and Virtualization**: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. **Virtualization and Cloud Computing**: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.		
#Exemplar/Case Studies	Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Cloud Platforms and Cloud Applications**	**07 Hours**
Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).**Microsoft Cloud Services:** Azure core concepts, SQL Azure, Windows Azure Platform Appliance. **Cloud Computing Applications:** Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.		
#Exemplar/Case Studies	Multiplayer Online Gaming	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Security in Cloud Computing**	**07 Hours**
Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. **Data Security in Cloud**: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. **Cloud Security Services**: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.		
#Exemplar/Case Studies	Cloud Security Tool: Acunetix.	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Advanced Techniques in Cloud Computing**	**07 Hours**
Future Tends in cloud Computing, Mobile Cloud, **Automatic Cloud Computing**: Comet Cloud. **Multimedia Cloud**: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. **IOT and Cloud Convergence**: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.		
#Exemplar/Case Studies	Case studies on Dev Ops: DocuSign, Forter, Gengo.	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books :

1. A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0

Reference Books :

1. James Bond ,"The Enterprise Cloud", O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
4. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications", Cambridge University Press, ISBN: 9780511778476
5. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
6. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
7. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication, ISBN:

e-Books :

- https://sjceodisha.in/wp-content/uploads/2019/09/CLOUD-COMPUTING-Principles-and-Paradigms.pdf
- https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf
- https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf
- https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf

MOOCs Courses link:

- Cloud Computinghttps://onlinecourses.nptel.ac.in/noc21_cs14/preview?
- Cloud Computing and Distributed System: https://onlinecourses.nptel.ac.in/noc21_cs15/preview?
- https://www.digimat.in/nptel/courses/video/106105167/L01.html
- https://www.digimat.in/nptel/courses/video/106105167/L03.html
- https://www.digimat.in/nptel/courses/video/106105167/L20.html

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	-	-	-	-	-	-	-	-	1
CO2	1	2	1	-	-	-	-	-	-	-	-	-
CO3	1	2	1	-	2	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	1
CO5	1	2	2	2	-	-	-	-	-	-	-	-
CO6	1	2	2	1	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(D): Software Modeling and Architecture

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Object Oriented Programming (210243), Software Engineering (210253)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand and apply Object Oriented concept for designing Object Oriented based model or application
- To transform Requirement document to appropriate design
- To acquaint with the interaction between quality attributes and software architecture
- To understand different architectural designs, transform them into proper model and document them
- To understand software architecture with case studies and explore with examples, use of design pattern application

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application

CO2: Design and analyze an application using UML modeling as fundamental tool

CO3: Evaluate software architectures

CO4: Use appropriate architectural styles and software design patterns

CO5: Apply appropriate modern tool for designing and modeling

Course Contents

Unit I	Concepts of Software Modeling	07 Hours

Software Modeling: Introduction to Software Modeling, Advantages of modeling, Principles of modeling. **Evolution of Software Modeling and Design Methods**: Object oriented analysis and design methods, Concurrent, Distributed Design Methods and Real-Time Design Methods, Model Driven Architecture (MDA), 4+1 Architecture, Introduction to UML, UML building Blocks, COMET Use Case–Based Software Life Cycle. **Requirement Study**: Requirement Analysis, SRS design, Requirements Modeling. **Use Case**: Actor and Use case identification, Use case relationship (Include, Extend, Use case Generalization, Actor Generalization), Use case template.

#Exemplar/Case Studies	Requirement modeling and use case modeling for Real life applications (e.g., Online shopping system)
***Mapping of Course Outcomes for Unit I**	CO1, CO2

Unit II	Static Modeling	07 Hours

Study of classes (analysis level and design level classes). **Methods for identification of classes**: RUP (Rational Unified Process), CRC (Class, Responsibilities and Collaboration), Use of Noun Verb analysis (for identifying entity classes, controller classes and boundary classes). **Class Diagram**: Relationship between classes, Generalization/Specialization Hierarchy, Composition and Aggregation Hierarchies, Associations Classes, Constraints.

Object diagram, Package diagram, Component diagram, Composite Structure diagram, Deployment Diagram.

#Exemplar/Case Studies	UML Static Diagrams for Real life applications (e.g., Online shopping system).	
***Mapping of Course Outcomes for Unit II**	CO1 ,CO2	
Unit III	**Dynamic Modeling**	**07 Hours**
Activity diagram: Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins. **Interaction diagram**: Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.		
#Exemplar/Case Studies	UML dynamic Diagrams of for Real life applications.	
***Mapping of Course Outcomes for Unit III**	CO1 ,CO2	
Unit IV	**Software Architecture and Quality Attributes**	**07 Hours**
Introduction to Software Architecture, Importance of Software Architecture, Architectural Structure and Views. **Architectural Pattern**: common module, Common component-and-connector, Common allocation. **Quality Attributes**: Architecture and Requirements, Quality Attributes and Considerations		
#Exemplar/Case Studies	Case study of any real-life application	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Architectural Design and Documentation**	**07 Hours**
Architecture in the Life Cycle: Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture. **Documenting Software Architecture**: Notations, Choosing and Combining views, Building the documentation Package, Documenting Behavior, Documenting Architecture in an Agile Development Project.		
#Exemplar/Case Studies	Air Traffic Control.	
***Mapping of Course Outcomes for Unit V**	CO4 , CO5	
Unit VI	**Design Patterns**	**07 Hours**
Design Patterns: Introduction, Different approaches to select Design Patterns. **Creational patterns**: Singleton, Factory, Structural pattern: Adapter, Proxy. **Behavioral Patterns**: Iterator, Observer Pattern with applications.		
#Exemplar/Case Studies	Flight Simulation	
***Mapping of Course Outcomes for Unit VI**	CO4, CO5	
Learning Resources		

Text Books :

1. Jim Arlow, Ila Neustadt, “UML 2 and the unified process –practical object-oriented analysis and design”, Addison Wesley, Second edition, ISBN 978-0201770605.
2. Len Bass, Paul Clements, Rick Kazman, “Software Architecture in Practice”, Second Edition, Pearson ,ISBN 978-81-775-8996-2
3. Erich Gamma, “Design Patterns”, Pearson, ISBN 0-201-63361-2.

Reference Books :

1. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures", Cambridge University Press, 2011, ISBN 978-0-521-76414-8
2. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562
3. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

e-Books :

- https://ebookpdf.com/roger-s-pressman-software-engineering
- https://dhomaseghanshyam.files.wordpress.com/2016/02/gomaa-softwaremodellinganddesign.pdf
- https://balu051989.files.wordpress.com/2011/06/the-unified-modeling-language-user-guide-by-grady-booch-james-rumbaugh-ivar-jacobson.pdf
- http://index-of.co.uk/Engineering/Software%20Engineering%20(9th%20Edition).pdf)

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105224/
- https://onlinecourses.nptel.ac.in/noc20_cs59/preview
- https://onlinecourses.nptel.ac.in/noc20_cs84/preview

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	-	3	-	-	-	-	-	-	1
CO2	1	1	3	-	3	-	-	-	-	-	-	1
CO3	1	1	2	1	2	-	-	-	-	-	-	1
CO4	1	1	3	2	3	-	-	-	-	-	-	1
CO5	1	1	3	-	3	-	-	-	-	-	-	2

Savitribai Phule Pune University Third Year of Computer Engineering (2019 Course) 310255: Internship**		Home
Teaching Scheme: **	**Credit:** 04	**Examination Scheme:** **Term work:** 100 Marks

Course Objectives:

Internship provides an excellent opportunity to learner to see how the conceptual aspects learned in classes are integrated into the practical world. Industry/on project experience provides much more professional experience as value addition to classroom teaching.

- To encourage and provide opportunities for students to get professional/personal experience through internships.
- To learn and understand real life/industrial situations.
- To get familiar with various tools and technologies used in industries and their applications.
- To nurture professional and societal ethics.
- To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

Course Outcomes:

On completion of the course, learners should be able to

CO1: To demonstrate professional competence through industry internship.
CO2: To apply knowledge gained through internships to complete academic activities in a professional manner.
CO3: To choose appropriate technology and tools to solve given problem.
CO4: To demonstrate abilities of a responsible professional and use ethical practices in day to day life.
CO5: Creating network and social circle, and developing relationships with industry people.
CO6: To analyze various career opportunities and decide carrier goals.

** Guidelines:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:

Internship is to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

Internship work Identification:

Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO’s/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry[1].

Students must register at Internshala [2]. Students must get Internship proposals sanctioned from college authority well in advance. Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination and before academic schedule of semester VI.

Student can take internship work in the form of the following but not limited to:

- Working for consultancy/ research project,
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute /
- Learning at Departmental Lab/Tinkering Lab/ Institutional workshop,
- Development of new product/ Business Plan/ registration of start-up,
- Industry / Government Organization Internship,
- Internship through Internshala,
- In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship,
- Research internship under professors, IISC, IIT's, Research organizations,
- NGOs or Social Internships, rural internship,
- Participate in open source development.

Internship Diary/ Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Work Evaluation:

Every student is required to prepare a maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks

Evaluation through Seminar Presentation/Viva-Voce at the Institute-

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Depth of knowledge and skills
- Communication & Presentation Skills
- Team Work
- Creativity
- Planning & Organizational skills
- Adaptability
- Analytical Skills
- Attitude & Behavior at work

- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Diary/Work book
- Student's Feedback from External Internship Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

Internship Diary/workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries
- Adequacy & quality of information recorded
- Data recorded
- Thought process and recording techniques used
- Organization of the information

The report shall be presented covering following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details- Company background-organization and activities/Scope and object of the study / Supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor(External and Internal)

Post internship, faculty coordinator should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership…..

Reference:

[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
[2] https://internship.aicte-india.org/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO3	-	-	-	-	-	1	-	-	2	2	1	1
CO4	2	-	-	-	-	2	2	3	-	1	-	2
CO5	-	-	-	-	-	1	2	1	1	1	2	1
CO6	-	-	-	-	-	1	-	-	2	1	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310256:Data Science and Big Data Analytics Laboratory

Home

Teaching Scheme Practical: 04 Hours/Week	Credit:02	Examination Scheme and Marks Term work: 50 Marks Practical: 25 Marks

Companion Course: Data Science and Big Data Analytics (310251)

Course Objectives:

- To understand principles of Data Science for the analysis of real time problems
- To develop in depth understanding and implementation of the key technologies in Data Science and Big Data Analytics
- To analyze and demonstrate knowledge of statistical data analysis techniques for decision-making
- To gain practical, hands-on experience with statistics programming languages and Big Data tools

Course Outcomes:

On completion of the course, learners will be able to

CO1: Apply principles of Data Science for the analysis of real time problems
CO2: Implement data representation using statistical methods
CO3: Implement and evaluate data analytics algorithms
CO4: Perform text preprocessing
CO5: Implement data visualization techniques
CO6: Use cutting edge tools and technologies to analyze Big Data

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

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Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

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The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A and B. Each student must perform 13 assignments (10 from group A, 3 from group B), 2 mini project from Group C

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - JAVA/Python/R/Scala

Virtual Laboratory:

- "Welcome to Virtual Labs - A MHRD Govt of india Initiative"
- http://cse20-iiith.vlabs.ac.in/List%20of%20Experiments.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A,B,C) are compulsory.

Sr. No.	Group A : Data Science
1.	**Data Wrangling, I** Perform the following operations using Python on any open source dataset (e.g., data.csv) 1. Import all the required Python Libraries. 2. Locate an open source data from the web (e.g. https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site). 3. Load the Dataset into pandas data frame. 4. Data Preprocessing: check for missing values in the data using pandas insult(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame. 5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions. 6. Turn categorical variables into quantitative variables in Python. In addition to the codes and outputs, explain every operation that you do in the above steps and explain everything that you do to import/read/scrape the data set.
2.	**Data Wrangling II** Create an "Academic performance" dataset of students and perform the following operations using Python. 1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them. 3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution. Reason and document your approach properly.

3.	**Descriptive Statistics - Measures of Central Tendency and variability** Perform the following operations on any open source dataset (e.g., data.csv) 1. Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each response to the categorical variable. 2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of ‘Iris-setosa’, ‘Iris-versicolor’ and ‘Iris-versicolor’ of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.
4.	**Data Analytics I** Create a Linear Regression Model using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through different parameters. There are 506 samples and 14 feature variables in this dataset. The objective is to predict the value of prices of the house using the given features.
5.	**Data Analytics II** 1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.
6.	**Data Analytics III** 1. Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.
7.	**Text Analytics** 1. Extract Sample document and apply following document preprocessing methods: Tokenization, POS Tagging, stop words removal, Stemming and Lemmatization. 2. Create representation of document by calculating Term Frequency and Inverse Document Frequency.
8.	**Data Visualization I** 1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data. 2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram.
9.	**Data Visualization II** 1. Use the inbuilt dataset 'titanic' as used in the above problem. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age') 2. Write observations on the inference from the above statistics.

10.	**Data Visualization III** Download the Iris flower dataset or any other dataset into a DataFrame. (e.g., https://archive.ics.uci.edu/ml/datasets/Iris). Scan the dataset and give the inference as: 1. List down the features and their types (e.g., numeric, nominal) available in the dataset. 2. Create a histogram for each feature in the dataset to illustrate the feature distributions. 3. Create a box plot for each feature in the dataset. 4. Compare distributions and identify outliers.
	Group B- Big Data Analytics – JAVA/SCALA (Any three)
1.	Write a code in JAVA for a simple Word Count application that counts the number of occurrences of each word in a given input set using the Hadoop Map-Reduce framework on local-standalone set-up.
2.	Design a distributed application using Map-Reduce which processes a log file of a system.
3.	Locate dataset (e.g., sample_weather.txt) for working on weather data which reads the text input files and finds average for temperature, dew point and wind speed.
4.	Write a simple program in SCALA using Apache Spark framework
	Group C- Mini Projects/ Case Study – PYTHON/R (Any TWO Mini Project)
1.	Write a case study on Global Innovation Network and Analysis (GINA). Components of analytic plan are 1. Discovery business problem framed, 2. Data, 3. Model planning analytic technique and 4. Results and Key findings.
2.	Use the following dataset and classify tweets into positive and negative tweets. https://www.kaggle.com/ruchi798/data-science-tweets
3.	Develop a movie recommendation model using the scikit-learn library in python. Refer dataset https://github.com/rashida048/Some-NLP-Projects/blob/master/movie_dataset.csv
4.	Use the following covid_vaccine_statewise.csv dataset and perform following analytics on the given dataset https://www.kaggle.com/sudalairajkumar/covid19-in-india?select=covid_vaccine_statewise.csv a. Describe the dataset b. Number of persons state wise vaccinated for first dose in India c. Number of persons state wise vaccinated for second dose in India d. Number of Males vaccinated d. Number of females vaccinated
5.	Write a case study to process data driven for Digital Marketing **OR** Health care systems with Hadoop Ecosystem components as shown. (Mandatory) ● HDFS: Hadoop Distributed File System ● YARN: Yet Another Resource Negotiator ● MapReduce: Programming based Data Processing ● Spark: In-Memory data processing ● PIG, HIVE: Query based processing of data services ● HBase: NoSQL Database (Provides real-time reads and writes) ● Mahout, Spark MLLib: (Provides analytical tools) Machine Learning algorithm libraries ● Solar, Lucene: Searching and Indexing
	Learning Resources

Reference Books :

1. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press,(2020), ISBN : ISBN 978-1-108-47244-9.
2. Wes McKinney, "Python for Data Analysis", O' Reilly media, ISBN : 978-1-449-31979-3.
3. "Scikit-learn Cookbook", Trent hauk,Packt Publishing, ISBN: 9781787286382
4. R Kent Dybvig, "The Scheme Programming Language", MIT Press, ISBN 978-0-262-51298-5.
5. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", OReilly Media, Inc.
6. Jake VanderPlas,"Python Data Science Handbook" https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
7. Gareth James, "An Introduction to Statistical Learning" https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
8. Cay S Horstmann, "Scala for the Impatient", Pearson, ISBN: 978-81-317-9605-4,
9. Alvin Alexander, "Scala Cookbook", O'Reilly, SPD,ISBN: 978-93-5110-263-2

Web Links:

- https://www.simplilearn.com/data-science-vs-big-data-vs-data-analytics-article
- https://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html
- https://www.edureka.co/blog/hadoop-ecosystem
- https://www.edureka.co/blog/mapreduce-tutorial/#mapreduce_word_count_example
- https://github.com/vasanth-mahendran/weather-data-hadoop
- https://spark.apache.org/docs/latest/quick-start.html#more-on-dataset-operations
- https://www.scala-lang.org/

MOOCs Courses link:

- https://nptel.ac.in/courses/106/106/106106212/
- https://onlinecourses.nptel.ac.in/noc21_cs33/preview
- https://nptel.ac.in/courses/106/104/106104189/
- https://onlinecourses.nptel.ac.in/noc20_cs92/preview

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	1	-	-	-	1	-	1	3
CO2	2	2	3	1	2	-	-	-	1	-	-	3
CO3	2	2	3	2	2	2	-	-	2	-	1	3
CO4	2	2	2	2	2	-	-	-	-	-	-	3
CO5	2	2	3	3	3	1	-	-	2	-	2	3
CO6	2	2	1	1	3	2	1	-	2	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310257:Web Technology Laboratory

Home

Teaching Scheme Practical: 02 Hours/Week	Credit: 01	Examination Scheme and Marks Term Work: 25 Marks Oral: 25 Marks

Companion Course : Web Technology (310252)

Course Objectives:

- To learn the web based development environment
- To use client side and server side web technologies
- To design and develop web applications using front end technologies and backend databases

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand the importance of website planning and website design issues

CO2: Apply the client side and server side technologies for web application development

CO3: Analyze the web technology languages, frameworks and services

CO4: Create three tier web based applications

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Oral Examination

Oral examination should be jointly conducted by the internal examiner and external examiner. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementations in term work. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Mini project should be implemented by the students in a group of 2-3 students.

Suggested List of Laboratory Experiments/Assignments
(All assignments are compulsory)

Sr. No.	Assignment Title
1.	Case study: Before coding of the website, planning is important, students should visit different websites (Min. 5) for the different client projects and note down the evaluation results for these websites, either good website or bad website in following format: <table><tr><th>Sr. No.</th><th>Website URL</th><th>Purpose of Website</th><th>Things liked in the website</th><th>Things disliked in the website</th><th>Overall evaluation of the website (Good/Bad)</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> From the evaluation, students should learn and conclude different website design issues, which should be considered while developing a website.
2.	Implement a web page index.htm for any client website (e.g., a restaurant website project) using following: a. HTML syntax: heading tags, basic tags and attributes, frames, tables, images, lists, links for text and images, forms etc. b. Use of Internal CSS, Inline CSS, External CSS
3.	Design the XML document to store the information of the employees of any business organization and demonstrate the use of: a) DTD b) XML Schema And display the content in (e.g., tabular format) by using CSS/XSL.
4.	Implement an application in Java Script using following: a) Design UI of application using HTML, CSS etc. b) Include Java script validation c) Use of prompt and alert window using Java Script e.g., Design and implement a simple calculator using Java Script for operations like addition, multiplication, subtraction, division, square of number etc. a) Design calculator interface like text field for input and output, buttons for numbers and operators etc. b) Validate input values c) Prompt/alerts for invalid values etc.
5.	Implement the sample program demonstrating the use of Servlet. e.g., Create a database table ebookshop (book_id, book_title, book_author, book_price, quantity) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using servlet.
6.	Implement the program demonstrating the use of JSP. e.g., Create a database table students_info (stud_id, stud_name, class, division, city) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using JSP.
7.	Build a dynamic web application using PHP and MySQL. a. Create database tables in MySQL and create connection with PHP. b. Create the add, update, delete and retrieve functions in the PHP web app interacting with MySQL database

8.	Design a login page with entries for name, mobile number email id and login button. Use struts and perform following validations a. Validation for correct names b. Validation for mobile numbers c. Validation for email id d. Validation if no entered any value e. Re-display for wrongly entered values with message f. Congratulations and welcome page upon successful entries
9.	Design an application using Angular JS. e.g., Design registration (first name, last name, username, password) and login page using Angular JS.
10.	Design and implement a business interface with necessary business logic for any web application using EJB. e.g., Design and implement the web application logic for deposit and withdraw amount transactions using EJB.
11.	**Mini Project**: Design and implement a dynamic web application for any business functionality by using web development technologies that you have learnt in the above given assignments.

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CO3	2	-	3	-	-	1	-	-	-	1	1	-
CO4	1	2	2	1	2	1	1	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310258:Laboratory Practice II

Home

Teaching Scheme	Credit: 02	Examination Scheme and Marks
Practical: 04 Hours/Week		Term Work: 50 Marks Practical: 25 Marks

Companion Course: Artificial Intelligence (310253), Elective II (310254)

Course Objectives:

- To learn and apply various search strategies for AI
- To Formalize and implement constraints in search problems
- To understand the concepts of Information Security / Augmented and Virtual Reality/Cloud Computing/Software Modeling and Architectures

Course Outcomes:

On completion of the course, learner will be able to

- **Artificial Intelligence**
  - **CO1:** Design a system using different informed search / uninformed search or heuristic approaches
  - **CO2:** Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning
  - **CO3:** Design and develop an interactive AI application
- **Information Security**
  - **CO4:** Use tools and techniques in the area of Information Security
  - **CO5:** Use the cryptographic techniques for problem solving
  - **CO6:** Design and develop security solution

OR

- **Augmented and Virtual Reality**
  - **CO4:** Use tools and techniques in the area of Augmented and Virtual Reality
  - **CO5:** Use the representing and rendering system for problem solving
  - **CO6:** Design and develop ARVR applications

OR

- **Cloud Computing**
  - **CO4:** Use tools and techniques in the area of Cloud Computing
  - **CO5:** Use cloud computing services for problem solving
  - **CO6:** Design and develop applications on cloud

OR

- **Software Modeling and Architectures**
  - **CO4:** Use tools and techniques in the area Software Modeling and Architectures
  - **CO5:** Use the knowledge of Software Modeling and Architectures for problem solving
  - **CO6:** Design and develop applications using UML as fundamental tool

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Operating System recommended :- 64-bit Windows OS and Linux

Programming tools recommended: -

Information Security : - C/C++/Java

Augmented and Virtual Reality :- Unity, C#, Blender, VRTK, ARTK, Vuforia

VR Devices: HTC Vive, Google Daydream and Samsung gear VR.

Software Modeling and Architectures:-Front end:HTML5, Bootstarp, JQuery, JS etc.

Backend: MySQL /MongoDB/NodeJS

Virtual Laboratory:

Software Modeling and Architectures : http://vlabs.iitkgp.ernet.in/se

Information Security : http://cse29-iiith.vlabs.ac.in

Part I : Artificial Intelligence

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A All assignments are compulsory
1.	Implement depth first search algorithm and Breadth First Search algorithm, Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.
2.	Implement A star Algorithm for any game search problem.
3.	Implement Greedy search algorithm for any of the following application: I. Selection Sort II. Minimum Spanning Tree III. Single-Source Shortest Path Problem IV. Job Scheduling Problem V. Prim's Minimal Spanning Tree Algorithm VI. Kruskal's Minimal Spanning Tree Algorithm VII. Dijkstra's Minimal Spanning Tree Algorithm
	Group B
4.	Implement a solution for a Constraint Satisfaction Problem using Branch and Bound and Backtracking for n-queens problem or a graph coloring problem.
5.	Develop an elementary catboat for any suitable customer interaction application.

	Group C
6.	Implement any one of the following Expert System I. Information management II. Hospitals and medical facilities III. Help desks management IV. Employee performance evaluation V. Stock market trading VI. Airline scheduling and cargo schedules
Part II : Elective II	
Suggested List of Laboratory Experiments/Assignments	
Sr. No.	**Assignment Name**
	Information Security (Any five)
1.	Write a Java/C/C++/Python program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.
2.	Write a Java/C/C++/Python program to perform encryption and decryption using the method of Transposition technique.
3.	Write a Java/C/C++/Python program to implement DES algorithm.
4.	Write a Java/C/C++/Python program to implement AES Algorithm.
5.	Write a Java/C/C++/Python program to implement RSA algorithm.
6.	Implement the different Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
7.	Calculate the message digest of a text using the MD5 algorithm in JAVA.
	Cloud Computing (All assignments are compulsory)
1.	Case study on Microsoft azure to learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed data centers. OR Case study on Amazon EC2 and learn about Amazon EC2 web services.
2.	Installation and configure Google App Engine. OR Installation and Configuration of virtualization using KVM.
3.	Creating an Application in SalesForce.com using Apex programming Language.
4.	Design and develop custom Application (Mini Project) using Sales force Cloud.
5.	**Mini-Project** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open-source technologies to implement **with HDFS**. Implement the basic operations may be like to divide the file in segments/blocks and upload/ download file on/from cloud in encrypted form.
	Augmented and Virtual Reality (Assignments 1,2, 3,7 are mandatory, any 2 from 4, 5 & 6)
1.	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2.	Demonstration of the working of HTC Vive, Google Daydream or Samsung gear VR.
3.	Develop a scene in Unity that includes:

	i.A cube, plane and sphere, apply transformations on the 3 game objects. ii.Add a video and audio source.
4.	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the color and material/texture of the game objects dynamically on button click.
5.	Develop and deploy a simple marker based AR app in which you have to write a C# program to play video on tracking a particular marker.
6.	Develop and deploy an AR app, implement the following using Vuforia Engine developer portal: i. Plane detection ii. Marker based Tracking(Create a database of objects to be tracked in Vuforia) iii. Object Tracking
7.	**Mini-Projects/ Case Study** Create a multiplayer VR game (battlefield game). The game should keep track of score, no. of chances/lives, levels(created using different scenes), involve interaction, animation and immersive environment. **OR** Create a treasure hunt AR application which should have the following features: i. A help button for instruction box to appear. ii. A series of markers which would give hints on being scanned. iii. Involve interaction, sound, and good UI.
	Software Modeling and Architectures **(Problem statement 1, 2 , 5 are mandatory and any one from 3 and 4)**
1.	Consider a library, where a member can perform two operations: issue book and return it. A book is issued to a member only after verifying his credentials. Develop a use case diagram for the given library system by identifying the actors and use cases and associate the use cases with the actors by drawing a use case diagram. Use UML tool.
2.	Consider online shopping system. Perform the following tasks and draw the class diagram using UML tool. Represent the individual classes, and objects Add methods Represent relationships and other classifiers like interfaces
3.	Consider the online shopping system in the assignment 2. Draw the sequence diagram using UML tool to show message exchanges
4.	Consider your neighboring travel agent from whom you can purchase flight tickets. To book a ticket you need to provide details about your journey i.e., on which date and at what time you would like to travel. You also need to provide your address. The agency has recently been modernized. So, you can pay either by cash or by card. You can also cancel a booked ticket later if you decide to change your plan. In that case you need to book a new ticket again. Your agent also allows you to book a hotel along with flight ticket. While cancelling a flight ticket you can also cancel hotel booking. Appropriate refund as per policy is made in case of cancellation. Perform the following tasks and draw the use case diagram using UML tool. a. Identify the use cases from a given non-trivial problem statement. b. Identify the primary and secondary actors for a system. **c.** Use to generalization of use cases and «include» stereotypes to prevent redundancy in the coding phase

Mini-Projects

5.	Select a moderately complex system and narrate concise requirement Specification for the same. Design the system indicating system elements organizations using applicable architectural styles and design patterns with the help of a detailed Class diagram depicting logical architecture. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.

Learning Resources

Text Books:

Artificial Intelligence

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5

Information Security

1. Atul Kahate, "Cryptography and Network Security", 3e, McGraw Hill Education
2. Prakash C. Gupta, "Cryptography and Network Security", PHI
3. V.K. Pachghare, "Cryptography and Information Security", PHI Learning

Cloud Computing

1. A. Srinivasan, J. Suresh," Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0

Augmented and Virtual Reality

1. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086

Software Modeling and Architectures

1. Jim Arlow, Ila Neustadt, "UML 2 and the unified process –practical object-oriented analysis and design", Addison Wesley, Second edition, ISBN 978-0201770605
2. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
3. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures", Cambridge University Press, 2011, ISBN 978-0-521-76414-8
4. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India-

ISBN: 978-0-470-51250-0

Information Security

1. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", 3rd_Edition, Pearson
2. William Stallings, "Cryptography and Network Security Principals and Practice", Fifth edition, Pearson
3. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley, ISBN: 978-81-265-2179-1

Augmented and Virtual Reality

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
4. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

Cloud Computing

1. James Bond ,"The Enterprise Cloud", O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.

Software Modeling and Architectures

1. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8.
2. Lan Sommerville, "Software Engineering", 9th edition, ISBN-13: 978-0-13-703515-1 ISBN-10: 0-13-703515-2.

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	3	-	-	2	2	2	1	2
CO2	1	-	2	2	3	2	-	2	2	2	1	2
CO3	1	-	2	2	3	2	-	2	2	2	2	2
CO4	1	-	2	-	3	-	-	2	2	2	2	2
CO5	1	-	2	-	3	-	-	2	2	2	2	2
CO6	1	-	2	-	3	-	-	2	2	2	2	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
310259: Audit Course 6

Home

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 6 Options

Audit Course Code	Audit Course Title
310259(A)	Digital and Social Media Marketing
310259(B)	Sustainable Energy Systems
310259(C)	Leadership and Personality Development
310259(D)	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese (Module 4)** are provided. For other languages institute may design suitably.
310259(E)	Learn New Skills - Software Development Using Agility Approach

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(A): Digital and Social Media Marketing

Home

Prerequisites: Internet Technologies

Course Objectives:

- To understand the importance of digital marketing
- To understand the social media and marketing

To understand the effective marketing strategies and ways

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand the fundamentals and importance of digital marketing

CO2: Use the power of social media for business marketing

CO3: Analyze the effectiveness of digital marketing and social media over traditional process

Course Contents

1. A Framework for Digital Marketing
2. Domain Names, Email, and Hosting
3. Yes, You need a Website
4. The Three Components of a Modern Website: Mobile, Fast, and Accessible
5. Lock It Down: Digital Privacy, Data Security, and the Law
6. Social Media
7. Email Marketing
8. Online Advertising

Reference Books :

1. Avery Swartz, “See You on the Internet: building your small business with Digital Marketing”, ISBN 978-1-989603-08-6.
2. Social Media Marketing Workbook (2021): How to Use Social Media for Business (2021 Social Media Marketing 1).

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	1	-	1	-	1	-	-	-	-
CO2	-	1	2	-	1	-	-	-	-	-	1	-
CO3	2	-	2	2	1	-	1	-	-	-	-	-

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(B): Sustainable Energy Systems

Home

Prerequisites: General awareness of environment and natural resources of energy

Course Objectives:

- To understand the importance of sustainable energy systems development
- To create awareness about renewable energy sources and technologies
- To learn about adequate inputs on a variety of issues in harnessing renewable energy
- To recognize current and possible future role of renewable energy sources

Course Outcomes:

On completion of the course, learners will be able to

CO1: Comprehend the importance of Sustainable Energy Systems

CO2: Correlate the human population growth and its trend to the natural resource degradation and develop the awareness about his/her role towards Sustainable Energy Systems protection

CO3: Identify different types of natural resource pollution and control measures

CO4: Correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents

1. **Wind Energy:** Power in the Wind, Types of Wind Power Plants (WPPs), Components of WPPs, Working of WPPs, Siting of WPPs, Grid integration issues of WPPs.
2. **Solar Pv and Thermal Systems:** Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds, Thermal Energy storage system with PCM, Solar Photovoltaic systems: Basic Principle of SPV conversion, Types of PV Systems, Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency and Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.
3. **Other Energy Sources:** Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC), Hydrogen Production and Storage. Fuel cell: Principle of working, various types, construction and applications. Energy Storage System, Hybrid Energy Systems.

Reference Books :

1. Joshua Earnest, Tore Wizeliu, "Wind Power Plants and Project Development", PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan,"Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt .Ltd, New Delhi, 2013.
3. A.K.Mukerjee and Nivedita Thakur, "Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12
CO1	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(C): Leadership and Personality Development

Home

Prerequisites: General awareness of communication and relationship.

Course Objectives:

- To understand the importance of communication
- To create awareness about teamwork and people skills
- To know thyself
- To recognize current and possible future of new-age thinking

Course Outcomes:

On completion of the course, learners will be able to

CO1: Express effectively through communication and improve listening skills

CO3: Develop **e**ffective team leadership abilities.

CO4: Explore self-motivation and practicing creative/new age thinking.

CO5: Operate effectively in heterogeneous teams through the knowledge of team work, people skills and leadership qualities.

Course Contents

1. **Communication :**
   Listening Skills, Communication - 7 C's, Vision and Charisma, Planning and Organizing - Complex Tasks and Ideas --> Actionable Tasks, Presentation Skills.
2. **Teamwork and People Skills :**
   Talent Picking skills, Strong networking and Employee engagement, Coach and Mentor the team, Influencing, Delegate and Empower, Generous, open communicator, Patience and Clarity of Mind, Inspire and Motivate, Ensure Team Cohesion, Empathy, Trust and Reliability.
3. **New-age Thinking :**
   Strategic Thinking, Critical and Lateral Thinking, Problem Solving Skills, Flexibility, Change Management – VUCA.
4. **Self-Awareness :**
   What is Self? – Real, Ideal and Social Self, Concepts related to Self - Self Concept, Self-Presentation, Self-Regulation and Impression Management, Definition and Causes of Prejudice, Relationship between Prejudice, Discrimination and Exclusion, Application – Attitudinal Change and Reducing Prejudices, Self Esteem and Self Awareness, SWOT – JOHARI, Self Esteem Quiz, Introduce Your Partner, Self Introduction - How to sell yourself?-appearance, voice modulation, verbal(simple language), Motivation and Optimism, Positive Emotions and Success.

Reference Books :

1. Paul Sloane, “The Leader's Guide to Lateral Thinking Skills Unlocking the Creativity and Innovation in You and Your Team”, 2006
2. Ronald Bennett, Elaine Millam,“Leadership for engineers : the magic of mindset”
3. Urmila Rai and S.M. Rai, “Business Communication”, Himalay Publication House
4. Baron R, Byrne D, Branscombe N, BharadwajG (2009), “Social Psychology, Indian adaptation” , Pearson , New Delhi
5. Baumgartner S.R, Crothers M.K. (2009) “Positive Psychology”, Pearson Education.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	2	-	1	1	3	-	2
CO2	-	-	-	-	-	-	-	1	-	2	1	2
CO3	-	-	-	-	-	1	-	-	2	1	-	1
CO4	-	-	-	-	-	-	-	1	-	-	2	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(D): Foreign Language (Japanese) Module 4

Home

Prerequisites: We recommend that candidates should have previously completed AC3-V(210251) , AC4-V (210260) and AC-5(310250)

Course Objectives:

- To open up more doors and job opportunities
- To introduce to Japanese society, culture and entertainment

Course Outcomes:

On completion of the course, learner will be able to

CO1: Have the ability to communicate confidently and clearly in the Japanese language
CO2: Understand the nature of Japanese script
CO3: Get introduced to reading, writing and listening skills
CO4: Develop interest to pursue further study, work and leisure

Course Contents

1. Introduction to types of adjectives (i and na)
2. Formation of adjectives (according to tense / negative / affirmative)
3. Introduction to more particles
4. Making sentences using various particles / verbs / adjectives
5. Topic based vocabulary (Places / Train travel related / Technical Katakana words)
6. More verb forms (te form, ta form, nai form, root verb etc.)
7. Question words
8. Further 25 Kanjis
9. Scenario based conversation practice / skits / role plays (At the market, At the hospital etc.)

Reference Books :

1. Minna No Nihongo, “JapaneseforEveryone”,ElementaryMainTextbook1-1(IndianEdition),GoyalPublishers and Distributors Pvt.Ltd.
2. http://www.tcs.com(http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)
3. Kazuko Karasawa, Mikiko Shibuya, “Nihongo Challenge N4 N5 Kannji Tomoko Kigami”, ISBN-10 4872177576,Ask Publishing Co.,Ltd.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(E): Learn New Skill- 'Software Development Using Agility Approach'

Home

Prerequisites: Software Engineering (210253)

Course Objectives:

- To understand the fundamentals of Dev Ops
- To understand the Agility and ways of Agility
- To understand the software development using Agility approach

Course Outcomes:

On completion of the course, learner will be able to

CO1: Illustrate the agility and principles

CO2: Understand the software development using agile methodology

CO3: Apply Dev Ops for the software product development

CO4: Develop software products for early delivery through continual feedback and learning

Course Contents

1. **THE THREE WAYS :**Agile, continuous delivery and the three ways, The First Way: The Principles of Flow, The Second Way: The Principle of Feedback, The Third Way: The Principles of Continual Learning.
2. **WHERE TO START :**Selecting which value stream to start with, Understanding the work in our value stream…, How to design our organization and architecture, How to get great outcomes by integrating operations into the daily work for development.
3. **THE FIRST WAY: THE TECHNICAL PRACTICES OF FLOW :** Create the foundations of our deployment pipeline, Enable fast and reliable automated testing, Enable and practice continuous integration, Automate and enable low-risk releases, Architect for low-risk releases.
4. **THE SECOND WAY: THE TECHNICAL PRACTICES OF FEEDBACK :**Create telemetry to enable seeing and solving problems, Analyze telemetry to better anticipate problems, Enable feedback so development and operation can safely deploy code, Integrate hypothesis-driven development and A/B testing into our daily work, Create review and coordination processes to increase quality of our current work.
5. **THE THRID WAY: THE TECHNICAL PRACTICES OF CONTINUAL LEARNING :** Enable and inject learning into daily work, Convert local discoveries into global improvements, Reserve time to create organizational learning, Information security as everyone's job, every day, Protecting the deployment pipeline.

Reference Books :

1. Gene Kim, Jez Humble, Petrick Debois, "The Dev Ops Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations"
2. Len Bass, Ingo Weber, Liming Zhu, "Dev Ops: A Software Architect's Perspective " Publisher(s): Addison-Wesley Professional, ISBN: 9780134049885

Note: This is sample contents for Software Development Using Agility Approach, however the course instructor may design suitable course giving opportunity to the students for learning new skills.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	2	1	3	1	-	1	-	1	-	-
CO2	-	3	2	2	1	-	-	-	1	1	-	1
CO3	2	3	1	1	-	1	1	-	-	-	-	1
CO4	2	1	1	3	1	-	1	1	-	1	1	1

Home

Acknowledgement

It is with great pleasure and honor that I share the curriculum for Third Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.
It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone’s contribution and suggestions in finalizing the contents.
Success is sweet. But it’s sweeter when it’s achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!
Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all-inclusive curriculum for Third Year of Computer Engineering.
Thank you to all of you for delivering such great teamwork. I don’t think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to **Dr. Pramod D. Patil (Dr. D. Y. Patil Institute of Technology, Pimpri), member BoS, Computer Engineering**, for coordinating the complete activity and getting it to completion in a smooth manner.
I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.
I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!
Special thanks are due to Dr. Santosh Kumar Chobe, Dr. Jyoti Rao, Dr. Swati Nikam, Dr. C. R. Jadhav, Dr. S. S. Das, Dr. Rachna Somkunwar, Prof. Rajesh D. Bharati, Prof. Rupesh Mahajan for helping with the formatting and crisp presentation of this draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

I am thankful to Prof. Abhijit D. Jadhav, Dr. D. Y. Patil Institute of Technology, Pimpri for the time he has spent in critically reading the draft and giving the final touches. I appreciate his initiative and thank him for his time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that’s what makes the team stronger! You took the meaning of teamwork to a whole new level.
Thank you for all your efforts!

Professor (Mrs.) Dr. Varsha H. Patil, Chairman, and
Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University.

Task Force at Curriculum Design

1. Advisors, the Team of Board of Studies-

Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

2. Team Leader- Dr. Pramod D. Patil, Dr. D. Y. Patil Institute of Technology, Pimpri

Home

3. Teams, Course Design-

Name of Course	Team Coordinator	Team Members	
Database Management Systems	Dr. Anuradha Thakare	Dr. Sarika Nitin Zaware Dr. S. B. Tambe Prof. Ranjit M. Gawande	Prof. Rahul Patil Prof. Prashant Ahire Dr. Sharmila Wagh
Theory of Computation	Dr. Sunil Dhore	Dr. Santosh Chobe Dr. Jyoti Rao Dr. G.R.Shinde Mr. Tushar Samnerkar (Industry)	Dr.Vaishali Tidake Prof. Anita Shinde Mr. Vivek Kulkarni (Industry)
Systems Programming and Operating Systems	Dr. Manisha Bhende	Dr. R.A. Satao Prof. Rupesh Mahajan Prof. Mrs.B.Mahalakshmi Prof. Mrs. Neelam Patil	Dr. V. S. Pawar Prof. S. R. Pandit Prof. Mrs. Dhanashree Patel
Computer Networks and Security	Dr. P. B. Kumbharkar	Dr. Aparna A. Junnarkar Dr. A.V. Dhumane Dr. Vinod V. Kimbahune	Prof. D. B. Gothwal Dr. M. L. Dhore
Elective I: Internet of Things and Embedded Systems	Dr. A. B. Pawar	Dr.Sandeep Chaware Dr. M.S.Chaudhari Dr. M.P. Wankhade	Mr.Rajnikant(Industry) Mr.Mahesh Aher(Industry)
Elective I: Human Computer Interface	Dr. S. D. Babar	Prof. Mrs. G. J. Chhajed Prof. D.D.Sapkal Prof. Mrs.Jayshree R. Pansare Mr. Mukesh Jain (Industry) Prof. Mrs. Shailaja N. Lohar	Prof. S. A. Thanekar Dr.Deepak Dharrao Dr. Ganesh Bhutkar Mr. Himmat Sankhala (Industry)
Elective I: Distributed System	Dr. Amar Buchade	Prof. Rajesh Bharati Dr. Suresh V. Limkar Mr. Pratik Dixit (Industry)	Dr. Swati A. Bhavsar Dr. Sonali Patil Dr. Rachna Somkunwar Mr. Vijay Bahiraji (Industry)
Elective I: Software Project Management	Dr. Sachin Sakhare	Dr. R. L. Paikrao Prof. Santosh Sambare Prof. Pimpalkar S.P.	Prof. Shinde Sushma S Prof. Mrs. Vina M Lomte Mr. Prashant Pund (Industry) Mr. Shekhar Dhupkar (Industry)
Database Management System Laboratory	Prof. Rahul Patil	Prof. Rajesh Bharati	Nitin Ghadage (Industry)
Computer Networks and Security Laboratory	Dr. Vinod V. Kimbahune	Dr. P. B. Kumbharkar Dr. Aparna A. Junnarkar Dr. A.V. Dhumane	Prof. D. B. Gothwal Dr. M. L. Dhore
Laboratory Practice I	Dr. Amol Potgantwar	Dr. Manisha Bhende Dr. M.P. Wankhade Mrs. Shailaja N. Lohar	Dr. Sonali Patil Prof. Santosh Sambare
Seminar	Dr. Swati A. Bhavsar	Mr. Rushikesh Jadhav(Industry) Mr. Krishna Auti(Industry)	Dr. (Mrs.) Nuzhat F. Shaikh Mr. Ranjit M. Gawande

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Audit Course 5	Dr. Kishor Wagh	Dr. S. S. Das Dr. D. V. Patil	Dr. Sandeep Patil Dr. Bendre Mr. B. B. Gite
Data Science and Big Data Analytics	Dr. Sheetal Sonawane	Dr. H. K. Khanuja Prof. Devidas S. Thosar Dr. S. K. Shinde Mr. Anand Bhalerao (Industry) Mr. Amod Vaidya (Industry)	Dr. B. D. Phulpagar Dr. K. V. Metre Mr. Atul Bengeri (Industry) Mr. Summer Patil (Industry) Mr. Sanjeev Kumar (Industry)
Web Technology	Prof. Abhijit D. Jadhav	Prof. Jayvant Devare	Mr. Avinash Patil (Industry) Mr. Saikrishna Mamidishetty (Industry)
Artificial Intelligence	Dr. J. R. Prasad	Dr. Gayatri M. Bhandari Dr. V. P. Vikhe Dr. Snehal Mohan Kamalapur	Dr. K Rajeswari Dr.Mrs.Madhuri Potey
Elective II: Information Security	Dr. Swati Nikam	Dr Pathan Mohd Shafi Dr.Mininath Nighot Dr. Ms. K.C. Nalavade	Dr. Lomte Archana C. Dr. Amol Potgantwar Mr. Akshay Kokil (Industry)
Elective II: Augmented and Virtual Reality	Dr. (Mrs.) Nuzhat F. Shaikh	Prof.Sagar Balasaheb Shinde Prof. Shweta Ashish Koparde	Prof.Sanjay Agrawal Prof.Priyanka More Mr. Soumya Ranjan (Industry) Mr. Ravi Kiran (Industry)
Elective II: Cloud Computing	Dr. S. K. Sonkar	Prof. Abhijit D. Jadhav Dr. Pankaj Agarkar Dr. N. M. Ranjan	Dr. A. S. Rumale Prof. Thombre B. H. Mr.Ashok Pomnar (Industry) Mr.Santosh Ugale (Industry)
Elective II: Software Modeling and Architectures	Dr M A Pradhan	Prof. Mrs. Dipalee Divakar Rane Prof Jyoti Kulkarni	Dr. Neeta Deshpande Prof . Nareshkumar Mustary Dr Aarti D K
Internship	Dr. Gitanjali V. Kale	Mr. Arun Kadekodi - (Industry) Mr.Nilesh Deshmukh - (Industry) Prof. Pradnya Kulkarni	Prof. Dheeraj Agrawal Prof. Pranjali Joshi
Data Science and Big Data Analytics Laboratory	Dr. H. K. Khanuja	Dr. Sheetal Sonawane Prof. Devidas S. Thosar Dr. S. K. Shinde Mr. Anand Bhalerao (Industry) Mr. Amod Vaidya (Industry)	Dr. B. D. Phulpagar Dr. K. V. Metre Mr. Atul Bengeri (Industry) Mr. Summer Patil (Industry) Mr. Sanjeev Kumar (Industry)
Web Technology Laboratory	Prof. Abhijit D. Jadhav	Mr. Avinash Patil (Industry)	Mr. Saikrishna Mamidishetty (Industry)
Laboratory Practice II	Dr. Snehal Mohan Kamalapur	Dr. K Rajeswari Dr Pathan Mohd Shafi Dr. Shaikh Nuzhat Faiz	Dr. N. M. Ranjan Dr M A Pradhan
Audit Course 6	Dr. Sangve Sunil M.	Dr. S. S. Das	Prof. Abhijit D. Jadhav

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Faculty of Engineering
Savitribai Phule Pune University, Pune

Maharashtra, India

Curriculum
for
Fourth Year of Computer Engineering
(2019 Course)
(With effect from 2022-23)

www.unipune.ac.in

Final Year of Computer Engineering
(2019 Course)
(With effect from 2022-23)

Prologue

It is with great pleasure and honor that I share the syllabi for Fourth Year of Computer Engineering (2019 Course) on behalf of Board of Studies, Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BoS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks,

Dr. Varsha H. Patil
Chairman, Board of Studies (Computer Engineering), SPPU, Pune

links for First Year, Second Year and Third Year Computer Engineering Curriculum 2019:

1. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
2. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf
3. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt_03.072020.pdf
4. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2021/Third%20Year%20Engineering%202019%20Pattern_16022022.rar

Savitribai Phule Pune University

Fourth Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2022-23)

Table of Contents

Savitribai Phule Pune University
Bachelor of Computer Engineering

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO1	**Professional Skills-**The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills-** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship-** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

BE Computer Engineering 2019 Course tentative Curriculum structure:

Savitribai Phule Pune University

Fourth Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2022-23)

Semester VII

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral\Pre	Total	Lecture	Practical	Tutorial	Total
410241	Design and Analysis of Algorithms	03	-	-	30	70	-	-	-	100	3	-	-	3
410242	Machine Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
410243	Blockchain Technology	03	-	-	30	70	-	-	-	100	3	-	-	3
410244	Elective III	03	-	-	30	70	-	-	-	100	3	-	-	3
410245	Elective IV	03	-	-	30	70	-	-	-	100	3	-	-	3
410246	Laboratory Practice III	-	04	-	-	-	50	50	-	100	-	2	-	2
410247	Laboratory Practice IV	-	02	-	-	-	50	-	-	50	-	1	-	1
410248	Project Stage I	-	02	-	-	-	50	-	-	50	-	2	-	2
										Total Credit	**15**	**05**	**-**	**20**
	Total	**15**	**08**	**-**	**150**	**350**	**150**	**50**	**-**	**700**	**15**	**05**	**-**	**20**
410249	Audit Course 7										**Grade**			

Elective III

410244(A) Pervasive Computing
410244(B) Multimedia Techniques
410244(C) Cyber Security and Digital Forensics
410244(D) Object Oriented Modeling and Design
410244(E) Digital Signal Processing

Elective IV

410245(A) Information Retrieval
410245(B) GPU Programming and Architecture
410245(C) Mobile Computing
410245(D)Software Testing and Quality Assurance
410245(E) Compilers

Laboratory Practice III:
Laboratory assignments Courses- 410241, 410242, 410243

Laboratory Practice IV:
Laboratory assignments Courses- 410244, 410245

Audit Course 7(AC7) Options:

AC7- I MOOC- Learn New Skills
AC7- II Entrepreneurship Development
AC7- III Botnet of Things
AC7- IV 3D Printing
AC7- V Industrial Safety and Environment Consciousness

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Savitribai Phule Pune University
Final Year of Computer Engineering (2019 Course)
(With effect from Academic Year 2022-23)

Semester VIII

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral/Pre	Total	Lecture	Practical	Tutorial	Total
410250	High Performance Computing	03	-	-	30	70	-	-	-	100	03			03
410251	Deep Learning	03	-	-	30	70	-	-	-	100	03			03
410252	Elective V	03	-	-	30	70	-	-	-	100	03			03
410253	Elective VI	03	-	-	30	70	-	-	-	100	03			03
410254	Laboratory Practice V	-	02	-	-	-	50	50	-	100		01		01
410255	Laboratory Practice VI	-	02	-	-	-	50	-	-	50		01		01
410256	Project Stage II	-	06	-	-	-	100	-	50	150		06		06
										Total Credit	**12**	**08**	**-**	**20**
	Total	**12**	**10**	**-**	**120**	**280**	**200**	**50**	**50**	**700**	**12**	**08**	**-**	**20**
410257	Audit Course 8										**Grade**			

Elective V	**Elective VI**
410252(A) Natural Language Processing 410252(B) Image Processing 410252(C) Software Defined Networks 410252(D) Advanced Digital Signal Processing 410252(E) Open Elective I	410253(A) Pattern Recognition 410253(B) Soft Computing 410253(C) Business Intelligence 410253(D) Quantum Computing 410253(E) Open Elective II
Lab Practice V: Laboratory assignments Courses- 410250, 410251	**Lab Practice VI:** Laboratory assignments Courses- 410252, 410253

Audit Course 8(AC8) Options:

AC8- I Usability Engineering
AC8- II Conversational Interfaces
AC8- III Social Media and Analytics
AC8- IV MOOC- Learn New Skills
AC8- V Emotional Intelligence

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. These **Program Outcomes (POs)** are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course, many a times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.
2. **@CO and PO Mapping Matrix**(Course Objectives and Program Outcomes) attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there isno correlation between CO and PO.
3. For each course, contents are divided into six units-I, II, III, IV, V and VI.

#Elaborated examples/Case Studies are included at each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *For each unit contents, the content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.
5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as the part of laboratory work. Inclusion of it will be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.
6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.
7. For each course, irrespective of the examination head, the instructor should motivate students to read articles/research papers related to recent development and invention in the field.
8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed.
9. **Term Work** –Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

10. **Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.(In laboratory Practices the lab teachers can give different applications other than the indicated.)**

Abbreviations

TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**Sem: Semester**	

Faculty of Engineering Savitribai Phule Pune University

SEMESTER VII

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410241: Design and Analysis of Algorithms

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Fundamentals of Data Structures(210242, Data Structures and Algorithms(210252), Theory of Computation (310242)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- To develop problem solving abilities using mathematical theories.
- To apply algorithmic strategies while solving problems.
- To analyze performance of different algorithmic strategies in terms of time and space.
- To develop time and space efficient algorithms.
- To study algorithmic examples in distributed and concurrent environments
- To Understand Multithreaded and Distributed Algorithms

Course Outcomes:

On completion of the course, student will be able to–

CO1: Formulate the problem
CO2: Analyze the asymptotic performance of algorithms
CO3: Decide and **apply** algorithmic strategies to solve given problem
CO4: Find optimal solution by applying various methods
CO5: Analyze and **Apply** Scheduling and Sorting Algorithms.
CO6: Solve problems for multi-core or distributed or concurrent environments

Course Contents

Unit I	Algorithms and Problem Solving	07 Hours

Algorithm: The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues.
Problem solving Principles: Classification of problem, problem solving strategies, classification of timecomplexities (linear, logarithmic etc.)

#Exemplar/Case Studies	Towers of Hanoi
***Mapping of Course Outcomes for Unit I**	CO1,CO3

Unit II	Analysis of Algorithms and Complexity Theory	07 Hours

Analysis: Input size, best case, worst case, average case
Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, ϴ, o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.

#Exemplar/Case Studies	Analysis of iterative and recursive algorithm

***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Greedy And Dynamic Programming algorithmic Strate**	**08 Hours**

Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem,scheduling algorithms-Job scheduling and activity selection problem.
Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomialcoefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.

#Exemplar/Case Studies	Rail tracks connecting all the cities
***Mapping of Course Outcomes for Unit III**	CO3, CO4

Unit IV	**Backtracking and Branch-n-Bound**	**08 Hours**

Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem,graph coloring problem, sum of subsets problem.
Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies- FIFO,
LIFO and LC approaches, TSP, knapsack problem.

#Exemplar/Case Studies	Airline Crew Scheduling
***Mapping of Course Outcomes for Unit IV**	CO3, CO4

Unit V	**Amortized Analysis**	**07 Hours**

Amortized Analysis: Aggregate Analysis, Accounting Method, Potential Function method, Amortized analysis-binary counter, stack Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

#Exemplar/Case Studies	cutting stock problem
***Mapping of Course Outcomes for Unit V**	CO3,CO5

Unit VI	**Multithreaded And Distributed Algorithms**	**07 Hours**

Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms,Parallel loops, Race conditions.
Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreadedmerge sort.
Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum SpanningTree.
String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm.

#Exemplar/Case Studies	Plagiarism detection

*Mapping of Course Outcomes for UnitVI	CO6

Learning Resources

Text Books:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms",Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2

Reference Books :

1. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations," Analysis and InternetExamples‖, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction toAlgorithms", MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 817371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms" Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press,ISBN:0-521-67035-7

e-Books :

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf
2. https://www.ebooks.com/en-in/book/1679384/algorithms-design-techniques-and-analysis/m-h-alsuwaiyel

MOOC Courses links :

- Design and Analysis of Algorithms - https://nptel.ac.in/courses/106106131

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	2	3	3	2	-	-	-	-	-	-	-	3
CO5	2	2	2	2	-	-	-	-	-	-	-	3
CO6	2	2	1	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410242: Machine Learning		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Data Science and Big Data Analytics(310251)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- To understand the need for Machine learning
- To explore various data pre-processing methods.
- To study and understand classification methods
- To understand the need for multi-class classifiers.
- To learn the working of clustering algorithms
- To learn fundamental neural network algorithms.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Identify the needs and challenges of machine learning for real time applications.

CO2: Apply various data pre-processing techniques to simplify and speed up machine learning algorithms.

CO3: Select and apply appropriately supervised machine learning algorithms for real timeapplications.

CO4: Implement variants of multi-class classifier and measure its performance.

CO5 :Compare and contrast different clustering algorithms.

CO6: Design a neural network for solving engineering problems.

Course Contents

Unit I	Introduction To Machine Learning	07 Hours

Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science.

Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models.

Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches

#Exemplar/Case Studies	Suppose you are working for Uber where a task to increase sales is given.Understand the requirements of the client
***Mapping of Course Outcomes for Unit**	CO1

Unit II	Feature Engineering	07 Hours

Concept of Feature, Preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern.
Introduction to various Feature Selection Techniques, Sequential Forward Selection, Sequential Backward Selection.
Statistical feature engineering: count-based, Length, Mean, Median, Mode etc. based feature vectorcreation.
Multidimensional Scaling, Matrix Factorization Techniques.

#Exemplar/CaseStudies	You are a Data Scientist, and a client comes to you with their data. Client is running a few campaigns from the past few months, but no campaign seemseffective. Client provides you the data of customers, product sales and past campaign success. They want to increase their sales and figure out which marketing strategy isworking the best for them? Questions for data scientists: 1. What data analysis approach will you follow? 2. What statistical approach do you need to follow? How will you select important features?
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Supervised Learning : Regression**	**06 Hours**

Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Regression: Lasso regression, Ridge regression, Gradient descent algorithm.
Evaluation Metrics: MAE, RMSE, R2

#Exemplar/Case Studies	Stock market price prediction
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Supervised Learning : Classification**	**08 Hours**

Classification: K-nearest neighbour, Support vector machine.
Ensemble Learning: Bagging, Boosting, Random Forest,
Adaboost.
Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems,Variants of Multiclass Classification: One-vs-One and One-vs-All
Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation, Micro-Average Precision and Recall, Micro-Average F-score, Macro-Average Precision and Recall, Macro-Average F-score.

#Exemplar/Case Studies	Prediction of Thyroid disorders such as Hyperthyroid, Hypothyroid, Euthyroid-sick,and Euthyroid using multiclass classifier.
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Unsupervised Learning**	**07 Hours**

K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering. Outlier analysis: introduction of isolation factor, local outlier factor.
Evaluation metrics and score: elbow method, extrinsic and intrinsic methods

#Exemplar/Case Studies	Market basket analysis/Customer Segmentation
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	Introduction To Neural Networks	07 Hours

Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions,
Introduction to Recurrent Neural Networks and Convolutional Neural Networks

#Exemplar/Case Studies	Movie Recommendation System
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning",Vol. 4.No. 4. New York: springer, 2006.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013

Reference Books:

1. Tom Mitchell, " Machine learning", McGraw-Hill series in Computer Science, 1997
2. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory toalgorithms", Cambridge university press, 2014.
3. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
4. Hastie, Trevor, et al., "The elements of statistical learning: data mining, inference, and prediction", Vol. 2. New York: springer, 2009.
5. McKinney, "Python for Data Analysis ",O' Reilly media, ISBN : 978-1-449-31979-3
6. Trent hauk, "Scikit-learn", Cookbook , Packt Publishing, ISBN: 9781787286382
7. Goodfellow I.,Bengio Y. and Courville, " A Deep Learning", MIT Press, 2016

e-Books :

1. Python Machine Learning : http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Python-for-machine-learning-2015.pdf
2. Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/
3. Dive into Deep Learning: http://d2l.ai/
4. A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf
5. Feature selection: https://dl.acm.org/doi/pdf/10.5555/944919.944968
6. Introductory Machine Learning Nodes : http://lcsl.mit.edu/courses/ml/1718/MLNotes.pdf

MOOC Courses Links:

- Introduction to Machine Learning : https://nptel.ac.in/courses/106105152
- Introduction to Machine Learning (IIT Madras): https://onlinecourses.nptel.ac.in/noc22_cs29/prevew
- Deep learning: https://nptel.ac.in/courses/106106184

@The CO-PO Mapping Matrix												
CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	2	-	-	1	1	1	1	1	1
CO2	2	1	-	1	1	1	1	1	1	1	1	1
CO3	2	2	2	1	1	1	1	1	1	1	1	1
CO4	2	2	2	1	1	1	1	1	1	1	1	1
CO5	2	2	2	1	1	1	1	1	1	1	1	1
CO6	2	-	2	1	1	1	1	1	1	1	1	1

home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410243: Blockchain Technology

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- Technology behind Blockchain
- Crypto currency, Bitcoin and Smart contracts
- Different consensus algorithms used in Blockchain
- Real-world applications of Blockchain
- To analyze Blockchain Ethereum Platform using Solidity
- To Describe Blockchain Case Studies

Course Outcomes:

On completion of the course, student will be able to–

CO1: Interpret the fundamentals and basic concepts in Blockchain
CO2: Compare the working of different blockchain platforms
CO3: Use Crypto wallet for cryptocurrency based transactions
CO4: Analyze the importance of blockchain in finding the solution to the real-world problems.

CO5: Illustrate the Ethereum public block chain platform
CO6: Identify relative application where block chain technology can be effectively used andimplemented.

Course Contents

Unit I	Mathematical Foundation for Blockchain	06 Hours

Cryptography: Symmetric Key Cryptography and Asymmetric Key Cryptography, Elliptic Curve Cryptography (ECC), Cryptographic Hash Functions: SHA256, Digital Signature Algorithm (DSA), Merkel Trees.

#Exemplar/Case Studies	Compare the Symmetric and Asymmetric Cryptography algorithms
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Feature Engineering	07 Hours

History, Centralized Vs. Decentralized Systems, Layers of Blockchain: Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Block chain important? Limitations of Centralized Systems, Blockchain Adoption So Far.

#Exemplar/CaseStudies	Study of a research paper based on Blockchain.

***Mapping of Course Outcomes for Unit II**	CO1	
Unit III	**Blockchain Platforms and Consensus in Blockchain**	**06 Hours**
Types of Blockchain Platforms: Public, Private and Consortium, Bitcoin, Ethereum, Hyperledger,IoTA, Corda, R3. Consensus in Blockchain: Consensus Approach, Consensus Elements, Consensus Algorithms, Proof of Work, Byzantine General problem, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn.		
#Exemplar/Case Studies	Compare different consensus algorithms used in Blockchain Technology.	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**Cryptocurrency – Bitcoin, and Token**	**06 Hours**
Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics Types of Cryptocurrency, Cryptocurrency Usage, Cryptowallets: Metamask, Coinbase, Binance		
#Exemplar/Case Studies	Create your own wallet for crypto currency using any of the Blockchain Platforms.	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Blockchain Ethereum Platform using Solidity**	**06 Hours**
What is Ethereum, Types of Ethereum Networks, EVM (Ethereum Virtual Machine), Introduction to smart contracts, Purpose and types of Smart Contracts, Implementing and deploying smart contracts using Solidity, Swarm (Decentralized Storage Platform), Whisper (Decentralized Messaging Platform)		
#Exemplar/Case Studies	Study Truffle Development Environment.	
***Mapping of Course Outcomes for Unit V**	CO4	
Unit VI	**Blockchain Case Studies**	**06 Hours**
Prominent Blockchain Applications, Retail, Banking and Financial Services, Government Sector, Healthcare, IOT, Energy and Utilities, Blockchain Integration with other Domains		
#Exemplar/Case Studies	Study 2 uses cases of Blockchain and write a detailed report on every aspect implemented in the same	
***Mapping of Course Outcomes for Unit VI**	CO5, CO6	
Learning Resources		

Text Books:

1. Martin Quest, "Blockchain Dynamics: A Quick Beginner's Guide on Understanding the Foundations of Bit coin and Other Crypto currencies", Create Space Independent PublishingPlatform, 15-May-2018
2. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018
3. Alex Leverington, "Ethereum Programming", Packt Publishing, 2017

Reference Books:

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Blockchain ABeginner's Guide to Building Blockchain Solutions",2018
2. Chris Dannen, "Introducing Ethereum and Solidity", Foundations of Crypto currency andBlockchain Programming for Beginners
3. Daniel Drescher, "Blockchain Basics", A Non -Technical Introduction in 25Steps.
4. Ritesh Modi, "Solidity Programming Essentials", Packt Publishing,2018
5. Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, "Blockchain Technology", Universities Press, ISBN-9789389211634

e-Books :

1. https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf
2. https://www.lopp.net/pdf/princeton_bitcoin_book.pdf
3. https://www.blockchainexpert.uk/book/blockchain-book.pdf

MOOC Courses Links:

1. NPTEL Course on "Introduction to Blockchain Technology & Applications"
https://nptel.ac.in/courses/106/104/106104220/
2. NPTEL Course on **b**
https://nptel.ac.in/courses/106/105/106105184/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	2	2	-	-	-	-	-	-	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	2
CO6	2	2	2	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective III
410244(A): Pervasive Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses:-Internet of Thigs and Embedded Systems(310245A)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the characteristics, basic concepts and systems issues in pervasive computing.
- To illustrate smart devices and architectures in pervasive computing.
- To introduce intelligent systems and interactions in Pervasive computing.
- To identify the trends and latest development of the technologies in the area.
- To Understand Interaction Design – HCI and Wearable Computing Environment.
- To identify Security Challenges & Ethics in Pervasive Computing

Course Outcomes:

On completion of the course, student will be able to–

CO1.Demonstrate fundamental concepts in pervasive computing.

CO2.Explain pervasive devices and decide appropriate one as per the need of real timeapplications.

CO3.Classify and analyze context aware systems for their efficiency in different ICT systems.

CO4.Illustrate intelligent systems and generic intelligent interactive applications.

CO5.Design HCI systems in pervasive computing environment.

CO6.Explore the security challenges and know the role of ethics in the context of pervasivecomputing.

Course Contents

Unit I	Introduction To Pervasive Computing	07 Hours

Pervasive Computing: History, Principles, Characteristics, Problems/Issues & Challenges, Advantages of Pervasive Computing

Pervasive Computing Applications: Pervasive computing devices and interfaces, Device technology trends, Connecting issues and protocols.

#Exemplar/Case Studies	Pervasive Computing for Personalized medicine
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Smart Computing with Pervasive Computing Devices	07 Hours

Smart Devices: CCI, Smart Environment: CPI and CCI, Smart Devices: iHCI and HPI, Wearable devices, Application and Requirements, Device Technology and Connectivity, PDA Device characteristics - PDA Based Access Architecture, Voice Enabling Pervasive Computing: Voice Standards, Speech Applications in Pervasive Computing.

#Exemplar/CaseStudies	Amazon Alexa	
*Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Context Aware Systems**	**07 Hours**
Introduction, Types of Context, Context Aware Computing and Applications, Modelling Context-Aware Systems, Mobility awareness, spatial awareness, temporal awareness: Coordinating and scheduling, ICT system awareness, Middleware Support		
#Exemplar/Case Studies	Mobile Hanging Services systems	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Intelligent Systems and Interaction**	**07 Hours**
Introduction, Basic Concepts, IS Architectures, Semantic KBIS, Classical Logic IS, Soft Computing IS Models, IS System Operations, Interaction Multiplicity, IS Interaction Design, Generic Intelligent Interaction Applications.		
#Exemplar/Case Studies	Curious information displays: A motivated reinforcement learning IE application.	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**User Interaction Design – HCI and Wearable Computing**	**07 Hours**
Introduction of Interaction Design, Basics of Interaction Design and its Concepts, Importance of Interaction Design, Difference between Interaction Design and UX. What is HCI? Importance of HCI, Advantages and Disadvantages of HCI, Elements of HCI, HCI Design and Architecture,Define Wearable Computing, Importance of Wearable Computing, Security issues in Wearable Computing, Wearable Computing Architecture and Applications, Wearable Computing Challenges and Opportunities for Privacy Protection		
#Exemplar/Case Studies	Smart Fabric/ Textile, Sensory Fabric for Ubiquitous interfaces	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Security Challenges & Ethics in Pervasive Computing**	**07 Hours**
Security issues in Pervasive Computing: security model, authentication & authorization, access control, secure resource discovery, open issues. Pervasive computing security challenges & requirements: Privacy & trust issues, social & user interaction issues, solution for pervasive computing challenges, Role of Ethics in pervasive computing security: Autonomy and Self-determination, Responsibility: legal, moral & social, distributive justice, digital divide and sustainable development		
#Exemplar/Case Studies	Pervasive Computing Security Gaia Project	
*Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

Text Books:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices: Environments and Interactions", Wiley Publication, Student Edition, ISBN 9788126527335.
2. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtroff, Thomas Schack, " Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson Education, ISBN 9788177582802
3. Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing" McGraw Hill Education, Indian Edition, ISBN 9780070603646

Reference Books:

1. Sen Loke, "Context Aware Pervasive Systems; Architectures for new Breed of applications",Taylor and Fransis, ISBN 0-8493-7255-0
2. LaurnceYang, Evi Syukur, Seng Loke, "Handbook on Mobile and Ubiquitous Computing : Status and Perspective‖", CRC Press, 2013 ISBN 978-1-4398-4811-1
3. M. Haque and S. I. Ahamed, "Security in pervasive computing: Current status and open issues",
   Int. J. Netw. Secur., vol. 3, no. 3, pp. 203–214, 2006.

e-Books :

1. M. Hilty, –Ubiquitous Computing in the Workplace: What Ethical Issues?‖ no. August, pp. 1–16, 2014, [Online].http://link.springer.com/bookseries/11156L.
2. https://web.uettaxila.edu.pk/CMS/SP2014/teMPCms/tutorial%5CFundamentalsOfMobilePervasiveComputing.pdf
3. http://pervasivecomputing.se/M7012E_2014/material/Wiley.Ubiquitous.Computing.Smart.Devices.Environments.And.Interactions.May.2009.eBook.pdf
4. http://media.techtarget.com/searchMobileComputing/downloads/Mobile_and_pervasive_computing_Ch06.pdf

MOOC Courses Links:

https://www.georgiancollege.ca/academics/part-time-studies/courses/mobile-and-pervasive-computing-comp-3025/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	--	--	--	--	--	--	--	--	--	--
CO2	2	3	2	2	--	--	--	--	--	--	--	--
CO3	3	3	3	3	--	--	--	--	--	--	--	--
CO4	3	2	3	3	--	--	--	--	--	--	--	--
CO5	3	3	3	3	--	--	--	--	--	--	--	--
CO6	1	2	-	3	--	--	--	--	--	--	--	--

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective III
410244(B): Multimedia Techniques

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Graphics (210241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To understand input and output devices, device drivers, control signals and protocols, DSPs
- To study and use standards (e.g., audio, graphics, video)
- To implement applications, media editors, authoring systems, and authoring by studying streams/structures, capture/represent/transform, spaces/domains, compression/coding
- To design and develop content-based analysis, indexing, and retrieval of audio, images, animation, andvideo
- To demonstrate presentation, rendering, synchronization, multi-modal integration/interfaces
- To Understand IoT architecture's and Multimedia Internet of things

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the media and supporting devices commonly associated with multimedia information andsystems.

CO2: Demonstrate the use of content-based information analysis in a multimedia information system.

CO3: Critique multimedia presentations in terms of their appropriate use of audio, video, graphics, color,and other information presentation concepts.

CO4: Implement a multimedia application using an authoring system.

CO5: Understanding of technologies for tracking, navigation and gestural control.

CO6: Implement Multimedia Internet of Things Architectures.

Course Contents

Unit I	Introduction to multimedia	07 Hours

What is Multimedia and their Components, History of Multimedia; Hypermedia, WWW, and Internet; Multimedia Tools: Static (text, graphics, and still images), Active (sound, animation, and video, etc.); Multimedia Sharing and Distribution; Multimedia Authoring Tools: Adobe Premiere, Adobe Director, Adobe Flash.

#Exemplar/Case Studies	To study and install open-source multimedia Tools
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Graphics and Data Representation Techniques	07 Hours

What are Graphics data types, 1-bit Images, 8 –bit grey level ,16-bit grey level images, Image data type,Image data type:8 bit & 24-bit color images, Higher bit depth images, Color Lookup tables.
File Formats: GIF, JPEG, PNG, TIFF, PSD, APS, AI, INDD, RAW, Windows BMP, Windows WMF,
Netpbm format, EXIF, PTM, Text file format: RTF, TGA Applications/Use of text in Multimedia

#Exemplar/CaseStudies	To study conversion of image file formats from one to Other.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Multimedia Representations Techniques**	**07 Hours**

Principal concepts for the analog video: CRT, NTSC Video (National Television System Committee), PAL Video (Phase Alternating Line), SECAM Video (System Electronic Couleur Avec Memoire), Digital Video: Chroma Subsampling, High-Definition TV, Ultra High Definition TV (UHDTV), Component Video: High-Definition Multimedia Interface (HDMI),3D Video and TV: various cues, Basics of Digital Audio: What is Sound?, Nyquist Theorem, SNR, SQNR, Audio Filtering, Synthetic Sounds, MIDI Overview: Hardware, Structure, Conversion to WAV, Coding of Audio: PCM, DPCM, DM (Delta Modulation)

#Exemplar/Case Studies	Install and use Handbrake (link is https://handbrake.fr) software to understand the concept of interlaced, deinterlace, noise filters, bitrate, and frame rate for any sample 30 min video, and note down the observations from the output video.
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Compression Algorithms**	**07 Hours**

Introduction to multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Types of compression algorithms- lossless compression algorithms RLC, VLC, DBC, AC, lossless image compression, differential coding of Images, lossy compression algorithms-Rate distortion theory, Quantization ,Transform coding, wavelet based coding, embedded Zerotress of wavelet coefficients . Image compression standard -JPEG standard, JPEG 2000 standard, LS standard, Bilevel image compression standard. Introduction to video compression - video compression based on motion compensation, Search for motion vectors, MPEG Video coding I , MPEG 1,2,4,7 onwards. Basic Audio Compression Techniques -ADPCM in speech coding, Vocoders, MPEG audio compression

#Exemplar/Case Studies	Implementation of compression algorithms
***Mapping of Course Outcomes for Unit IV**	CO3, CO4

Unit V	**Augmented Reality(AR), Virtual Reality (VR) and Mixed Reality (MR)**	**07 Hours**

Basics of Virtual Reality, difference between Virtual Reality and Augmented Reality, Requirement of Augmented Reality, Components and Performance issues in AR, Design and Technological foundations for Immersive Experiences. Input devices – controllers, motion trackers and motion capture technologies for tracking, navigation and gestural control. Output devices – Head Mounted VR Displays, Augmented and Mixed reality glasses. 3D interactive and procedural graphics. Immersive surround sound. Haptic and vibrotactile devices. Best practices in VR, AR and MR Future applications of Immersive Technologies.
VRML Programming Modeling objects and virtual environments Domain Dependent applications:

Medical, Visualization, Entertainment, etc.

#Exemplar/Case Studies	Navigation Assistance System
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Multimedia Internet of Things**	**07 Hours**

IoT and Multimedia IoT Architecture: IoT Architecture; M-IoT Architectures: Multi-Agent Based, AI-Based Software-Defined, Big Data Layered; Applications of M-IoT: Road Management System, Multimedia IoT in Industrial Applications, Health Monitoring

#Exemplar/Case Studies	Traffic Monitoring System
***Mapping of Course Outcomes for Unit VI**	**CO6**

Learning Resources

Text Books:

1. Tay Vaughan, "Multimedia making it work", Tata McGraw-Hill, 2011, ISBN: 978-0-07-174850-6 MHID: 0-07-174850-4, eBook print version of this title: ISBN: 978-0-07-174846-9, MHID: 0-07-174846-6
2. Ze-Nian Li, Mark S. Drew and Jiang chuan Liu, "Fundamentals of Multimedia", Second Edition, Springer, 2011, ISSN 1868-0941 ISSN 1868-095X (electronic), ISBN 978-3-319-05289-2 ISBN 978-3-319-05290-8 (eBook), DOI 10.1007/978-3-319-05290-8, Pearson Education, 2009.

Reference Books:

1. Ali Nauman et al. "Multimedia Internet of Things: A Comprehensive Survey", Special Section on Mobile Multimedia: Methodology and Applications, IEEE Access, Volume 8, 2020

2. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842. Amazon

e-Books :

1. https://users.dimi.uniud.it/~antonio.dangelo/MMS/materials/Fundamentals_of_Multimedia.pdf
2. https://mu.ac.in/wp-content/uploads/2021/04/Multimedia.pdf
3. https://www.baschools.org/pages/uploaded_files/chap13.pdf

MOOC Courses Links:

- https://nptel.ac.in/courses/117105083

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	2	1	-	2	3	-	-	-	-	1	-	-
CO4	3	3	2	2	1	1	1	1	1	1	1	1
CO5	2	1	2	-	-	-	-	-	-	-	-	-
CO6	3	3	2	1	2	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective III
410244(C): Cyber Security and Digital Forensics

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Networks and Security(310244), Information Security(310254(A))

Companion Course: 410246: Laboratory Practice IV

Course Objectives:

- To enhance awareness cyber forensics.
- To understand issues in cyber crime and different attacks
- To understand underlying principles and many of the techniques associated with the digital forensic practices
- To know the process and methods of evidence collection
- To analyze and validate forensic data collected.
- To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Outcomes: At the end of the course, the student should be able to:

CO1: Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
CO2: Build appropriate security solutions against cyber-attacks.
CO3:Underline the need of digital forensic and role of digital evidences.
CO4: Explain rules and types of evidence collection
CO5: Analyze, validate and process crime scenes
CO6: Identify the methods to generate legal evidence and supporting investigation reports.

Course Contents

Unit 1	Introduction to Cyber Security	06 Hours

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: crime against an individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism. Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

#Exemplar/Case Studies	Data Breach Digest – Perspective & Reality : http://verizonenterprise.com/databreachdigest
***Mapping of Course Outcome for Unit I**	CO1

Unit 2	Cyber Crime Issues and Cyber attacks	06 Hours

Unauthorized Access to Computers, Computer Intrusions, Viruses, and Malicious Code, Internet Hacking and Cracking, Virus and worms, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Cybercrime prevention methods, Application security (Database, E-mail, and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Hardware protection mechanisms, OS Security

#Exemplar/Case Studies	Cyber Stalking types & their cases respectively
***Mapping of Course Outcome for Unit II**	CO2

Unit 3	Introduction to Digital Forensics	06 Hours

What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of

Professional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology, Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution.			
#Exemplar/Case Studies	Demonstrate practice Linux networking security recovery commands.& Study Tools viz; FTK & The Sleuth Kit		
***Mapping of Course Outcome for Unit III**	CO3		
Unit 4	**Evidence Collection and Data Seizure**		**06 Hours**
Why Collect Evidence? Collection Options ,Obstacles, Types of Evidence — The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.			
#Exemplar/Case Studies	Understand how computer forensics works by visiting: http://computer.howstuffworks.com/computer-forensic.htm/printable(23 December 2010)		
***Mapping of Course Outcome for Unit IV**	CO4		
Unit 5	**Computer Forensics analysis and validation**		**06 Hours**
Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, and performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case			
#Exemplar/Case Studies	Discuss cases under Financial Frauds, Matrimonial Frauds, Job Frauds, Spoofing, and Social media. Then write down safety tips, precautionary measures for the discussed fraud cases.		
***Mapping of Course Outcomes for Unit V**	CO5		
Unit 6	**Current Computer Forensic tools**		**06 Hours**
Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.			
#Exemplar/Case Studies	Install Kali Linux & practice following examples: 1. https://www.youtube.com/watch?time_continue=6&v=MZXZctqIU-w&feature=emb_logo		
***Mapping of Course Outcome for Unit VI**	CO6		
Learning Resources			
Text Books: **1.** John R. Vacca, “Computer Forensics”, Computer Crime Investigation Firewall Media, New Delhi. **2.** Nelson, Phillips Enfinger, Steuart, “Computer Forensics and Investigations”, CENGAGE Learning			
Reference Books:			

1. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, "Real Digital Forensics", Addison-Wesley Pearson Education
2. Tony Sammes and Brian Jenkinson, "Forensic Compiling", A Tractitioneris Guide, Springer International edition.
3. Christopher L.T. Brown, "Computer Evidence Collection & Presentation", Firewall Media.
4. Jesus Mena, "Homeland Security, Techniques & Technologies", Firewall Media.

e books:

1.**https://www.pdfdrive.com/computer-forensics-investigating-network-intrusions-and-cyber-crime-e15858265.html**

2.**https://dokumen.pub/handbook-of-computer-crime-investigation-forensic-tools-and-technology-1stnbsped-0121631036-9780121631031.html**

3.Massachusetts Institute of Technology Open Courseware: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/

MOOC Courses Links:

- **MIT Open CourseWare: https://ocw.mit.edu/courses/**

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	2
CO2	1	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	2	3	3	-	-	-	-	-	-	-	-	3
CO5	2	2	2	2	-	-	-	-	-	-	-	3
CO6	2	3	2	3	-	-	-	-	-	-	-	3

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective III 410244(D): Object oriented Modeling and Design		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Software Engineering (210245)

Companion Course: Laboratory Practice IV (410247)

Course Objectives:

- Describe the concepts involved in Object-Oriented modelling and their benefits.
- Demonstrate concept of use-case model, sequence model and state chart model for a given problem.
- Explain the facets of the unified process approach to design and build a Software system.
- Translate the requirements into implementation for Object Oriented design.
- Choose an appropriate design pattern to facilitate development procedure. Select suitable design pattern depending on nature of application.
- To describe Designing and Management of Patterns.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the concepts of object-oriented and basic class modelling.
CO2: Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
CO3: Choose and apply a befitting design pattern for the given problem
CO4: To Analyze applications, architectural Styles & software control strategies
CO5: To develop Class design Models & choose Legacy Systems.
CO6:To Understand Design Patterns

Course Contents

Unit I	Introduction To Modeling	06 Hours

What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

#Exemplar/Case Studies	Case Study of ATM System
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Advanced Class Modeling and State Modeling	06 Hours

Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram

behavior; Practical tips.		
#Exemplar/CaseStudies	Case Study of Train Reservation System	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Advanced State Modeling and Interaction Modeling**	**06 Hours**
Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips.Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.		
#Exemplar/Case Studies	Case Study of Coffee Vending Machine	
***Mapping of Course Outcomes for Unit III**	CO2, C03	
Unit IV	**User Application Analysis : System Design**	**06 Hours**
Application Analysis: Application interaction model; Application class model; Application state model; Adding operations. Overview of system design; Estimating performance; Making a reuse plan; Breaking asystem in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of datastorage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example		
#Exemplar/Case Studies	Case System of ATM System	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**Class Design ,Implementation Modeling, Legacy Systems**	**06 Hours**
Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example. Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing. Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance		
#Exemplar/Case Studies	Case study of College Library System	
***Mapping of Course Outcomes for Unit V**	CO4, CO5	
Unit VI	**Design Pattern**	**06 Hours**
What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Patterndescription Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber. Management Patterns: Command processor; View handler. Idioms: Introduction; what can idioms provide? Idiomsand style; Where to find idioms; Counted Pointer example		

#Exemplar/Case Studies	Design Pattern for Any suitable System
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Michael Blaha, James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education, 2005.
2. Frank Buchmann, Regine Meunier, Hans Rohnert, Peter Sommer lad, Michael Stal, "Pattern-Oriented Software Architecture, A System of Patterns", Volume 1, John Wiley and Sons, 2007

Reference Books:

1. Grady Booch et al, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2007
2. Brahma Dathan, Sarnath Ramnath, "Object-Oriented Analysis, Design, and Implementation", Universities Press, 2009
3. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, " UML 2 Toolkit", Wiley-Dreamtech India, 2004
4. Simon Bennett, Steve McRobb and Ray Farmer, " UML 2 Toolkit, Object- Oriented Systems Analysis and Design Using UML, 2 nd Edition, Tata McGraw-Hill, 2002

e-Books :

1. Object Oriented Modeling and Design - https://www.pdfdrive.com/object-oriented-design-and-modeling-d10014860.html
2. https://www.gopalancolleges.com/gcem/course-material/computer-science/course-plan/sem-Vll/object-oriented-modeling-and-design-10CS71.pdf

MOOC Lectures Links:

- https://nptel.ac.in/courses/106105153

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	--	--	--	--	--	--
CO2	2	2	2	2	2	2	--	--	--	--	--	--
CO3	2	2	2	2	2	2	--	--	--	--	--	--
CO4	2	2	2	2	2	2	--	--	--	--	--	--
CO5	2	2	2	2	2	2	--	--	--	--	--	--
CO6	2	2	2	2	2	2	--	--	--	--	--	--

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective III 410244(E): Digital Signal Processing		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Engineering Mathematics III(207003)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand Design of filters as DT systems
- To get acquainted with the DSP Processors and DSP applications

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand the mathematical models and representations of DT Signals and Systems
CO2: Apply different transforms like Fourier and Z-Transform from applications point of view.
CO3: Understand the design and implementation of DT systems as DT filters with filter structuresand different transforms.
CO4: Demonstrate the knowledge of signals and systems for design and analysis of systems
CO5: Apply knowledge and use the signal transforms for digital processing applications
CO6:To understand Filtering and Different Filter Structures

Course Contents

Unit I	Signals and Systems	08 Hours

Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding

#Exemplar/Case Studies	Audio/Music Sampling
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Frequency Domain Representation of Signal	08 Hours

Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral leakage

#Exemplar/Case Studies	Spectral Analysis using FFT
***Mapping of Course Outcomes for Unit II**	CO1

Unit III	**Fast Fourier Transform (FFT) and Z-Transform(ZT)**	**08 Hours**

Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method.

#Exemplar/Case Studies	Discrete Hilbert Algorithm
***Mapping of Course Outcomes for Unit III**	CO2

Unit IV	**Analysis of DT - LTI Systems**	**08 Hours**

System function H(z), H(z) in terms of Nth order general difference equation, all poll and all zero systems, Analysis of LTI system using H(Z), Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of H(Z) and difference equation, Frequency response of system, Frequency response from pole-zero plot using Simple geometric construction.

#Exemplar/Case Studies	Schur Algorithm
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Digital Filter Design**	**08 Hours**

Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, Linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, Frequency Warping, Pre-warping, Design examples, Comparison of IIR and FIR Filters.

#Exemplar/Case Studies	Realization of an Analogue Second-order Differentiator
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Filter Structures and DSP Processors**	**08 Hours**

Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).

#Exemplar/Case Studies	Architectures and Design techniques for energy efficient embedded DSP

	and multimedia processing
***Mapping of Course Outcomes for Unit VI**	**CO6**

Learning Resources

Text Books:

1. Proakis J, Manolakis D, "Digital Signal Processing", 4th Edition, Pearson Education, ISBN9788131710005
2. Oppenheium A, Schafer R, Buck J, "Discrete time Signal Processing", 2nd Edition, PearsonEducation, ISBN 9788131704929

Reference Books:

1. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill,1998, ISBN 0-07-044705-5
2. Ifleachor E. C., Jervis B. W., “Digital Signal Processing: A Practical Approach “, Pearson-Education, 2002, , ISBN-13: 978-0201596199,ISBN-10: 0201596199
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw-Hill,ISBN 0-07-463996-X
4. S. Poornachandra, B. Sasikala, “Digital Signal Processing”,3rd Edition, McGraw-Hill, ISBN-13:978-07- 067279-6

e-Books :

1. An Introduction to Digital Signal Processing: A Focus on Implementation https://www.riverpublishers.com/pdf/ebook/RP_E9788792982032.pdf

MOOC Courses Links:

- **Digital signal Processing Introduction- https://nptel.ac.in/courses/117102060**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	1	2	2	2	1	-	-	-	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	-
CO5	3	2	3	2	2	-	-	-	-	-	-	-
CO6	2	2	2	2	2	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective IV
410245(A): Information Retrieval

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Database Management Systems(310241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To study basic concepts of Information Retrieval.
- To study concepts of Indexing for Information Retrieval.
- To analyze the performance of information retrieval using advanced techniques such asclassification, clustering, and filtering over multimedia.
- To provide comprehensive details about various Evaluation methods.
- To understand the changes necessary to transfer a Basic IR system into large scale search service system.
- To understand Parallel Information retrieval and Web structures .

Course Outcomes:

On completion of the course, student will be able to–

CO1:Implement the concept of Information Retrieval

CO2:Generate quality information out of retrieved information

CO3:Apply techniques such as classification, clustering, and filtering over multimedia to analyzethe information

CO4:Evaluate and analyze retrieved information

CO5:Understand the data in various Application and Extensions of information retrieval

CO6: Understand Parallel information retrieving and web structure.

Course Contents

Unit I	Introduction , Basic techniques, &Token	07 Hours

Introduction: The IR System, The Software Architecture Of The IR System.

Basic IR Models: Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model and Latent Semantic Indexing Model.

Basic Tokenizing: Simple Tokenizing, Stop-Word Removal and Stemming.

#Exemplar/Case Studies	A Case Study Of Onitsha Divisional Library Which Aims At Finding TheCauses And Solutions To The Problems Of Information Retrieval Methods By The Library.
*Mapping of Course Outcomes for Unit I	CO 1

Unit II	Static Inverted Indices and Query Processing	07 Hours

Static Inverted Indices :Inverted Index Construction, **Index Components and Index Life Cycle, The Dictionary** : Sort-based dictionary ,Hash-based dictionary, Interleaving Dictionary and Postings Lists,

Index Construction: Different types of Index Construction, In-Memory Index Construction, Sort-Based Index Construction, Merge-Based Index Construction, Disk-Based Index Construction), **Other types of Indices**.

Query Processing : Query Processing for Ranked Retrieval , Document-at-a-Time Query Processing, Term-at-a-Time Query Processing, Pre-computing Score Contributions, Impact Ordering)

Query optimization, Lightweight Structure : Generalized Concordance Lists, Operators, Implementation & Examples

#Exemplar/CaseStudies	Match the search statement with the stored database
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Index Compression and Dynamic Inverted Indices**	**07 Hours**

General-Purpose Data Compression,

Data Compression : Modeling and Coding, Huffman Coding, Arithmetic Coding, Symbolwise Text Compression

Compressing Postings Lists:

Nonparametric Gap Compression, Parametric Gap Compression, Context-Aware Compression Methods, Index Compression for High Query Performance, Compression Effectiveness, DecodingPerformance, Document Reordering.

Dynamic Inverted Indices:

Incremental Index Updates, Contiguous Inverted Lists, Noncontiguous Inverted,

Document Deletions: Invalidation List, Garbage Collection, Document Modifications,

#Exemplar/Case Studies	Translating Short Segments with NMT: A Case Study in English-to-Hindi
***Mapping of Course Outcomes for Unit III**	CO2

Unit IV	**Probabilistic Retrieval and Language Modeling & Related Methods , Categorization & Filtering**	**07 Hours**

Probabilistic Retrieval: Mdeling Relevance, The Binary Independence Model, Term Frequency, Document Length:BM25, Relevance Feedback, Field Weights; **Language Modeling and Related Methods:** Generating Queries from Documents, Language Models and Smoothing, Ranking with Language Models, Divergence from Randomness, PassageRetrieval and Ranking **Categorization and Filtering:** Detailed Examples, Classification, Linear, Similarity- Based, Probabilistic Classifiers, Generalized Linear Models. Information-Theoretic Model.

#Exemplar/Case Studies	E-Mail on the Move: Study of E-mail Categorization, Filtering, and Alerting on Mobile Devices
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Measuring Effectiveness and Measuring Efficiency**	**07 Hours**

Measuring Effectiveness - Traditional effectiveness measure, The Text Retrieval Conference (TREC), Using statistics in evaluation, Minimizing adjudication Effort, Nontraditional effectiveness measures, **Measuring Efficiency** – Efficiency criteria, Query Scheduling, Caching, Introduction to Redisand Memcached

#Exemplar/Case Studies	Study of API Handling
***Mapping of Course Outcomes for Unit V**	CO4

Unit VI	Parallel Information retrieval , Web Search	07 Hours

Parallel Information retrieval - Parallel Query Processing, MapReduce

Web Search- The structure of the web, Quires and Users, Static ranking, Dynamic ranking, Evaluation web search, Web Crawlers, Web crawler libraries, Python Scrapy, Beautiful Soup

#Exemplar/Case Studies	Study of Google Map / Facebook information retrieval
***Mapping of Course Outcomes for Unit VI**	CO5, CO6

Learning Resources

Text Books:

1. S. Buttcher, C. Clarke and G. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines" MIT Press, 2010, ISBN: 0-408-70929-4.
2. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008, -13: 9780521865715
3. Ricardo Baeza , Yates and Berthier Ribeiro Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", 2nd Edition, ACM Press Books 2011.
4. Bruce Croft, Donald Metzler and Trevor Strohman, "Search Engines: Information Retrieval in Practice", 1st Edition Addison Wesley, 2009, ISBN: 9780135756324

Reference Books:

1. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html)
2. W.R. Hersh, "Information Retrieval: A Health and Biomedical Perspective", Springer, 2002.
3. G. Kowalski, M.T. Maybury. "Information storage and Retrieval System" , Springer, 2005
4. W.B. Croft, J. Lafferty, "Language Modeling for Information Retrieval", Springer, 2003

e-Books :

1. Information Retrieval- www.informationretrieval.org

MOOC Courses Links:

- https://nptel.ac.in/courses/117102060

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	1	-	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-
CO4	1	1	2	1	-	-	-	-	-	-	-	-
CO5	1	1	2	3	2	-	-	-	-	-	-	-
CO6	1	2	2	2	1	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective IV
410245(B): GPU Programming and Architecture

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Computer Graphics(210244)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To Understand Graphics Processing Unit (GPU) Concepts.
- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models
- To examine the architecture and capabilities of modern GPUs.

Course Outcomes:

After completion of the course, students should be able to-

CO1: Describe GPU architecture

CO2: Write programs using CUDA, identify issues and debug them.

CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication

CO4: Write simple programs using OpenCL

CO5: Identify efficient parallel programming patterns to solve problems

CO6: Explore the modern GPUs architecture and it's Applications.

Course Contents

Unit I	Introduction to Graphics Processing Unit (GPU)	07 Hours

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

#Exemplar/Case Studies	Review of traditional Computer Architecture
***Mapping of Course Outcomes for Unit I**	CO 1

Unit II	Cuda Programming	07 Hours

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

#Exemplar/Case Studies	Write basic CUDA programs.
***Mapping of Course Outcomes for Unit II**	CO 2

Unit III	Programming Issues	07 Hours

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.			
#Exemplar/Case Studies	Study of various CUDA errors		
***Mapping of Course Outcomes for Unit III**	CO 3		
Unit IV	**Opencl Basics**		**07 Hours**
OpenCL Standard, Kernels, Host Device Interaction, Execution Environment, Memory Model, Basic OpenCL Examples.			
#Exemplar/Case Studies	Write OpenCL basic program		
***Mapping of Course Outcomes for Unit IV**	CO 4		
Unit V	**Algorithms on GPU**		**07 Hours**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster			
#Exemplar/Case Studies	Describe multi-dimensional mapping of dataspace.		
***Mapping of Course Outcomes for Unit V**	CO 5		
Unit VI	**OpenCL and Application Design**		**07 Hours**
OpenCL for Heterogeneous Computing, Application Design : Efficient Neural Network Training/Inferencing			
#Exemplar/Case Studies	Describe OpenCL for Heterogeneous computing		
***Mapping of Course Outcomes for Unit VI**	CO6		

Learning Resources

Text Books:

1. Shane Cook, " CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3rd Edition, Morgan Kauffman, 2015.
3. Benedict Gaster,Lee Howes, David R. Kaeli, "Heterogeneous Computing with OpenCL"

Reference Books :

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison –Wesley, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPUProgramming", Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors ", A Hands-onApproach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

e-Books :

1. https://www.perlego.com/book/1418742/cuda-handbook-a-comprehensive-guide-to- gpu-programming-the-pdf

NPTEL/YouTube video lecture link

- https://onlinecourses.nptel.ac.in/noc20_cs41/preview

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-
CO3	1	2	2	2	2	-	-	-	-	-	-	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	2	-	-	-	-	-	-	-
CO6	1	2	2	1	2	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective IV
410245(C): Mobile Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	3	In-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications
- To demonstrate the protocols of mobile communication.
- To know GSM architecture and support services
- To Study on location, handoff management and wireless fundamentals.
- To summarize VLR and HLR identification algorithms
- To learn current technologies being used on field and design and development of various network protocol using simulation tools.

Course Outcomes:

CO1: Develop a strong grounding in the fundamentals of mobile Networks

CO2: Apply knowledge in MAC, Network, and Transport Layer protocols ofWireless Network

CO3: Illustrate Global System for Mobile Communications

CO4: Use the 3G/4G technology based network with bandwidth capacity planning,VLR and HLR identification algorithms

CO5: Classify network and transport layer of mobile communication

CO6: Design & development of various wireless network protocols using simulationtools

Course Contents

Unit I	Introduction to Mobile Computing	07 Hours

Introduction to Mobile computing, Constraints in mobile computing, Application of mobile computing, Generations of mobile wireless 1G to 5G, Future of mobile computing, Radio frequency Technology, Public Switched Telephone network, (PSTN), Public Communication service (PCS), PCS Architecture, , Blue tooth, Ad-hoc Networks.

#Exemplar/Case Studies	5G Network , Spectrum sharing for D2D communication in 5G cellular networks
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Mobile Wireless protocols	07 Hours

Introduction of WAP, WAP applications, WAP Architecture, WAP Protocol Stack, Challenges in WAP . Introduction, Benefits, Difference, Routing protocols for ad hoc wireless networks: DSDV and AODV, Wireless Application protocols: MAC, SDMA, FDMA, TDMA, CDMA, Cellular Wireless Networks. Wireless Communication: Cellular systems, Frequency Management and Channel Assignment Types of handoff

and their characteristics.		
#Exemplar/Case Studies	IPoC: A New Core Networking Protocol for 5G Networks.	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Global System for Mobile Communication**	**07 Hours**
Global System for Mobile Communications (GSM) architecture , Mobile Station, Base Station System, Switching subsystem, Security, Data Services, HSCSD, GPRS - GPRS system and protocol architecture 2.3 UTRAN, UMTS core network; Improvements on Core Network, 802.11 Architecture 802.11a, 802.11b standard		
#Exemplar/Case Studies	5G mobile communications	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**GSM Networking Signaling and Mobile Management**	**07 Hours**
GSM MAP Service framework, MAP protocol machine, GSM location management, Transaction management, Mobile database, Introduction to location management HLR andLR VLR and HLR Failure restoration, VLR identification algorithm, O-I, O-II algorithm etc. Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical).		
#Exemplar/Case Studies	5G Mobility Management , Micro Mobility: CellularIP, HAWAII, HMIPv6	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Mobile Network and Transport Layers**	**07 Hours**
Mobile IP , IP packet delivery, Tunnelling and encapsulation, IPv6, DHCP, Vehicular Ad Hoc networks (VANET), MANET , Traditional TCP, Snooping TCP, Mobile TCP, 3G wireless network, Wireless Application Protocol, WDP WTP, WML, WTA architecture, Cellular IP		
#Exemplar/Case Studies	5G Network and Transport Layers	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**3G and 4G Technologies**	**07 Hours**
3G and 4G Technologies for GSM and CDMA:, W-CDMA, UMTS, HSPA (High Speed Packet Access), HSDPA, HSUPA, HSPA+, TD-SCDMA, LTE (E-UTRA) 3GPP2 family CDMA2000 1x, 1xRTT, EV-DO (Evolution-Data Optimized), Long Term Evolution (LTE) in 4G. Architecture of 5G. Role of 5G in IoT.		

#Exemplar/Case Studies	Long-Term Evolution (LTE) of 3GPP
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Jochen Schiller, "Mobile Communications", Pearson Education, 2009.
2. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together", 2012, ISBN-13: 978-1118341483
3. Raj Kamal, "Mobile Computing", 2/e, Oxford University Press

Reference Books :

1. William Stallings, ""Wireless Communications & Networks", Second Edition, Pearson Education
2. Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G MobileCommunications", Wiley publications
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2012.

e-Books :

1. http://www.dauniv.ac.in/downloads/Mobilecomputing/Microsoft%20%20MobileCompChap02L02HandhelCompandMobileOSes.pdf

MOOC Courses Links :

- https://nptel.ac.in/courses/106106147

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	1	2	-	2	-	-	-	-	-	-	-	1
CO6	2	2	-	2	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective IV
410245 (D): Software Testing and Quality Assurance

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Software Engineering (210253), Software Project Management(310245(D))

Companion Course: **Lab Practice IV**

Course Objectives:

- Introduce basic concepts of software testing.
- Understand the best way to increase the effectiveness, test coverage, and execution speed in software testing.
- Understand white box, block box, object oriented, web based and cloud testing.
- Understand the importance of software quality and assurance software systems development.
- Know in details automation testing and tools used for automation testing.
- To learn and understand the combination of practices and tools that are designed to help QAprofessionals test more efficiently.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe fundamental concepts in software testing such as manual testing, automation testingand software quality assurance.

CO2: Design and Develop project test plan, design test cases, test data, and conduct test operations.

CO3: Apply recent automation tool for various software testing for testing software.

CO4: Apply different approaches of quality management, assurance, and quality standard to softwaresystem.

CO5: Apply and analyze effectiveness Software Quality Tools.

CO6: Apply tools necessary for efficient testing framework.

Course Contents

Unit I	Introduction to Software Testing	07 Hours

Introduction: historical perspective, Definition, Core Components, Customers suppliers and process, Objectives of Testing, Testing and Debugging, Need of Testing, Quality Assurance and Testing, Why Software has Errors, Defects and Failures and its Causes and Effects, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, Benchmarking and metrics, Problem Solving Techniques and Software Tools. Software Quality, Constraints of Software product Quality assessment, Quality and Productivity Relationship, Requirements of Product, Software Development Process, Types of Products, Software Development Lifecycle Models, Software Quality Management, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

#Exemplar/Case Studies	1. Offshore delivery model for an Airline Company. 2. SAP test automation CoE for Financial Service Provider.

***Mapping of Course Outcomes for Unit I**	CO1	
Unit II	**Test Planning and Quality Management**	**07 Hours**
Test Planning –Artifacts, Strategy, Test Organization –Test Manager & Tester Role, Test plan purpose & contents, Test Strategy and Approach, Test cases & Test Data, Test Entry-Exit criteria, Test Execution Schedule, Use case Testing, Scenario Testing, Test Monitoring & Control- Test Metrics –Test Case Productivity, Test case Coverage, Defect Acceptance & Rejection, Test Efficiency, Efforts and Schedule Variance, Test Efforts biasing Factors, Test Report & configuration Management, Quality Assurance Process, Documentation Risk & Issues. Software Quality, Quality Management Importance, Quality Best practices.		
#Exemplar/CaseStudies	1. Online Recommendation System 2. Quality Engineering services for Medical Devices company | CaseStudy (cigniti.com)	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Test Case Design Techniques**	**07 Hours**
Software Testing Methodologies: White Box Testing, Black Box Testing, Grey Box Testing. Test Case Design Techniques: Static Techniques: Informal Reviews, Walkthroughs, Technical Reviews, Inspection. Dynamic Techniques: Structural Techniques: Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing Black Box Techniques: Boundary Value Analysis, Equivalence Class Partition, State Transition Technique, Cause Effective Graph, Decision Table, Use Case Testing, Experienced Based Techniques: Error guessing, Exploratory testing **Levels of Testing**: Functional Testing: Unit Testing, Integration Testing, System Testing, User Acceptance Testing, Sanity/Smoke Testing, Regression Test, Retest. Non-Functional Testing: Performance Testing, Memory Test, Scalability Testing, Compatibility Testing, Security Testing, Cookies Testing, Session Testing, Recovery Testing, Installation Testing, Adhoc Testing, Risk Based Testing, I18N Testing, L1ON Testing, Compliance Testing. Link:https://www.besanttechnologies.com/training-courses/software-testing-training/manual-testing-training-institute-in-chennai		
#Exemplar/Case Studies	1. Case Study: Manual Testing (Online Marketing SoftwarePlatform) Link: https://www.360logica.com/blog/case-study-manual-testing-online-marketing-software-platform/ 2. Case Study: Decision Table Testing (transferring money online to an account which is already added and approved.)	
***Mapping of Course Outcomes for Unit III**	**CO3**	
Unit IV	**Software Quality Assurance and Quality Control**	**07 Hours**
Software Quality Assurance: Introduction, Constraints of Software Product Quality Assessment, Quality and Productivity Relationship, Requirements of a Product, Characteristics of Software,		

Software Development Process, Types of Products, Schemes of Criticality Definitions, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects ofQualityManagement.

Software Quality Control: Software quality models, Quality measurement and metrics, Quality plan, implementation and documentation, Quality tools including CASE tools, Quality control and reliability of quality process, Quality management system models, Complexity metrics and Customer Satisfaction, International quality standards – ISO, CMM

#Exemplar/Case Studies	1. Case Study #1 – Android Application Acceptance Test Suite 2. Case Study #2 – API Acceptance Test Suite Link for above case studies - Software Quality Assurance Case Studies - Beta Breakers
***Mapping of Course Outcomes for Unit IV**	**CO4**

Unit V	**Automation Testing Tools / Performance Testing Tools**	**07 Hours**

Automation Testing: What is automation testing, Automated Testing Process, Automation Frameworks, Benefits of automation testing, how to choose automation testing tools. Selenium Automation Tools: Selenium's Tool Suite- Selenium IDE, Selenium RC, Selenium Web driver, Selenium Grid. Automation Tools: SoapUI, Robotic Process Automation (RPA), Tosca, Appium.

Performance Testing : What is Performance Testing what is use of it? Tools used for performance testing - Apache Jmeter.

#Exemplar/Case Studies	**1.** Case Study: Cucumber open-source automation testingframework. **2.** Case Study: (PDF) Automated Software Testing—A Case Study(researchgate.net)
***Mapping of Course Outcomes for Unit V**	**CO5**

Unit VI	**Testing Framework**	**07 Hours**

Testing Framework: Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance Elements of SQA, SQA Tasks, Goals and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan, Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Flow Chart, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process.

#Exemplar/Case Studies	1. Case study: Software Quality In AcademicCurriculum. 2. Case study: Evaluation of an Automated Testing Framework: ACase Study (scielo.sa.cr)
***Mapping of Course Outcomes for Unit VI**	**CO6**

Learning Resources

Text Books:

1. M G Limaye, “Software Testing Principles, Techniques and Tools”, Tata McGraw Hill, ISBN:9780070139909 0070139903
2. Srinivasan Desikan, Gopal Swamy Ramesh, “Software Testing Principles and Practices”, Pearson,ISBN-10: 817758121X

Reference Books:

1. Naresh Chauhan, “Software Testing Principles and Practices", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Stephen Kan, “Metrics and Models in Software Quality Engineering”, Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

e-Books :

1. M G Limaye, “Software Testing Principles, Techniques and Tools"
https://books.google.co.in/books?id=zUm8My7SiakC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. Srinivasan Desikan, Gopalswamy Ramesh, “Software Testing Principles and Practices”
https://kupdf.net/queue/software-testing-principles-and-practices-by-srinivasan_5b0ae8eae2b6f51f7d862d26_pdf?queue_id=-1&x=1656562364&z=MTE1LjI0Mi4yNDIuNzA=
3. Naresh Chauhan, “Software Testing Principles and Practice"
. https://pdfcoffee.com/download/se-4-pdf-free.html

MOOC Courses Links:

- https://nptel.ac.in/courses/106105150
- NPTEL : NOC: Software Testing (2017) (Computer Science and Engineering) (digimat.in)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	2	-	-	1	2	1	2	1
CO2	1	3	3	2	1	-	-	1	2	1	2	-
CO3	1	-	1	2	3	-	-	-	2	1	1	-
CO4	1	1	2	3	1	1	1	2	2	2	2	-
CO5	1	2	1	2	3	1	-	-	1	1	2	-
CO6	1	2	3	2	3	1	-	-	2	1	1	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective IV 410245(E): Compilers		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Theory of Computation(310241), Systems Programming and Operating System (310251)

Companion Course : Laboratory Practice IV (410247)

Course Objectives:

- To aware about language translation theories and compiler design stages
- To illustrate the various parser configurations
- To exemplify the use of syntax directed translation in intermediate code
- To Understand Storage Management and Control Structure Environment .
- Learn to develop a Code generator
- To demonstrate the numerous optimization methods used in the creation of different optimizing compilers

Course Outcomes:

On completion of the course, student will be able to–

CO1: **Design** and **implement** a lexical analyzer using LEX tools

CO2: **Design** and **implement** a syntax analyzer using YACC tools

CO3:**Understand** syntax-directed translation and run-time environment

CO4 : **Generate** intermediate codes for high-level statements.

CO5 :**Construct** algorithms to produce computer code.

CO6: **Analyze and transform** programs to improve their time and memory efficiency

Course Contents

Unit I	Notion and Concepts	08 Hours
Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.		
#Exemplar/Case Studies	Study of LEX Compiler	
***Mapping of Course Outcomes for Unit**	CO1	
Unit II	**Parsing**	**08 Hours**
Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.		

#Exemplar/Case Studies	Study of YAAC	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Syntax Translation Schemes**	**08 Hours**
Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.		
#Exemplar/Case Studies	Applications of Syntax Directed Translation	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Run-time Storage Management**	**08 Hours**
Storage Management – Static, Stack and Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do -while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.		
#Exemplar/Case Studies	CARAT - Compiler and runtime based address translation model	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Code Generation**	**07 Hours**
Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.		
#Exemplar/Case Studies	Code Generator for a Virtual Machine Code based JavaScript Compiler (http://article.nadiapub.com/IJAST/vol119/11.pdf)	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Code Optimization**	**07 Hours**
Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.		
#Exemplar/Case Studies	Execution of super-scalar processors	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books:

1. V Aho, R Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8
2. Dick Grune, Bal, Jacobs, Langendoen, " Modern Compiler Design", Wiley, ISBN 81-265-0418-8

Reference Books:

1. Anthony J. Dos Reis, "Compiler Construction Using Java", JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7
2. K Muneeswaran, "Compiler Design", Oxford University press, ISBN 0-19-806664-3
3. J R Levin, T Mason, D Brown, "Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X

eBooks:

1. **Basics of Compiler Design**
   http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
2. **Modern Compiler Design**
   http://160592857366.free.fr/joe/ebooks/ShareData/Modern%20Compiler%20Design%202e.pdf

MOOC Courses Links:

- **https://nptel.ac.in/courses/106105190**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	2	-
CO3	1	2	1	1	1	-	-	-	-	-	-	-
CO4	1	2	1	1	1	-	-	-	-	-	-	-
CO5	1	2	2	2	-	-	-	-	-	-	-	-
CO6	1	2	2	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410246: Laboratory Practice III		
Teaching Scheme: **Practical: 04 Hours/Week**	**Credit** **02**	**Examination Scheme:** **Term work: 50 Marks** **Practical: 50 Marks**

Companion Course: Design and Analysis of Algorithms (410241), Machine Learning(410242), Blockchain Technology(410243)

Course Objectives:

- Learn effect of data preprocessing on the performance of machine learning algorithms
- Develop in depth understanding for implementation of the regression models.
- Implement and evaluate supervised and unsupervised machine learning algorithms.
- Analyze performance of an algorithm.
- Learn how to implement algorithms that follow algorithm design strategies namely divide and conquer, greedy, dynamic programming, backtracking, branch and bound.
- Understand and explore the working of Blockchain technology and its applications.

Course Outcomes:

After completion of the course, students will be able to

CO1: Apply preprocessing techniques on datasets.

CO2: Implement and evaluate linear regression and random forest regression models.

CO3: Apply and evaluate classification and clustering techniques.

CO4: Analyze performance of an algorithm.

CO5: Implement an algorithm that follows one of the following algorithm design strategies: divide and conquer, greedy, dynamic programming, backtracking, branch and bound.

CO6: Interpret the basic concepts in Blockchain technology and its applications

Guidelines for Instructor's Manual

The instructor’s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as a softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to a journal must be avoided. Use of DVD containing student programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Assessment of each Laboratory assignment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality, documentation and neatness.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to each branch beyond the scope of the syllabus.
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - C++, Java, Python, Solidity, etc.

Virtual Laboratory:

- **http://cse01-iiith.vlabs.ac.in/**
- **http://vlabs.iitb.ac.in/vlabs-dev/labs/blockchain/labs/index.php**
- **http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php**

Suggested List of Laboratory Experiments/Assignments.
Assignments from all the Groups (A, B, C) are compulsory.

Course Contents

Group A: Design and Analysis of Algorithms

Any 5 assignments and 1 mini project are mandatory.

1.	Write a program non-recursive and recursive program to calculate Fibonacci numbers and analyze their time and space complexity.
2.	Write a program to implement Huffman Encoding using a greedy strategy.
3.	Write a program to solve a fractional Knapsack problem using a greedy method.
4.	Write a program to solve a 0-1 Knapsack problem using dynamic programming or branch and bound strategy.
5.	Design n-Queens matrix having first Queen placed. Use backtracking to place remaining Queens to generate the final n-queen's matrix.
6.	Write a program for analysis of quick sort by using deterministic and randomized variant.

7.	**Mini Projects** **Mini Project -** Write a program to implement matrix multiplication. Also implement multithreaded matrix multiplication with either one thread per row or one thread per cell. Analyze and compare their performance.
8.	**Mini Project -** Implement merge sort and multithreaded merge sort. Compare time required by both the algorithms. Also analyze the performance of each algorithm for the best case and the worst case.
9.	**Mini Project -** Implement the Naive string matching algorithm and Rabin-Karp algorithm for string matching. Observe difference in working of both the algorithms for the same input.
10	**Mini Project -** Different exact and approximation algorithms for Travelling-Sales-Person Problem
Group B: Machine Learning	
Any 5 assignments and 1 Mini project are mandatory.	
1.	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks: 1. Pre-process the dataset. 2. Identify outliers. 3. Check the correlation. 4. Implement linear regression and random forest regression models. 5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2.	Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3.	Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling Perform following steps: 1. Read the dataset. 2. Distinguish the feature and target set and divide the data set into training and test sets. 3. Normalize the train and test data. 4. Initialize and build the model. Identify the points of improvement and implement the same. 5. Print the accuracy score and confusion matrix (5 points).
4.	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point x=2.

5.	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes
6.	Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data
7.	**Mini Project** **Mini Project -** Use the following dataset to analyze ups and downs in the market and predict future stock price returns based on Indian Market data from 2000 to 2020. Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data
8.	**Mini Project -** Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.). Dataset Link: https://www.kaggle.com/competitions/titanic/data
9.	**Mini Project -** Develop a application for signature identification by creating your own dataset of your college student
Group C: Blockchain Technology	
Any 5 assignments and 1 Mini project are mandatory.	
1.	Installation of MetaMask and study spending Ether per transaction.
2.	Create your own wallet using Metamask for crypto transactions.
3.	Write a smart contract on a test network, for Bank account of a customer for following operations: • Deposit money • Withdraw Money • Show balance
4.	Write a program in solidity to create Student data. Use the following constructs: • Structures • Arrays • Fallback Deploy this as smart contract on Ethereum and Observe the transaction fee and Gas values.
5.	Write a survey report on types of Blockchains and its real time use cases.
6.	Write a program to create a Business Network using Hyperledger
7.	**Mini Projects** **Mini Project -** Develop a Blockchain based application dApp (de-centralized app) for e-voting system.

8.	**Mini Project -** Develop a Blockchain based application for transparent and genuine charity
9.	**Mini Project -** Develop a Blockchain based application for health related medical records
10.	**Mini Project -** Develop a Blockchain based application for mental health

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CO4	3	2	2	-	1	-	-	1	2	-	2	2
CO5	3	2	3	-	1	-	-	1	2	-	-	2
CO6	3	3	2	2	2	-	-	1	2	-	-	2

Savitribai Phule Pune University
Fourth Year of Computer Engineering(2019Course)
410247:Laboratory Practice IV

Teaching Scheme **Practical: 02 Hours/Week**	**Credit** **01**	**Examination Scheme :** **Term Work: 50 Marks**

Companion Course: Elective III(410244), Elective IV(410245)

Course Objectives:

- Learn android application development related to pervasive computing
- Understand various multimedia file formats
- Understand various vulnerabilities and use of various tools for assessment of vulnerabilities
- Understand information retrieval process using standard tools available
- Learn GPU programming and implementation of same using open source libraries
- Learn installation and use of open source software testing tools

Course Outcomes:

After completion of the course, students will be able to

CO1: Apply android application development for solving real life problems
CO2: Design and develop system using various multimedia components.
CO3: Identify various vulnerabilities and demonstrate using various tools.
CO4: Apply information retrieval tools for natural language processing
CO5: Develop an application using open source GPU programming languages
CO6: Apply software testing tools to perform automated testing

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

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Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes and punctuality.

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Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Virtual Laboratory:

- https://hci-iitg.vlabs.ac.in/
- http://vlabs.iitkgp.ernet.in/se/
- https://vlab.amrita.edu/?sub=3&brch=179&sim=1293&cnt=2

410244(A): Pervasive Computing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1.	Develop an indoor location system to Library guide system where it can direct a user to the bookshelf from a mobile device.
2.	Design a pervasive application in which remote computer monitors our health statistics & will determine when one is in trouble & will take appropriate action for rescue.
3.	Develop an Android application in which car will use the Internet to find nearby open parking space.
4.	Android User Activity Recognition – Still, Walking, Running, Driving etc.
5.	Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
6.	Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device.

Group 2

7.	**PMini project:** Develop Food Ordering System which uses the GPS of an Android-based Smartphone to record and analyze various locations that could give alert to the user, then asking the user to select particular food from given hotel list and place an order.
8.	**Mini Project:** Design a mobile sensing platform mounted on a glove that integrates several sensors, such as touch pressure, imaging, inertial measurements, localization and a Radio Frequency Identification (RFID) reader for fruit classification and grading system.
9.	**Mini Project:** Sensor-Based Assistive Devices for Visually Impaired People. It should cover following points: • Determining obstacles around the user body from the ground to the head; • Affording some instructions to the user about the movement surface consists of gaps or textures; • Finding items surrounding the obstacles; • Providing information about the distance between the user and the obstacle with essential direction instructions.

10.	**Mini Project:** Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

410244(B): Multimedia Techniques

Group 1	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.	
1.	To study and install open-source multimedia tools and create an application using appropriate tool to design the college webpage
2.	To create JPEG Image that demonstrates various features of an Image editing tool.
3.	Create or play a sample MIDI format sound file using LMMS / MuseScore / Tuxguitar software tool. Edit the sample file by applying effects like bend, slide, vibrato, and hammer-on/pull-off. Export / Convert final MIDI to WAV file format.
4.	Implement transform coding, quantization, and hierarchical coding for the encoder and decoder of three-level Hierarchical JPEG.
5.	Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
6.	Create a web page for a clothing company which contains all the details of that company and atleast five links to other web pages.
Group 2	
Group2	
7.	**Mini Project:** Design and develop a Navigation Assistance System.
8.	**Mini Project:** Design and Develop a Traffic Monitoring System.
9.	**Mini Project:** Design and develop a Tool for converting image format (e.g. bmp to jpeg)
10.	**Mini Project:** Design and develop a Tool for converting audio format (e.g. wav to mp3)

410244(C): Cyber Security and Digital Forensics

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.	
Group 1	
1.	Write a program for Tracking Emails and Investigating Email Crimes. i.e. Write a program to analyze e–mail header
2.	Implement a program to generate and verify CAPTCHA image
3.	A person on a nearby road is trying to enter into a WiFi network by trying to crack the Password to use the IP Printer resource; write a program detect such attempt and prohibit the access. Develop the necessary scenario by Using an IEEE 802.11, configure a Wi-Fi adapter and Access Point

4.	Write a computer forensic application program for Recovering permanent Deleted Files and Deleted Partitions
5.	Write a program for Log Capturing and Event Correlation
6.	Configure and demonstrate use of vulnerability assessment tool like Wireshark or SNORT
7.	Study of Honeypot
Group 2	
8.	**Mini–project-** Design and develop a tool for digital forensic of images
9.	**Mini Project -** Design and develop a tool for digital forensic of audio
10.	**Mini Project -:** Design and develop a tool for digital forensic of video
11.	**Mini Project -** Design a system for the analysis of cyber crime using various cyber forensic techniques and compare each technique with respect to integrity, confidentiality, availability

410244(D): Object Oriented Modeling And Design

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.	
Group 1	
1.	Draw state model for telephone line, with various activities.
2.	Draw basic class diagrams to identify and describe key concepts like classes, types in your system and their relationships.
3.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
4.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
5.	Draw activity diagrams to display either business flows or like flow charts
6.	Draw component diagrams assuming that you will build your system reusing existing components along with a few new ones
7.	Draw deployment diagrams to model the runtime architecture of your system.
Group 1	
8.	**Mini Project:** Draw all UML diagrams for your project work.
9.	**Mini Project -** Develop a Blockchain based application for health related medical records Draw following UML Diagrams for Bank Management application a. Class Diagram b. Object Diagram c. ER Diagram d. Component Diagram

410244(E): Digital Signal Processing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1	
1.	Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and

	sampling frequency (Fs)). 23. 4. 5. 6. 7.
2.	Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence x(n). Observe the response by considering system as FIR and IIR system).
3.	Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity).
4.	Find the N point DFT / IDFT of the given sequence x (n). Plot the magnitude spectrum |X(K)| Vs K. (Analyze the output for different N and the same input sequence x(n). Also observe the periodicity and symmetry property).
5.	Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6.	Develop a program to plot the magnitude and phase response of a given system (given: h(n): impulse response of system S) (Observe the frequency response for different systems. Compare the frequency response of a system (filter) for different length h(n) i.e filter coefficients).
Group 2:	
7.	**Mini-Project:** Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence x (n). (Analyze the output for different N. Program should work for any value of N and output should be generated for all intermediate stages.) 8 9.
8.	**Mini-Project:** Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Henning, Kaiser. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes).
9.	**Mini-Project:** Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency). 10.
10	**Mini-Project:** Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function H(Z). Application should work for different types of filter specifications that is LPF, HPF, BPF etc. and for different transfer functions of an analog filter).

410245(A): Information Retrieval

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1	
1.	Write a program to Compute Similarity between two text documents.
2.	Implement Page Rank Algorithm.
3.	Write a program for Pre-processing of a Text Document: stop word removal.
4.	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
5.	Write a program to implement simple web crawler.
6.	Write a program to parse XML text, generate Web graph and compute topic specific page
Group 2	

7.	Mini project: Develop Document summarization system
8.	Mini Project: Develop Tweet sentiment analysis system
9.	Mini Project: Develop Fake news detection system
10	Mini Project: Develop a Abstractive summarization system

410245(B): GPU Programing And Architecture

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1

1.	Write a program using OpenCL for Heterogeneous computing
2.	Write CUDA programming with some simple things such as dot product, calculation of pi using integration method etc.
3.	Write CUDA programming for matrix transpose and matrix multiplication
4.	Write OpenCL "Hello World" basic program
5.	Develop program using combining abilities of OpenGL and CUDA to accelerate the performance of simple graphics.
6.	Case study on "Review of traditional Computer Architecture"

Group 2:

7	**Mini Project :** Huge data computation
8	**Mini Project :** Visualization to develop project for image processing and then video processing
9	**Mini Project :** Parallel Algorithm for Searching
10	**Mini Project :** Parallel Algorithm for Sorting

410245(C): Mobile Computing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1

1.	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonally and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
2.	Implementation of GSM security algorithms (A3/A5/A8)
3.	Write an application that draws basic graphical primitives on the screen.
4.	Develop a native application that uses GPS location information.
5.	Design an android Application for Frame Animation
6.	Create a simulation to show working of 3G Mobile network
7.	Create a simulation to show working of 4G Mobile network

Group 2

8.	**Mini Project:** Create an application for Bank using spinner, intent i) Form 1: Create a new account for customer ii) Form 2: Deposit money in customer account. iiii) Link both forms, after completing of first form the user should be directed to second form iv) Provide different menu options
9.	**Mini Project:** Create the module for collecting cellular mobile network performance parameters using telephony API Manager i) Nearest Base Station ii) Signal Strengths iii) SIM Module Details iv) Mobility Management Information
10	**Mini Project:** Create the module for payment of fees for College by demonstrating the following methods. i) FeesMethod()- for calculation of fees ii) Use customized Toast for successful payment of fees iii) Implement an alarm in case someone misses out on the fee submission deadline iv) Demonstrate the online payment gateway
11	**Mini Project:** Create an app to add of a product to SQLite database and make sure to add following features i) SMS messaging and email provision ii) Bluetooth options iii) Accessing Web services iv) Asynchronous remote method call v) Use Alert box for user notification

410245(D): Software Testing and Quality Assurance

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	Write TEST Scenario for Gmail Login Page
2.	Test Scenario for Gmail Login Page
3.	Write Test cases in excel sheet for Social Media application or website
4.	Create Defect Report for Any application or web application
5.	Installation of Selenium grid and selenium Web driver java eclipse (automation tools).
6.	Prepare Software requirement specification for any project or problem statement
Group 2:	
7.	**Mini Project :**Software Testing and Quality Assurance Mini Project Dynamic website of covid-19 information using HTML, CSS, JAVASCRIPT And PHP, MySQL database used to store user account, comment, and registration form details. Regular Expression testcases for testing purpose
8.	**Mini Project :**Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios.

	Perform selective Black-box and White-box testing covering Unit and Integration test by using suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed
9.	**Mini Project :** Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDE and generate test reports encompassing exploratory testing.

410245(E) : Compilers

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory

Group 1

1.	Implement a Lexical Analyzer using LEX for a subset of C. Cross check your output with Stanford LEX.
2.	Implement a parser for an expression grammar using YACC and LEX for the subset of C. Cross check your output with Stanford LEX and YACC.
3.	Generate and populate appropriate Symbol Table.
4.	Implement Semantic Analysis Operations like type checking, verification offunction parameters, variable declarations and coercions possibly using an Attributed Translation Grammar.
5.	Implement the front end of a compiler that generates the three address code for a simple language.
6.	Implementation of Instruction Scheduling Algorithm.
7.	Implement Local and Global Code Optimizations such as Common Sub-expression Elimination, Copy Propagation, Dead-Code Elimination, Loop and Basic-Block Optimizations. (Optional)
8.	Implement a Lexical Analyzer using LEX for a subset of C. Cross check your output with Stanford LEX.

Group 2:

9.	**Mini-Project 1:** Implement POS tagging for simple sentences written Hindi or any Indian Language

@TheCO-POMappingMatrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	3	-	-	2	2	2	1	2
CO2	1	-	2	2	3	2	-	2	2	2	1	2
CO3	1	-	2	2	3	2	-	2	2	2	2	2
CO4	1	-	2	-	3	-	-	2	2	2	2	2
CO5	1	-	2	-	3	-	-	2	2	2	2	2
CO6	1	-	2	-	3	-	-	2	2	2	2	2

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410248: Project Work Stage I

Teaching Scheme: Practical:02Hours/Week	Credit 02	Examination Scheme: Presentation:50Marks

Course Objectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods
- To Reflect upon the experience gained and lessons learned
- To Consider relevant social, ethical and legal issues
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in Team and learn professionalism

Course Outcomes:

On completion of the course, student will be able to–

- Solve real life problems by applying knowledge.
- Analyze alternative approaches, apply and use most appropriate one for feasible solution.
- Write precise reports and technical documents in a nutshell.
- Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work
- Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
AC7-I	MOOC- Learn New Skills
AC7-II	Entrepreneurship Development
AC7-III	Botnet of Things
AC7-IV	3D Printing
AC7-V	Industrial Safety and Environment Consciousness

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7
AC7 – I: MOOC-learn New Skill

This course aims to create awareness among the students regarding various courses available under MOOC and learn new skills through these courses.

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, , students will be able to

CO1: To acquire additional knowledge and skill.

About Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you'reinterested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effortis to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/
3. https://www.edx.org

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – II: Entrepreneurship Development

This Course aims at instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur

Course Objectives:

- To introduce the aspects of Entrepreneurship
- To acquaint with legalities in product development
- To understand IPR, Trademarks, Copyright and patenting
- To know the facets of functional plans, Entrepreneurial Finance and Enterprise Management

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the legalities in product development
CO2: Undertake the process of IPR, Trademarks, Copyright and patenting
CO3: Understand and apply functional plans
CO4: Manage Entrepreneurial Finance
CO5: Inculcate managerial skill as an entrepreneur

Course Contents

1. Introduction: Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

2. Creating Entrepreneurial Venture : Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights.

3. Functional plans: Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, Ratio Analysis.

4. Entrepreneurial Finance: Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India. 5. Enterprise Management: Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers and acquisition

Books:

1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization"", Pearson ISBN-10: 8131765784; ISBN-13: 978-8131765784
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise"", ISBN 0-256-14147- 9
3. Irwin Taneja, ``Entrepreneurship,"" Galgotia Publishers. ISBN: 978-93-84044-82-4
4.Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,"" Pearson Education, ISBN, 8177582607, 9788177582604.

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – III: Botnet of Things

This course aims to provide an understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities. It gives an outline of the techniques for developing a secure application.

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To learn the concept of Botnet

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Implement security as a culture and show mistakes that make applications vulnerable to attacks.

CO2: Understand various attacks like DoS, buffer overflow, web specific, database specific, web -spoofing attacks.

CO3: Demonstrate skills needed to deal with common programming errors that lead to most securityproblems and to learn how to develop secure applications

Course Contents

1. Introduction

2. IRC-Based Bot Networks

3. Anatomy of a Botnet: The Gaobot Worm

4. IoT Senosors and Security : Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots and Botnet

5. Service Layer Protocols and Security : Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport and Session layer protocols- transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) –

Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

1. Bernd Scholz - Reiter, Florian Michahelles, “Architecting the Internet of Things”, Springer ISBN 978 –3 – 642 – 19156 - 5 e - ISBN 978 – 3 -642 - 19157 - 2,

2. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1 st Edition 2004

3. Gunter Ollmann 2007. The Phishing Guide Understanding and Preventing Phishing Attacks. IBM Internet Security Systems.

4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978 – 1 – 118 – 47347 - 4, Willy Publications

5. White Papers :- https://www.sans.org/reading-room/whitepapers/malicious/bots-botnet-overview-1299

6. https://www-01.ibm.com/marketing/iwm/dre

Mike Kuniavsky, “Smart Things: Ubiquitous Computing User Experience Design,” Morgan Kaufmann Publishers.

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7
AC7 – IV: 3D Printing

This course aims to provide knowledge of 3D printing devices and explore the business side of 3D printing.

Course Objectives:

- To **acquire** basic knowledge of drafting terminology and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003
- To **inculcate** skill of technical sketching, multi-view drawings, Lettering, tolerance, and metricconstruction
- To **impart** practical aspects to generate detailed and assembly views with dimensions, annotations,in 3D Modeling software.
- To **develop** prototype/ end use product for 3D Printing

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the basic knowledge of Shop Floor Safety rules and regulations basics of Machinetools and 3D printing machines

CO2: Understand the concept of concept of technical sketching, multi-view drawings, Lettering,tolerance, and metric construction

CO3:Identify and Distinguish drafting terminologies and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003

CO4:Describe and Explain practical aspects to generate detailed and assembly views with dimensions,annotations, in 3D Modeling software.

CO5: Apply concepts and **Fabricate** the simple mechanical parts, prototype/ end use product for 3D Printing

Course Contents

1. Getting Started with 3D Printing: How 3D Printers Fit into Modern Manufacturing, Exploring theTypes of 3D Printing, Exploring Applications of 3D Printing.

2. Outlining 3D Printing Resources: Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.

3. Exploring the Business Side of 3D Printing: Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.

4. Employing Personal 3D printing Devices: Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, " 3D Printing for Dummies", Taschenbuch, ISBN: 9781119386315

2. Greg Norton, "3D Printing Business - 3D Printing for Beginners - How to 3D Print",ISBN:9781514785669

2. Liza Wallach Kloski and Nick Kloski, " Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution", Maker Media, ISBN: 1680450204

4.Jeff Heldrich , "3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business"

Home

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – V: Industrial Safety and Environment Consciousness

This course aims to provide knowledge of industrial safety performance planning and accident prevention.

Course Objectives:

- To understand Industrial hazards and Safety requirements with norms
- To learn the basics of Safety performance planning
- To know the means of accident prevention
- To understand the impact of industrialization on environment
- To know the diversified industrial requirements of safety and security

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop the plan for Safety performance

CO2: Demonstrate the action plan for accidents and hazards

CO3: Apply the safety and security norms in the industry

CO4: Evaluate the environmental issues of Industrialization

Course Contents

1. Introduction: Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

2. Safety Performance Planning

Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.

3. Accident Prevention

What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.

4. Organization Safety

Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.

5. Industrial Pollution

Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers,

6. Industrial Security(Industry wise)

General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments.

Books :

1. Basudev Panda,"Industrial Safety, Health Environment and Security",Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439

2. L.M. Deshmukh, "Industrial Safety Management", TMH, ISBN: 9780070617681

SEMESTER VIII

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410250: High Performance Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	3	In- Sem (TH) : 30 End- Sem (TH): 70

Prerequisites Courses: -Microprocessor (210254), Principles of Programming Languages(210255), Computer Networks and Security(310244)

Companion Course: Laboratory Practice V(410254)

Course Objectives:

- To understand different parallel programming models
- To analyze the performance and modeling of parallel programs
- To illustrate the various techniques to parallelize the algorithm
- To implement parallel communication operations.
- To discriminate CUDA Architecture and its components.
- To Understand Scope of Parallel Computing and its search algorithms.

Course Outcomes:

CO1: **Understand** various Parallel Paradigm
CO2: **Design and Develop** an efficient parallel algorithm to solve given problem
CO3: **Illustrate** data communication operations on various parallel architecture
CO4: **Analyze** and measure performance of modern parallel computing systems
CO5: **Apply** CUDA architecture for parallel programming
CO6: **Analyze** the performance of HPC applications

Course Contents

Unit I	Introduction to Parallel Computing	07 Hours

Introduction to Parallel Computing: Motivating Parallelism, **Modern Processor:** Stored-program computer architecture, General-purpose Cache-based Microprocessor architecture. **Parallel Programming Platforms:** Implicit Parallelism, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines. Levels of parallelism, **Models:** SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation, **Architectures:** N-wide superscalar architectures, multi-core, multi-threaded.

#Exemplar/Case Studies	Case study: Multi-core System
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Parallel Algorithm Design	07 Hours

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, **Parallel Algorithm Models:** Data, Task, Work Pool and Master Slave Model, **Complexities:** Sequential and Parallel Computational Complexity, Anomalies in Parallel Algorithms.

#Exemplar/Case Studies	Foster's parallel algorithm design methodology. (http://compsci.hunter.cuny.edu/~sweiss/course_materials/csci493.65/lecture_notes/chapter03.pdf)
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Parallel Communication**	**07 Hours**

Basic Communication: One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Collective **Communication using MPI:**Scatter, Gather, Broadcast, Blocking and non blocking MPI, All-to-All Personalized Communication, Circular Shift, Improving the speed of some communication operations.

#Exemplar/Case Studies	Monte-Carlo Pi computing using MPI
***Mapping of Course Outcomes for UnitIII**	CO3

Unit IV	**Analytical Modeling of Parallel Programs**	**07 Hours**

Sources of Overhead in Parallel Programs, **Performance Measures and Analysis:** Amdahl's and Gustafson's Laws, Speedup Factor and Efficiency, Cost and Utilization, Execution Rate and Redundancy, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost, Optimal Execution Time, Asymptotic Analysis of Parallel Programs. **Matrix Computation:** Matrix-Vector Multiplication, Matrix-Matrix Multiplication.

#Exemplar/Case Studies	The DAG Model of parallel computation
***Mapping of Course Outcomes for UnitIV**	**CO4**

Unit V	**CUDA Architecture**	**07 Hours**

Introduction to GPU: Introduction to GPU Architecture overview, Introduction to CUDA C-CUDA programming model, write and launch a CUDA kernel, Handling Errors, CUDA memory model, Manage communication and synchronization, Parallel programming in CUDA- C.

#Exemplar/Case Studies	GPU applications using SYCL and CUDA on NVIDIA
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**High Performance Computing Applications**	**07 Hours**

Scope of Parallel Computing, **Parallel Search Algorithms:** Depth First Search(DFS), Breadth First Search(BFS), **Parallel Sorting:** Bubble and Merge, **Distributed Computing:** Document classification, Frameworks – Kuberbets, GPU Applications, Parallel Computing for AI/ ML

#Exemplar/Case Studies	Disaster detection and management/ Smart Mobility/Urban planning
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction toParallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Seyed H. Roosta, "Parallel Processing and Parallel Algorithms Theory and Computation‖", Springer-Verlag 2000 ,ISBN 978-1-4612-7048-5 ISBN 978-1-4612-1220-1
3. John Cheng, Max Grossman, and Ty McKercher, "Professional CUDA C Programming", John Wiley & Sons, Inc., ISBN: 978-1-118-73932-7

Reference Books :

1. Kai Hwang,, "Scalable Parallel Computing", McGraw Hill 1998.
2. George S. Almasi and Alan Gottlieb, "Highly Parallel Computing", The Benjamin and Cummings Pub. Co., Inc
3. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0-13-138768-3
4. Pacheco, Peter S., "An Introduction to Parallel Programming", Morgan Kaufmann Publishers ISBN 978-0-12-374260-5
5. Rieffel WH.EG, Polak, "Quantum Computing: A gentle introduction", MIT Press, 2011,ISBN 978-0-262-01506-6
6. Ajay D. Kshemkalyani , Mukesh Singhal, "Distributed Computing: Principles, Algorithms, andSystems", Cambridge March 2011, ISBN: 9780521189842

e Books :

1. http://prdrklaina.weebly.com/uploads/5/7/7/3/5773421/introduction_to_high_performance_computing_for_scientists_and_engineers.pdf
2. https://www.vssut.ac.in/lecture_notes/lecture1428643084.pdf

NPTEL/YouTube video lecture link

- https://nptel.ac.in/courses/106108055
- https://www.digimat.in/nptel/courses/video/106104120/L01.html

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	1	-	-	-	1	-	-
CO2	1	2	1	2	1	1	-	-	-	-	-	-
CO3	2	1	-	1	2	1	-	-	1	-	-	1
CO4	1	-	1	1	-	2	1	-	-	-	-	-
CO5	-	1	1	1	1	1	-	-	-	-	-	-
CO6	1	2	1	-	-	1	-	-	-	-	-	1

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410251: Deep Learning		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Machine Learning (410242)

Companion Course: Laboratory Practice V(410254)

Course Objectives:

- To understand the basics of neural networks.
- Comparing different deep learning models.
- To understand the Recurrent and Recursive nets in Deep Learning
- To understand the basics of deep reinforcement Learning models.
- To analyze Types of Networks.
- To Describe Reinforcement Learning.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand the basics of Deep Learning and apply the tools to implement deep learningapplications

CO2: Evaluate the performance of deep learning models (e.g., with respect to the bias-variance trade-off, overfitting and underfitting, estimation of test error).

CO3: To apply the technique of Convolution (CNN) and Recurrent Neural Network (RNN) forimplementing Deep Learning models

CO4: To implement and apply deep generative models.

CO5: Construct and apply on-policy reinforcement learning algorithms

CO6:To Understand Reinforcement Learning Process

Course Contents

Unit I	Foundations of Deep learning	07 Hours

What is machine learning and deep learning?,Supervised and Unsupervised Learning, bias variance tradeoff,hyper parameters, under/over fitting regularization, Limitations of machine learning, History of deep learning, Advantage and challenges of deep learning. Learning representations from data , Understanding how deep learning works in three figures, Common Architectural Principles of Deep Network, Architecture Design, Applications of Deep learning, Introduction and use of popular industry tools such as TensorFLow,
Keras, PyTorch, Caffe, Shogun.

#Exemplar/Case Studies	Deep Mind, AlphaGo, Boston Dynamics
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Deep Neural Networks(DNNs)	07 Hours

Introduction to Neural Networks :The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks , **Training Neural Networks** :Backpropagation and Forward propagation **Activation Functions** :Linear ,Sigmoid, Tannh, Hard Tanh, Softmax, Rectified Linear, **Loss Functions** :Loss Function Notation , Loss Functions for Regression , Loss Functions for Classification, Loss Functions for Reconstruction, **Hyperparameters** : Learning Rate, Regularization, Momentum, Sparsity, Deep Feedforward Networks – Example of Ex OR, Hidden Units, cost functions, error backpropagation, Gradient-Based Learning, Implementing Gradient Descent, vanishing and Exploding gradient descent, Sentiment Analysis, Deep Learning with Pytorch, Jupyter, colab.

#Exemplar/CaseStudies	A Case Study for Music Genre Classification
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Convolution Neural Network(CNN)**	**07 Hours**

Introduction, CNN architecture overview, The Basic Structure of a Convolutional Network- Padding, Strides, Typical Settings, the ReLU layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network

#Exemplar/Case Studies	AlexNet, VGG
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Recurrent Neural Network(CNN)**	**07 Hours**

Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory. **Practical Methodology**: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyper parameters.

#Exemplar/Case Studies	Multi-Digit Number Recognition
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Deep Generative Models**	**07 Hours**

Introduction to deep generative model, Boltzmann Machine, Deep Belief Networks, Generative adversarial network (GAN), discriminator network, generator network, types of GAN, Applications of GAN networks

#Exemplar/Case Studies	GAN for detection of real or fake images
***Mapping of Course Outcomes for Unit V**	CO4

Unit VI	**Reinforcement Learning**	**07 Hours**

Introduction of deep reinforcement learning, Markov Decision Process, basic framework of reinforcement learning, challenges of reinforcement learning, Dynamic programming algorithms for reinforcement learning,Q Learning and Deep Q-Networks, Deep Q recurrent networks, Simple reinforcement learning for Tic-Tac-Toe.

#Exemplar/Case Studies	Self driving cars, Deep learning for chatbots
***Mapping of Course Outcomes for Unit VI**	CO5

Learning Resources

Text Books:

1. Goodfellow, I., Bengio, Y.,,Courville, A, "Deep Learning", MIT Press, 2016.
2. Josh Patterson & Adam Gibson, "Deep Learning"
3. Charu Agarwal, "Neural Networks and deep learning", A textbook
4. Nikhil Buduma, "Fundamentals of Deep Learning", SPD
5. Francois chollet, "Deep Learning with Python"

Reference Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction"
2. by SethWeidman, "Deep Learning from Scratch: Building with Python from First Principles"O'Reily
3. Francois Duval, "Deep Learning for Beginners, Practical Guide with Python and Tensorflow"

e-Books :

1. http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf
2. https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

MOOC Courses Links:

- https://www.my-mooc.com/en/categorie/deep-learning

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3	-	-	-	-	-	-	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1
CO3	3	2	2	2	2	-	1	-	-	-	-	1
CO4	1	2	1	1	2	-	1	-	-	-	-	1
CO5	2	2	3	2	2	-	-	-	-	-	-	1
CO6	1	2	2	2	2	-	-	-	-	-	2	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252(A): Natural Language Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Discrete Mathematics (210241), Theory of Computation (310242), Data Science and Big Data Analytics (310251)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To be familiar with fundamental concepts and techniques of natural language processing (NLP)
- To acquire the knowledge of various morphological, syntactic, and semantic NLP tasks
- To develop the various language modeling techniques for NLP
- To use appropriate tools and techniques for processing natural languages
- To comprehend the advance real world applications in NLP domain.
- To Describe Applications of NLP and Machine Translations.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the fundamental concepts of NLP, challenges and issues in NLP

CO2: Analyze Natural languages morphologically, syntactical and semantically OR Describe the concepts of morphology, syntax, semantics of natural language

CO3: Illustrate various language modelling techniques

CO4: Integrate the NLP techniques for the information retrieval task

CO5: Demonstrate the use of NLP tools and techniques for text-based processing of natural languages

CO6: Develop real world NLP applications

Course Contents

Unit I	Introduction to Natural Language Processing	07 Hours

Introduction: Natural Language Processing, Why NLP is hard? Programming languages Vs Natural Languages, Are natural languages regular? Finite automata for NLP, Stages of NLP, Challenges and Issues(Open Problems) in NLP

Basics of text processing: Tokenization, Stemming, Lemmatization, Part of Speech Tagging

#Exemplar/Case Studies	Why English is not a regular language: http://cs.haifa.ac.il/~shuly/teaching/08/nlp/complexity.pdf#page=20
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Language Syntax and Semantics	07 Hours

Morphological Analysis: What is Morphology? Types of Morphemes, Inflectional morphology &Derivational morphology, Morphological parsing with Finite State Transducers (FST)
Syntactic Analysis: Syntactic Representations of Natural Language, Parsing Algorithms, Probabilistic context-free grammars, and Statistical parsing
Semantic Analysis: Lexical Semantic, Relations among lexemes & their senses – Homonymy,Polysemy, Synonymy, Hyponymy, WordNet, Word Sense Disambiguation (WSD), Dictionary
based approach, Latent Semantic Analysis

#Exemplar/CaseStudies	Study of Stanford Parser and POS Tagger https://nlp.stanford.edu/software/lex-parser.html https://nlp.stanford.edu/software/tagger.html
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Language Modelling**	**07 Hours**

Probabilistic language modeling, Markov models, Generative models of language, Log-Liner Models, Graph-based Models
N-gram models: Simple n-gram models, Estimation parameters and smoothing, Evaluating language models, **Word Embeddings/ Vector Semantics:** Bag-of-words, TFIDF, word2vec, doc2vec, Contextualized representations (BERT)
Topic Modelling: Latent Dirichlet Allocation (LDA), Latent Semantic Analysis, Non Negative
Matrix Factorization

#Exemplar/Case Studies	Study of language modelling for Indian languages.
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Information Retrieval using NLP**	**07 Hours**

Information Retrieval: Introduction, Vector Space Model
Named Entity Recognition: NER System Building Process, Evaluating NER System
Entity Extraction, Relation Extraction, Reference Resolution, Coreference resolution, Cross Lingual Information Retrieval

#Exemplar/Case Studies	Natural Language Processing based Information Extraction & Retrieval: https://www.cdac.in/index.aspx?id=mc_cli_cross_lingual_info
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**NLP Tools and Techniques**	**07 Hours**

Prominent NLP Libraries: Natural Language Tool Kit (NLTK), spaCy, TextBlob, Gensim etc.
Linguistic Resources: Lexical Knowledge Networks, WordNets, Indian Language WordNet (IndoWordnet), VerbNets, PropBank, Treebanks, Universal Dependency Treebanks
Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, WordNets for Word Sense Disambiguation

#Exemplar/Case Studies	Hindi Wordnet: https://www.cfilt.iitb.ac.in/wordnet/webhwn/ Sanskrit WordNet: https://www.cfilt.iitb.ac.in/wordnet/webswn/ Indic Library: http://anoopkunchukuttan.github.io/indic_nlp_library/

***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Applications of NLP**	**07 Hours**
Machine Translation: Rule based techniques, Statistical Machine Translation (SMT), Cross Lingual Translation Sentiment Analysis, Question Answering, Text Entailment, Discourse Processing, Dialog and Conversational Agents, Natural Language Generation		
#Exemplar/Case Studies	Study working of Google Translate Study working of IBM Watson Natural Language Processing	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Jurafsky, David, and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech Recognition‖, ‚PEARSON Publication
2. Manning, Christopher D., and nrich Schütze , "Foundations of Statistical Natural Language Processing", Cambridge, MA: MIT Press

Reference Books:

1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit", O'Reilly Publication
2. Dipanjan Sarkar , "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data", Apress Publication ISBN: 9781484223871
3. Alexander Clark, Chris Fox, and Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley Blackwell Publications
4. Jacob Eisenstein, "Natural Language Processing", MIT Press
5. Jacob Eisenstein, "An Introduction to Information Retrieval", Cambridge University Press

e-Books :

1. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf
2. https://www3.cs.stonybrook.edu/~cse521/L16NLP.pdf

NPTEL Courses links:

- https://nptel.ac.in/courses/106101007
- https://nptel.ac.in/courses/106106211

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	1
CO3	2	3	3	2	2	-	-	-	-	-	-	2
CO4	2	2	3	3	3	-	2	2	-	-	-	3
CO5	2	2	3	3	3	-	-	-	-	-	-	3
CO6	3	3	3	3	3	2	1	1	-	-	-	3

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252 (B): Image Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: Laboratory Practice VI (410255)

Course Objectives:

- To Understand Digital Image Processing Concepts.
- To Study Various Methods for Image Enhancement using Spatial and Frequency Domain.
- To Learn Classification Techniques for Image Segmentation.
- To Understand Image Compression and Object Recognition.
- To Study Various Image Restoration Techniques.
- To Understand various Medical and Satellite Image Processing Applications.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Apply Relevant Mathematics Required for Digital Image Processing.

CO2: Apply Special and Frequency Domain Method for Image Enhancement.

CO3: Apply algorithmic approaches for Image segmentation.

CO4: Summarize the Concept of Image Compression and Object Recognition.

CO5: Explore the Image Restoration Techniques.

CO6: Explore the Medical and Satellite Image Processing Applications.

Course Contents

Unit I	Introduction to Digital Image Processing	07 Hours

Introduction, Fundamental steps in Digital Image Processing, Components, Elements of visual perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, different Color Models, Image Types, Image File Formats, Component Labeling algorithm.

Introduction to OpenCV tool to Open and Display Images using Python or Eclipse C/C++.

#Exemplar/Case Studies	Write a program to create a simple image file, save the same in .jpg, .tiff, .bmp format and display it.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Image Enhancement	07 Hours

. Introduction to Image Enhancement and its Importance, Types of Image Enhancement- **Spatial Domain Image Enhancement:** Intensity Transformations, Contrast Stretching, Histogram Equalization, Correlation and Convolution, Smoothing Filters, Sharpening Filters, Gradient and Laplacian

Frequency Domain Image Enhancement: Low Pass filtering in Frequency Domain (Ideal,

Butterworth, Gaussian), High Pass filter in Frequency Domain (Ideal, Butterworth, Gaussian).	
#Exemplar/Case Studies	Write a program for image enhancement using suitable algorithm forHistogram equalization, Local enhancement, Smoothing and Sharpening.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Image Segmentation and Analysis**	**07 Hours**

Introduction to Image Segmentation and its need. **Classification of Image Segmentation Techniques:** Threshold Based Image Segmentation, Edge Based Segmentation, Edge Detection, Edge Linking, Hough Transform, Watershed Transform, Clustering Techniques, region approach

#Exemplar/Case Studies	Study the different image segmentation techniques for image segmentation
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Image Compression and Object Recognition**	**07 Hours**

Image Compression: Introduction to Image Compression and its need, Classification of Image Compression Techniques- run-length coding, Shannon Fano coding, Huffman coding, Scalar and vector quantization, Compression Standards-JPEG/MPEG, Video compression.

Object Recognition: Introduction, Computer Vision, Tensor Methods in Computer Vision, Classifications Methods and Algorithm, Object Detection and Tracking, Object Recognition.

#Exemplar/Case Studies	Explain image compression and object recognition techniques.
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Image Restoration and Reconstruction**	**07 Hours**

Introduction, Model of Image degradation, Noise Models, Classification of image restoration techniques, Blind-deconvolution techniques, Lucy Richardson Filtering, Wiener Filtering

#Exemplar/Case Studies	Explain classification of image restoration techniques.
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Medical and Satellite Image Processing**	**07 Hours**

Medical Image Processing: Introduction, Medical Image Enhancement, Segmentation, MedicalImage Analysis (Images of Brain MRI or Cardiac MRI or Breast Cancer).

Satellite Image Processing: Concepts and Foundations of Remote Sensing, GPS, GIS, Elements of Photographic Systems, Basic Principles of Photogrammetry, Multispectral, Thermal, and Hyper spectral Sensing, Earth Resource Satellites Operating in the Optical Spectrum

#Exemplar/Case Studies	Implement application for medical image processing or satellite image processing using OpenCV or Python.

***Mapping of Course Outcomes for UnitVI**	CO6

Learning Resources

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image processing", Pearson Education, Fourth Impression, 2008, ISBN: 978-81-7758-898- 9.
2. A. K. Jain, "Fundamentals of Digital Image Processing", PHI, ISBN-978-81- 203- 0929-6.
3. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, First Edition, 2007, ISBN-8177584790.
4. Boguslaw Cyganek, "Object Detection and Recognition in Digital Images: Theory and Practice", Wiley, First Edition, 2013, ISBN: 978-0-470-97637-1.
5. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, "Digital Watermarking and Steganography", Morgan Kaufmann (MK), ISBN: 978-0-12- 372585-1.
6. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, "Remote Sensing and Image Interpretation", Wiley, Seventh Edition, 2015, ISBN: 978-1-118-91947-7

Reference Books :

1. Isaac Bankman, "Handbook of Medical Imaging", Academic Press, Second Edition, 2008, ISBN: 9780080559148.
2. Jayaraman, Esakkirajan,Veerakumar, "Digital image processing" , , Mc Graw Hill, Second reprint- 2010, ISBN(13): 978-0-07-01447-8, ISBN(10):0-07-014479-6.

e-Books :

- **https://bookboon.com/en/3d-video-processing-and-transmission-fundamentals-ebook**

MOOC Courses links :

- http://nptel.ac.in/courses/117105079.

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	-	-	-	-	1	-	-	-
CO2	1	2	2	2	2	1	-	-	1	-	-	1
CO3	1	2	2	2	2	1	-	-	1	-	-	1
CO4	1	1	2	2	2	1	-	-	1	-	-	1
CO5	1	1	1	2	2	1	-	-	1	-	-	1
CO6	1	2	3	2	2	1	1	-	1	-	1	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252(C): Software Defined Networks

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	3	In-Sem (Paper):30 Marks End-Sem(Paper):70 Marks

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To learn the fundamentals of software defined networks and understand Differentiation between traditional networks and software defined networks
- To gain conceptual understanding of Software Defined Networking (SDN) and its rolein Data Center.
- To study about the SDN Programming.
- To study industrial deployment use-cases of SDN.
- To study about the various applications of SDN
- To Describe SDN Framework.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Interpret the need of Software Defined networking solutions.

CO2: Analyze different methodologies for sustainable Software Defined Networkingsolutions.

CO3: Select best practices for design, deploy and troubleshoot of next generation networks.

CO4: Develop programmability of network elements.

CO5: Demonstrate virtualization and SDN Controllers using Open Flow protocol

CO6: Design and develop various applications of SDN

Course Contents

Unit I	Introduction	07 Hours

Challenges of traditional networks, History of Software Defined Networking (SDN), Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

#Exemplar/Case Studies	Video Streaming https://kempsdn.com/what-is-sdn-and-use-cases/video-streaming/
***Mapping of Course Outcomes for Unit I**	CO1,CO2

Unit II	OPEN FLOW & SDN CONTROLLERS	07 Hours

Open Flow Overview, The Open Flow Switch, The Open Flow Controller, Open Flow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, Open Flow Protocol, Proactive and Reactive Flow, Timers, Open Flow Limitations, Open Flow Advantages and Disadvantages, Open v Switch Features, Drawbacks of Open SDN, Introduction to SDN controller.

#Exemplar/Case Studies	Behavior Anomaly Detection in SDN Control Plane: A Case Study of Topology Discovery Attacks https://www.hindawi.com/journals/wcmc/2020/8898949/	
***Mapping of Course Outcomes for Unit II**	CO2,CO3	
Unit III	**DATA CENTERS**	**07 Hours**
Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE		
#Exemplar/Case Studies	The World's Second Largest Tier IV Data Center A Yotta Infrastructure case study https://www.missioncriticalmagazine.com/articles/94105-the-worlds-seconzd-largest-tier-iv-data-center	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**SDN PROGRAMMING**	**07 Hours**
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Introduction of Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications		
#Exemplar/Case Studies	Case study: Ballarat Grammar uses SDN to fight malware https://www.zdnet.com/home-and-office/networking/case-study-ballarat-grammar-uses-sdn-to-fight-malware/	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Network Functions Virtualization (NFV)**	**07 Hours**
Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions		
Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.		
#Exemplar/Case Studies	NFV deployment case study failure migrate https://www.dell.com/en-us/blog/nfv-deployment-case-study-failure-migrate/	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**SDN Use Cases**	**07 Hours**
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration		
#Exemplar/Case Studies	CloudSeeds automate IaaS using SDN and a high-performance network from Juniper.	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
2. Siamak Azodolmolky, “Software Defined Networking with Open Flow”, Packt Publishing, 2013, ISBN: 9781849698726
3. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks”, An Authoritative Review of Network Programmability Technologies‖, 2013, ISBN : 10:1-4493-4230-2, 9781-4493-4230-2

Reference Books :

1. Vivek Tiwari, “SDN and Open Flow for Beginners”, Amazon Digital Services, Inc., 2013.
2. Fei Hu, Editor, “Network Innovation through Open Flow and SDN: Principles and Design”, CRC Press, 2014.

e-Books :

1. https://ridhanegara.staff.telkomuniversity.ac.id/files/2017/04/Paul-Goransson-and-Chuck-Black-Auth.-Software-Defined-Networks.-A-Comprehensive-Approach.pdf
2. https://speetis.fei.tuke.sk/KomunikacnaTechnika1/prednasky/7_11_2016/kniha_sietovanie.pdf
3. https://ridhanegara.staff.telkomuniversity.ac.id/files/2017/04/Thomas-D.-Nadeau-Ken-Gray-SDN-Software-Defined-Networks-O_039_Reilly-Media-2013.pdf

MOOC Courses Links:

- https://nptel.ac.in/courses/108107107

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	1	-	-	-	-	-
CO2	1	2	2	1	2	-	-	-	-	-	1	-
CO3	2	1	3	1	2	-	-	-	-	-	2	-
CO4	1	2	2	1	2	-	-	-	-	-	2	-
CO5	3	2	2	3	3	-	-	-	-	-		-
CO6	1	2	1	3	3	-	-	-	-	-	1	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252(D): Advanced Digital Signal Processing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 410244(A)Digital Signal Processing

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques and applications of adaptive filtering.
- To learn and understand Multi-rate DSP and applications
- To explore appropriate transforms
- Understand basic concepts of speech production, speech analysis, speech coding andparametric representation of speech
- Acquire knowledge about different methods used for speech coding and understandvarious applications of speech processing
- Learn and understand basics of Image Processing and various image filters with its applications

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand and apply different transforms for the design of DT/Digital systems

CO2: Explore the knowledge of adaptive filtering and Multi-rate DSP

CO3: Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rateDSP

CO4: Explore use of DCT and WT in speech and image processing

CO5: Develop algorithms in the field of speech , image processing and other DSP applications

CO6:Identify Image Processing Techniques

Course Contents

Unit I	DFT and Applications	07 Hours

DFT and Applications – Linear filtering, spectral leakage, Spectral resolution and selection of Window Length, Frequency analysis, 2-D DFT, applications in Image and Speech Processing

#Exemplar/Case Studies	Case Study of Image / Speech Processing Application
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Adaptive FIR and IIR filter Design	07 Hours

Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design:Pade Approximation, Least square design, Applications		
#Exemplar/Case Studies	Demonstration of DT filter and FIR filter with suitable application	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Multi-rate DSP and applications**	**07 Hours**
Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.		
#Exemplar/Case Studies	Implementation for sampling rate Conversion Multi-rate Digital Signal Processing	
***Mapping of Course Outcomes for Unit II**	CO3	
Unit IV	**Spectral Estimation**	**07 Hours**
Spectral Estimation – Estimation of density spectrum, Nonparametric method, Parametric method, Evaluation ,DCT and WT – DCT and KL transform, STFT, WT, Harr Wavelet and Dubecheis Wavelet, Applications of DCT and WT.		
#Exemplar/Case Studies	A spectral estimation case study in frequency-domain by subspace methods	
***Mapping of Course Outcomes for Unit II**	CO4	
Unit V	**Speech processing**	**07 Hours**
Speech processing - Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders. Fundamentals of Speech recognition, Speech segmentation, Text-to-speech conversion, speech enhancement, Speaker Verification, Applications.		
#Exemplar/Case Studies	Investigation of data augmentation techniques for disordered speech recognition	
***Mapping of Course Outcomes for Unit II**	CO5	
Unit VI	**Image Processing**	**07 Hours**
Image Processing – Image as 2D signal and image enhancement techniques, filter design: low pass, highpass and bandpass for image smoothing and edge detection, Optimum linear filter and order statistic filter, Examples – Wiener and Median filters, Applications		
#Exemplar/Case Studies	Medical image processing for coronavirus (COVID-19) pandemic: A survey	
***Mapping of Course Outcomes for Unit II**	CO6	

Books:

Text:

1. J. G. Proakis, D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications," Prentice Hall, 2007, 4th edition, ISBN: 10: 0131873741
2. Dr. Shaila D. Apate , " Advanced Digital Signal Processing," Wiley Publ., 2013, *ISBN*-10: 8126541245
3. S. K. Mitra, "Digital Signal Processing : A Computer Based Approach", McGraw HillHigher Education, 2006, 3rd edition, *ISBN*-10: 0070429537
4. Rabiner and Juang, "Fundamentals of Speech Recognition", Prentice Hall, 1994, ISBN:0-13-015157-2 .
5. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing and Analysis", Pearson Education, 3d Ed., 2007, ISBN: 81-7808-629-8

References:

1. Chanda, Muzumdar, "Digital Image Processing and Analysis," Estern Economy Edition,PHI, 2nd Ed., ISBN: 978-81-203-4096-*1*
2. TarunRawat, "Digital Signal Processing", Oxford University Press, 2015, ISBN-10:0198062281
3. Roberto Crist, "Modern Digital Signal Processing," Thomson Brooks/Cole 2004,ISBN:978-93-80026-55-8.
4. Nelson Morgan and Ben Gold, " Speech and Audio Signal Processing: Processing andPerception Speech and Music", 1999, John Wiley and Sons, ISBN: 0387951547
5. Raghuveer. M. Rao, AjitS.Bopardikar, "Wavelet Transforms: Introduction to Theory and applications," Pearson Education, Asia, 2000.Dale Grover and John R. (Jack) Deller, "Digital Signal Processing and the Microcontroller", Prentice Hall, ISBN:0-13-754920-2

eE Books:

1. Foundations of Signal Processing- http://fourierandwavelets.org/
2. http://www.tka4.org/materials/lib/Articles-Books/Speech%20Recognition/advanced-digital-signal-processing-and-noise-reduction.9780470094945.26435.pdf
3. https://www.riverpublishers.com/pdf/ebook/RP_E9788792982032.pdf
4. https://fmipa.umri.ac.id/wp-content/uploads/2016/03/Andreas-Intoniou-Digital-signal-processing.9780071454247.31527.pdf
5. http://www-syscom.univ-mlv.fr/~zaidi/teaching/dsp-esipe-oc2/Course-Notes__Advanced-DSP.pdf
6. https://dl.icdst.org/pdfs/files/25f1b31b38872a4aea5584206534368a.pdf

MOOC Courses Links:

- **https://onlinecourses.nptel.ac.in/noc22_ee86/preview**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	-	-	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-
CO3	2	2	3	2	2	-	-	-	-	-	3	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	3	2	-	-	-	-	-	-	-
CO6	1	2	1	1	1	-	-	-	-	-	-	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective V 410252(E): Open Elective I		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**
The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time. Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons. With this idea learner opts for the course without any boundaries to choose the approved by academic council and Board of Studies		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(A): Pattern Recognition

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Fundamentals of Data Structures(210242), Data Structures and Algorithms(210252)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To learn the basic concept of Pattern recognition
- To study different approaches of pattern recognition
- To learn various pattern classification techniques
- To survey on recent advances and applications in pattern recognition
- To implement Optimal Path Searching techniques.
- To Illustrate Pattern Recognition Techniques.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Analyze various type of pattern recognition techniques

CO2: Identify and apply various pattern recognition and classification approaches to solvethe problems

CO3: Evaluate statistical and structural pattern recognition

CO4: Percept recent advances in pattern recognition confined to various applications

CO5:Implement Bellman's optimality principle and dynamic programming

CO6:Analyze Patterns using Genetic Algorithms & Pattern recognition applications.

Course Contents

Unit I	Pattern Recognition	07 Hours

Introduction of Pattern Recognition with its application, Pattern Recognition system, Design cycle of pattern recognition, Learning and adaption, Representation of Patterns and classes, Feature Extraction, pattern recognition models/approaches.

#Exemplar/Case Studies	Evaluation on spatial and temporal variations in water quality by pattern recognition techniques.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Error Estimation & Decision Theory	07 Hours

Introduction, Error estimation methods, various distance measures (Euclidean, Manhattan, cosine, Mahalanobis) and distance based classifier, Feature selection based on statistical hypothesis testing, ROC curve.

Introduction, Bayesian decision theory-continuous and discrete features, two- category classification, minimum error rate classification, discriminant functions,

Parametric Techniques:- Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics; Problems of dimensionality. Non-Parametric Techniques:-Density estimation, Parzen Window, Metrics and Nearest-Neighbor classification; Fuzzy classification		
#Exemplar/Case Studies	Spatial and temporal air quality pattern recognition using environ metric techniques	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Structural Pattern Recognition**	**06 Hours**
Tree Classifiers-Decision Trees, Random Forests, **Structural Pattern recognition:** Elements of formal grammars ,String generation as pattern description ,Recognition of syntactic description ,Parsing ,Stochastic grammars and applications ,Graph based structural representation, **Stochastic method:** Boltzmann Learning.		
#Exemplar/Case Studies	Case Study on spoken word recognition	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Clustering**	**08 Hours**
Introduction, Hierarchical Clustering, agglomerative clustering algorithm, the single linkage, complete, linkage and average, linkage algorithm. Ward's method ,Partition clustering, , K- means algorithm, clustering algorithms based on graph theory(Minimum spanning tree algorithm),Optimization methods used in clustering: clustering using simulating Annealing.		
#Exemplar/Case Studies	Case Study on disease recognition from a list of symptoms	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Template Matching and Unsupervised Learning**	**07 Hours**
Measures based on Optimal Path Searching techniques: Bellman's optimality principle and dynamic programming, The Edit distance, Dynamic time Warping, Measures based on correlations, Deformable template models		
#Exemplar/Case Studies	Pattern recognition in time series database: A case study on financial database.	
***Mapping of Course Outcomes for Unit V**	CO4	
Unit VI	**Fuzzy Logic and Pattern Recognition**	**07 Hours**
Fuzzy logic,Fuzzy pattern classifiers, Pattern classification using Genetic Algorithms Pattern recognition applications: Application of pattern recognition techniques in object recognition, biometric, facial recognition, IRIS scanner, Finger prints, 3D object recognition		
#Exemplar/Case Studies	Study of fingerprint recognition	

Home

*Mapping of Course Outcomes for Unit VI	CO5

Learning Resources

Text Books:

1. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", 2nd Edition, Wiley-Inter- science, John Wiley &Sons, 2001
2. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Elsevier, Academic Press, ISBN: 978-1-59749-272-0
3. B.D. Ripley, "Pattern Recognition and Neural Networks", Cambridge University Press. ISBN 0 521 46086 7

Reference Books:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. David G. Stork and Elad Yom-Tov, "Computer Manual in MATLAB to accompany Pattern Classification", Wiley Inter-science, 2004, ISBN-10: 0471429775
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI, ISBN-978-81-203-4091-6
4. eMedia at NPTEL : http://nptel.ac.in/courses/106108057/33

e-Books :

1. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.320.4607&rep=rep1&type=pdf
2. https://cds.cern.ch/record/998831/files/9780387310732_TOC.pdf
3. https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20Ed.%20(2009).pdf
4. https://readyforai.com/download/pattern-recognition-and-machine-learning-pdf/

MOOC Courses Links:

- https://nptel.ac.in/courses/117105101

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	1	1	1	1	1	1
CO2	2	1	-	1	1	1	1	1	1	1	1	1
CO3	2	2	2	1	1	1	1	1	1	1	1	1
CO4	2	2	2	1	1	1	1	1	1	1	1	1
CO5	2	2	2	1	1	1	1	1	1	1	1	1
CO6	2	-	2	1	1	1	1	1	1	1	1	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(B): Soft Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Graphics(210244)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To study the various soft computing approaches.
- To understand the soft computing techniques and algorithms for problem solving.
- To be familiar with the various application areas of soft computing.
- To apply the soft computing techniques for developing intelligent systems
- To Explore and solve problems using genetic Algorithms.
- To Understand hybrid systems paradigm and Application Areas of Soft Computing.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand requirement of soft computing and be aware of various soft computing techniques.

CO2: Understand Artificial Neural Network and its characteristics and implement ANN algorithms.

CO3: Understand and Implement Evolutionary Computing Techniques.

CO4: Understand the Fuzzy logic and Implement fuzzy algorithms for solving real life problems.

CO5: Apply knowledge of Genetic algorithms for problem solving.

CO6: Develop hybrid systems for problem solving.

Course Contents

Unit I	Introduction To Soft Computing	07 Hours

Introduction to Soft Computing and Computational Intelligence, Characteristics of Soft computing, Comparison Soft Computing Vs Hard Computing, Requirements of Soft Computing, Soft Computing Techniques – Artificial Neural Network, Fuzzy Logic., Evolutionary computing and
Hybrid systems, Applications of Soft Computing

#Exemplar/Case Studies	1. Study of Soft Computing techniques for Waste WaterManagement 2. Study of IBM Research Neuro-symbolic AI- a new look for neuromorphic computing
*Mapping of Course Outcomes for Unit	CO1

Unit II	Artificial Neural Network	07 Hours

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation, functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory, perceptron model, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule coefficient; back propagation algorithm, factors affecting backpropagation training, applications.

#Exemplar/CaseStudies	Study of Handwriting recognition using ANN.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Evolutionary Computing**	**07 Hours**

Problem Solving as A Search Task, Hill Climbing And Simulated Annealing, Evolutionary Computing, Evolution Strategies, Evolutionary Programming, Genetic Programming, Selected Applications From The Literature: A Brief Description, Scope Of Evolutionary Computing, Introduction to Evolutionary Single-Objective Optimization, Particle Swarm Optimization: Introduction, inspiration, mathematical model, standard and binary PSO. Artificial hummingbird algorithm

#Exemplar/Case Studies	Study of Engineering application of Artificial hummingbird algorithm
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Fuzzy logic**	**08 Hours**

Introduction to Fuzzy Logic, Classical Set, Fuzzy Set- Introduction, Operations on classical sets, properties of classical sets, fuzzy set operations, properties of fuzzy sets, Classical Relation, Fuzzy Relation, **Fuzzy Inference process** – Membership functions, Fuzzification, Membership value Assignment- Inference, Rank ordering, defuzzification – Weighted Average Method, Mean-Max Membership, Fuzzy Bayesian Decision Making, **Developing a Fuzzy Control** – System Architecture and Operation of FLC System, FLC System Models, Application of FLC System

#Exemplar/Case Studies	Study of Object Detection Robot Using Fuzzy Logic Controller
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Genetic Algorithm**	**07 Hours**

Introduction To Basic Terminologies in Genetic Algorithm: Individuals, Genes, Fitness, Populations; **Simple GA; General Genetic Algorithm; Operators in Genetic Algorithm:** Encoding, Selection, Crossover (Recombination), Mutation; **Stopping Condition for GA Flow; Constraints in Genetic Algorithms; Problem Solving Using Genetic Algorithm; Holland Classifier System:** The Production System, The Bucket Brigade Algorithm and Rule Generation**; Advantages and Limitations of Genetic Algorithms; Applications of Genetic Algorithms.**

#Exemplar/Case Studies	Use Genetic Algorithm to design a solution to the Traveling Salesman Problem. **Solution**:1. Use Permutation Encoding 2. Define Objective Function. 3. Apply Selection Method 4. Crossover 5. Mutation 6. RepeatUntil stopping criteria is met. 7.Stop
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Hybrid System and Application Areas of Soft Computing**	**07 Hours**

Hybrid System towards comprehensive Soft Computing: The hybrid systems paradigm, Hybrid connectionist production systems, Hybrid connectionist logic programming systems, Hybrid fuzzy connectionist production systems, Hybrid systems for speech and language processing, Hybrid systems for decision making.

Application Areas of Soft Computing: Fuzzy-filtered Neural Networks-Plasma Spectrum Analysis, Hand-written Numeral Recognition, Fuzzy sets and Genetic Algorithms in Game Playing, Soft Computing for Color Recipe Prediction.

#Exemplar/Case Studies	Study of Hybrid models for disease prediction.
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. S.N. Sivanandam, "Principles of Soft Computing", Wiley India- ISBN- 9788126527410
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence", Prentice Hall, ISBN: 978-0132610667
3. L. N. de Castro, "Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications", 2006, CRC Press, ISBN-13: 978-1584886433 (Chapter 3)
4. S.Rajasekaran, and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms : Synthesis, and Applications", Prentice Hall of India

Reference Books:

Reference Books :

1. Nikola K. Kasabov, "Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering", MIT Press, ISBN:978-0-262-11212-3
2. Seyedali Mirjalili, "Evolutionary Algorithms and Neural Networks Theory and Applications, Studies in Computational Intelligence", Vol 780, Springer, 2019, ISBN 978-3-319-93024-4
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India, ISBN: 978-0-470-74376-8

e-Books :

1. https://kamenpenkov.files.wordpress.com/2016/01/pso-m-clerc-2006.pdf
2. http://www.shahed.ac.ir/stabaii/Files/CompIntelligenceBook.pdf
3. https://ctb.iau.ir/Files/%D9%88%D8%A8%20%D8%B3%D8%A7%DB%8C%D8%AA%20%D8%A7%D8%B3%D8%A7%D8%AA%DB%8C%D8%AF/fuzzy%20logic%20with%20engineering% 20application-3rdEdition.pdf
4. http://www.soukalfi.edu.sk/01_NeuroFuzzyApproach.pdf
5. https://www.yumpu.com/en/document/read/34361976/evolutionary-computation-a- unified-approach

MOOC Courses Links :

- NPTEL Course – Introduction of Soft Computing, IIT Kharagpur by Prof. Debidas Samantahttps://nptel.ac.in/courses/106105173
- NPTEL Course – Neural Network and Applications, IIT Kharagpur by Prof. Somnath Sengupta,https://nptel.ac.in/courses/117105084
- NPTEL Course – Fuzzy Logic and Neural Networks, IIT Kharagpur by Dilip Kumar Pratiharhttps://nptel.ac.in/courses/127105006

@The CO-PO Mapping Matrix												
CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	1	-	-	-	-	-	1
CO2	3	2	2	3	1	2	-	-	-	-	-	2
CO3	3	2	2	3	1	2	-	-	-	-	-	2
CO4	3	2	2	3	1	2	-	-	-	-	-	2
CO5	3	2	2	3	1	2	-	-	-	-	-	2
CO6	3	2	2	3	1	2	-	-	-	-	-	3

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(C): Business Intelligence

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper) : 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Database Management System(310241), Data Science & Big data Analytics(310251), Machine Learning (410242)

Companion Course: Laboratory Practice VI(410256)

Course Objectives:

- To introduce the concepts and components of Business Intelligence (BI)
- To evaluate the technologies that make up BI (data warehousing, OLAP)
- To identify the technological architecture of BI systems·
- To explain different data preprocessing techniques
- To identify machine learning model as per business need
- To understand the BI applications in marketing, logistics, finance and telecommunication sector

Course Outcomes: On completion of this course, the students will be able to

CO1: Differentiate the concepts of Decision Support System & Business Intelligence

CO2:Use Data Warehouse & Business Architecture to design a BI system.

CO3:Build graphical reports

CO4:Apply different data preprocessing techniques on dataset

CO5:mplement machine learning algorithms as per business needs

CO6:Identify role of BI in marketing, logistics, and finance and telecommunication sector

Course Contents

Unit I	Introduction to Decision support systems and Business intelligence	07 Hours

Decision support systems: Definition of system, representation of the decision-making process, evolution of information systems, Decision Support System, Development of a decision support system, the four stages of Simon's decision-making process, and common strategies and approaches of decision makers

Business Intelligence: BI, its components & architecture, previewing the future of BI, crafting a better experience for all business users, End user assumptions, setting up data for BI, data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence

#Exemplar/Case Studies	Decision support system in business intelligence: https://www.riverlogic.com/blog/five-decision-support-system-examples
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	The Architecture of DW and BI	07 Hours

BI and DW architectures and its types - Relation between BI and DW - OLAP (Online analytical processing) definitions - Different OLAP Architectures-Data Models-Tools in Business Intelligence-Role of DSS, EIS, MIS and digital Dash boards – Need for Business Intelligence

Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations.

#Exemplar/Case Studies	A case study on Retail Industry : https://www.diva-portal.org/smash/get/diva2:831050/FULLTEXT01.pdf
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Reporting Authoring**	**07 Hours**

Building reports with relational vs Multidimensional data models; Types of Reports – List, crosstabs, Statistics, Chart, map, financial etc; Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Drill up, drill- down, drill-through capabilities. Run or schedule report, different output forms – PDF, excel, csv, xml etc.

#Exemplar/Case Studies	Power BI Case Study – How the tool reduced hassles of Heathrow & Edsby: **https://data-flair.training/blogs/power-bi-case-study/**
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Data preparation**	**07 Hours**

Data validation: Incomplete data , Data affected by noise .**Data transformation**: Standardization , Feature extraction. **Data reduction** : Sampling, Feature selection, Principal component analysis, Data discretization .**Data exploration** : **1.Univarate analysis** :Graphical analysis of categorical attributes ,Graphical analysis of numerical attributes , Measures of central tendency for numerical attributes , Measures of dispersion for numerical attributes, Identification of outliers for numerical attributes **2.Bivariate analysis**: Graphical analysis , Measures of correlation for numerical attributes , Contingency tables for categorical attributes, **3.Multivariate analysis**: Graphical analysis , Measures of correlation for numerical attributes

#Exemplar/Case Studies	Case study on Data preparation phase of BI system https://blog.panoply.io/load-and-transform-how-to-prepare-your-data-for-business-intelligence
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Impact of Machine learning in Business Intelligence Process**	**07 Hours**

Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression. **Clustering:** Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models. **Association Rule**: Structure of Association Rule, Apriori Algorithm

#Exemplar/Case Studies	Business applications for comparing the performance of a stock over a period of time https://cleartax.in/s/stock-market-analysis
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**BI Applications**	**07 Hours**

Tools for Business Intelligence, Role of analytical tools in BI, Case study of Analytical Tools: WEKA, KNIME, Rapid Miner, R;
Data analytics, Business analytics, ERP and Business Intelligence, BI and operation management, BI in inventory management system, BI and human resource management, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI in salesforce management

#Exemplar/Case Studies	Logistics planning in the food industry https://www.foodlogistics.com/case-studies https://www.barrettdistribution.com/food-distribution-case-study
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Fundamental of Business Intelligence, Grossmann W, Rinderle-Ma, Springer,2015
2. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015

Reference Books :

1. Paulraj Ponnian, "Data Warehousing Fundamentals", John Willey.
2. Introduction to business Intelligence and data warehousing, IBM, PHI
3. Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Vercellis, Wiley,2019
4. Data Mining for Business Intelligence, Wiley
5. EMC Educational Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley ISBN-13 978 1118876138
6. Ken W. Collier, Agile Analytics: A value driven Approach to Business Intelligence and Data
7. Warehousing, Pearson Education,2012, ISBN-13 978 8131786826

e-Books :

1. https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf
2. www.cs.ccsu.edu/~markov/weka-tutorial.pdf
3. http://www.biomedicahelp.altervista.org/Magistrale/Clinics/BIC_PrimoAnno/IdentificazioneModelliDataMining/Business%20Intelligence%20-%20Carlo%20Vercellis.pdf
4. https://download.e-bookshelf.de/download/0000/5791/06/L-G-0000579106-0002359656.pdf

NPTEL/YouTube video lecture links:

- Business Analytics for management decision : https://nptel.ac.in/courses/110105089
- Business analytics and data mining modeling using R : https://nptel.ac.in/courses/110107092
- Business Analysis for Engineers : https://nptel.ac.in/courses/110106050

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	-	-	-	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	-	-
CO3	1	2	1	1	1	-	-	-	-	-	-	-
CO4	2	2	2	1	1	-	-	-	-	-	-	-
CO5	2	2	2	2	1	-	-	-	-	-	-	-
CO6	-	1	-	1	1	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(D): Quantum Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Data Structures and Algorithms(210243), Data Science and Big Data Analytics (310251)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To provide introduction and necessary expertise to the learner in the upcoming discipline of Quantum Computing and Machine Learning.
- To enable the students to learn Quantum Computing and Quantum Machine Learning in practical-oriented learning sessions so that he/she can independently use existing open-source Quantum Computing Hardware and Software Frameworks
- To teach the students to develop hybrid solutions by applying Quantum Machine Learning to potential business application areas.
- To study Quantum Information Theory and Quantum Computing Programming Model of Computation.
- To study Quantum Algorithms and apply these to develop hybrid solutions .
- To study Quantum Concepts necessary for understanding the Quantum Computing Paradigm and compare the available hardware and software infrastructure and frameworks made available open source by major players in the Industry and Academia.

Course Outcomes:

On completion of the course, student will be able to–

CO1: To understand the concepts of Quantum Computing
CO2: To understand and get exposure to mathematical foundation and quantum mechanics
CO3: To understand and implement buiding blocks of Quantum circuits
CO4: To understand quantum information, its processing and Simulation tools
CO5: To understand basic signal processing algorithms FT, DFT and FFT
CO6 : To study and solve examples of Quantum Fourier Transforms and their applications

Course Contents

Unit I	Introduction to Quantum Computing	07 Hours

Fundamental Concepts of Quantum computing:
Introduction and Overview, Global Perspective, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum information and Quantum information processing,

*Mapping of CourseOutcomes for Unit I	CO1

Unit II	Mathematical foundation of Quantum Computing	07 Hours

Quantum Mechanics:
Linear Algebra and Quantum mechanics, Postulates of Quantum mechanics, state space, evolution, Quantum measurement, distinguishing quantum states, projective measurements, POVM measurements, Phase, Composite systems, Global view and applications, Density operator

***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Building Blocks for Quantum Program**	**07 Hours**

Quantum Computations: Quantum circuits, Quantum algorithms and qubit operations, Controlled operations, Principal deferred and Principal implicit Measurements, Universal Quantum Gates, Two level unitary gates, single qubit and CNOT , discrete set of universal operations, Quantum computational complexity

***Mapping of CourseOutcomes for Unit III**	CO3

Unit IV	**Quantum Simulation Algorithms and Fourier Transform**	**07 Hours**

Simulation of Quantum Systems, Simulation in action,exponential complexity growth of quantum systems,, Quantum simulation algorithm, examples of quantum simulations, perspectives of quantum simulation,

Understanding Basics of Fourier transform, Discrete Fourier Transform, Fast Fourier Transform, Definitions, mathematical representations of FT, DFT and FFT

***Mapping of CourseOutcomes for Unit IV**	CO3,CO4

Unit V	**Quantum Fourier Transform and Applications**	**07 Hours**

Quantum Fourier Transform , Phase estimation performance and requirements, order finding application, factoring application, General applications of Quantum Fourier transform, period finding, discrete algorithms, Other Quantum Algorithms.

***Mapping of CourseOutcomes for Unit V**	CO5

Unit VI	**Quantum Machine Learning**	**07 Hours**

Quantum Machine Learning and Quantum AI, Quantum Neural Networks, Quantum Natural Language Understanding, Quantum Cryptography, Application Domains for Quantum Machine Learning: Chemistry/Material Science, Space Tech, Finance related Optimization Problems, Swarm Robotics, Cyber security

***Mapping of CourseOutcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University
2. Wittek, “Quantum Machine Learning (What Quantum Computing Means to Data Mining)”, Peter University of Boras, Sweden - Elsevier Publications
3. Andreas Winchert, “Principles of Quantum Artificial Intelligence”,Instituto Superior Técnico - Universidade de Lisboa, Portugal - World Scientific Publishing, British Library Cataloguing-in-Publication Data

Reference Books:

1. Press Stephen Kan, "MetricsandModelsinSoftwareQualityEngineering‖,Pearson,ISBN-10:0133988082; ISBN-13:978-0133988086
2. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University PressStephen Kan, ―Metrics and Models in Software Quality Engineering‖, Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086
3. David McMahon, "Quantum Computing Explained", Wiley
4. Microsoft Quantum Development Kithttps://www.microsoft.com/enus/quantum/development-kit Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/
5. Amazon Bracket Documentation on AWS:https://aws.amazon.com/braket/ 7 D-Wave Systems Documentation: https://docs.dwavesys.com/docs/latest/index.html

e-Books :

1.http://mmrc.amss.cas.cn/tlb/201702/W020170224608149940643.pdf
2.http://mmrc.amss.cas.cn/tlb/201702/W020170224608150244118.pdf

MOOC Courses Links:

- https://onlinecourses.nptel.ac.in/noc21_cs103/preview
- https://www.coursera.org/learn/introduction-to-quantum-information

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	-	-	-	2	-	2	2
CO2	1	3	3	2	3	-	-	-	2	-	2	-
CO3	1	3	3	2	3	-	-	-	2	-	2	-
CO4	1	3	3	2	3	-	-	-	2	-	2	-
CO5	1	3	3	2	3	-	-	-	-	-	2	1
CO6	3	2	1	3	1	-	-	-	-	-	-	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective VI 410253(E): Open Elective II		
Teaching Scheme: **TH: 03Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**
Companion Course: Laboratory Practice VI (410255)		

The open elective included, to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time.

Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons.

With this idea learner opts for the course without any boundaries to choose the approved by academiccouncil and Board of Studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410255: Laboratory Practice V

Teaching Scheme:	Credit	Examination Scheme
Practical: 2 Hours/Week	01	Term Work: 50 Marks Practical: 50 Marks

Companion Course: High Performance Computing (410250), Deep Learning(410251)

Course Objectives:

- To understand and implement searching and sorting algorithms.
- To learn the fundamentals of GPU Computing in the CUDA environment.
- To illustrate the concepts of Artificial Intelligence/Machine Learning (AI/ML).
- To understand Hardware acceleration.
- To implement different deep learning models.

Course Outcomes:

CO1: Analyze and measure performance of sequential and parallel algorithms.
CO2: Design and Implement solutions for multicore/Distributed/parallel environment.
CO3: Identify and apply the suitable algorithms to solve AI/ML problems.
CO4: Apply the technique of Deep Neural network for implementing Linear regression andclassification.
CO5: Apply the technique of Convolution (CNN) for implementing Deep Learning models.
CO6: Design and develop Recurrent Neural Network (RNN) for prediction.

Guidelines for Instructor's Manual

Laboratory Practice V is for practical hands on for core courses High Performance Computing and Data Learning. The instructor’s manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). Program codes with sample output of all performed assignments are to be submitted as softcopy.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness reserving weightage for successful mini-project completion and related documentation.

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related tothe respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.

- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming Languages: Object Oriented Languages
C++/JAVA/PYTHON/R
Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC

Suggested List of Laboratory Experiments/Assignments

410250 : High Performance Computing

Any 4 Assignments and 1 Mini Project are Mandatory

Group 1	
1.	Design and implement Parallel Breadth First Search and Depth First Search based on existing algorithms using OpenMP. Use a Tree or an undirected graph for BFS and DFS .
2.	Write a program to implement Parallel Bubble Sort and Merge sort using OpenMP. Use existing algorithms and measure the performance of sequential and parallel algorithms.
3.	Implement Min, Max, Sum and Average operations using Parallel Reduction.
4.	Write a CUDA Program for : 1. Addition of two large vectors 2. Matrix Multiplication using CUDA C
5.	Implement HPC application for AI/ML domain.
Group 2	
6.	Mini Project: Evaluate performance enhancement of parallel Quicksort Algorithm using MPI
7.	Mini Project: Implement Huffman Encoding on GPU
8.	Mini Project: Implement Parallelization of Database Query optimization
9.	Mini Project: Implement Non-Serial Polyadic Dynamic Programming with GPU Parallelization

410251 : Deep Learning

Any 3 Assignments and 1 Mini Project are Mandatory

Group 1

1.	**Linear regression by using Deep Neural network:** Implement Boston housing price predictionproblem by Linear regression using Deep Neural network. Use Boston House price predictiondataset.
2.	**Classification using Deep neural network** (Any One from the following) 1. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition datasethttps://archive.ics.uci.edu/ml/datasets/letter+recognition 2. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset
3.	**Convolutional neural network (CNN)** (Any One from the following) • Use any dataset of plant disease and design a plant disease detection system using CNN. • Use MNIST Fashion Dataset and create a classifier to classify fashion clothing into categories.
4.	**Recurrent neural network (RNN)** Use the Google stock prices dataset and design a time seriesanalysis and prediction system using RNN.
Group 2	
5.	**Mini Project:** Human Face Recognition
6.	**Mini Project:** Gender and Age Detection: predict if a person is a male or female and also their age
7.	**Mini Project:** Colorizing Old B&W Images: color old black and white images to colorful images

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	-	2	1	-	-	-	-	-
CO2	1	2	1	-	-	1	-	-	-	-	-	1
CO3	-	1	1	1	1	1	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	-	-
CO7	3	3	3	3	3		-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410256: Laboratory Practice VI

Teaching Scheme: Practical: 2 Hours/Week	Credit 01	Examination Scheme : Term Work: 50 Marks

Companion Course: Elective V (410252), Elective VI(410253)

Course Objectives:

- To understand the fundamental concepts and techniques of natural language processing (NLP)
- To understand Digital Image Processing Concepts
- To learn the fundamentals of software definednetworks
- Explore the knowledge of adaptive filtering and Multi-rate DSP
- To be familiar with the various application areas of soft computing.
- To introduce the concepts and components of Business Intelligence (BI)
- To study Quantum Algorithms and apply these to develop hybrid solutions

Course Outcomes:

On completion of this course, the students will be able to

CO1: Apply basic principles of elective subjects to problem solving and modeling.

CO2: Use tools and techniques in the area of software development to build mini projects

CO3: Design and develop applications on subjects of their choice.

CO4: Generate and manage deployment, administration & security.

Guidelines for Instructor's Manual

List of recommended programming assignments and sample mini-projects is provided for reference. Referring to these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses. Preferably there should be multiple sets of assignments/mini-project and distributed among batches of students. Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects. Mini-project can be completed in group of 2 to 3 students. Software Engineering approach with proper documentation is to be strictly followed. Use of open source software is to be encouraged. Instructor may also set one assignment or mini-project that is suitable to the respective course beyond the scope of syllabus.

Operating System recommended: - 64-bit Open source Linux or its derivative **Programming Languages**: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, **Backend**: MongoDB/MYSQL/Oracle, Database Connectivity: ODBC/JDBC, **Additional Tools**: Octave, Matlab, WEKA,powerBI

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal may consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab Home Faculty of Engineering Savitribai Phule Pune University

Syllabus for Fourth Year of Computer Engineering assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness reserving weightage for successful mini-project completion and related documentation.

Guidelines for Practical Examination

It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned. Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed. The supplementary and relevant questions may be asked at the time of evaluation to test the student‟s for advanced learning, understanding, effective and efficient implementation and demonstration skills. Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor’s manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Recommended / Sample set of assignments and mini projects for reference for four courses offered for Elective III and for four courses offered for Elective IV. Respective Student has to complete laboratory work for elective III and IV that he/she has opted.

410252(A): Natural Language Processing

Any 5 Assignments and 1 Mini Project are mandatory

Group 1	
1.	Perform tokenization (Whitespace, Punctuation-based, Treebank, Tweet, MWE) using NLTK library. Use porter stemmer and snowball stemmer for stemming. Use any technique for lemmatization. **Input / Dataset –use any sample sentence**
2	Perform bag-of-words approach (count occurrence, normalized count occurrence), TF-IDF on data. Create embeddings using Word2Vec. **Dataset to be used:** https://www.kaggle.com/datasets/CooperUnion/cardataset
3	Perform text cleaning, perform lemmatization (any method), remove stop words (any method), label encoding. Create representations using TF-IDF. Save outputs. **Dataset: https://github.com/PICT-NLP/BE-NLP-Elective/blob/main/3-Preprocessing/News_dataset.pickle**
4	Create a transformer from scratch using the Pytorch library
5	Morphology is the study of the way words are built up from smaller meaning bearing units. Study and understand the concepts of morphology by the use of add delete table
Group 2	
6	**Mini Project** (Fine tune transformers on your preferred task) Finetune a pretrained transformer for any of the following tasks on any relevant dataset of your choice: • Neural Machine Translation • Classification • Summarization
7	**Mini Project** - POS Taggers For Indian Languages
8	**Mini Project** -Feature Extraction using seven moment variants
9	**Mini Project** -Feature Extraction using Zernike Moments
Virual Lab:https://nlp-iiith.vlabs.ac.in/	
410252(B) Image Processing	
Any 5 Assignments and 1 Mini Project are mandatory	
Group 1	
Programming language: Python/C/C++ using OpenCV	

1.	Consider any image with size 1024*1024. Modify the image to the sizes 512*512, 256*256, 128*128, 64*64 and 32*32 using subsampling technique. Create the original image from all the above subsampled images using resampling technique. Read any image. Display the histogram, Equalized histogram, and image with equalized histogram
2	Consider any image with size 1024*1024. Modify the image to the sizes 512*512, 256*256, 128*128, 64*64 and 32*32 using subsampling technique. Create the original image from all the above subsampled images using resampling technique.
3	Read any image. Display the histogram, Equalized histogram, and image with equalized histogram
4	Read any image. Display the outputs of contrast stretching, intensity level slicing
5	Compare the results of any three edge detection algorithms on the same image dataset and do the analysis of the result.
6	Compare the result of any two image segmentation algorithm on the same image data set
7	Write a program for image compression using any three compression techniques and compare the results.
Group 2	
8	**Mini project:** Implement visual surveillance applications and detect moving objects using object detection and tracking algorithm Or Implement any medical image processing application for freely available medical image dataset.
9	**Mini Project** - Implement image segmentation to detect object in the background of image.
410252(C) : Software Defined Networks	
Any 5 Assignments and 1 Mini Project are mandatory	
Group 1	
1.	Prepare setup for Mininet network emulation environment with the help of Virtual box and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology(Simple, Linear, and Tree).View flow tables.
2	After studying open source POX and Floodlight controller, Install controller and run custom topology using remote controller like POX and floodlight controller. Recognize inserted flows by controllers.
3	Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller. Ref: https://github.com/mininet/openflow-tutorial/wiki/Create- Firewall

4	Using Mininet as an Emulator and POX controller, build your own internet router. Write simple outer with a static routing table. The router will receive raw Ethernet frames and process the packet forwarding them to correct outgoing interface. You must check the Ethernet frames are received and the forwarding logic is created so packets go to the correct interface. Ref: https://github.com/mininet/mininet/wiki/SimpleRouter
5	Emulate and manage a Data Center via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center. Implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management. Ref:https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf
6	Study Experiment: Study in details Cloud seeds automates IAAS using SDN and a high-performance network from Juniper SDN Framework.

410252(D) : Advanced Digital Signal Processing

Any 5 Assignments and 1 Mini Project are mandatory

Group 1

Use
A] MATLAB or other equivalent software working with speech and image signals/files and for analysis purpose.
B] C++ or JAVA for working with sampled data (n – point data samples of DT/Digital signal)
C] JAVA or other for image processing assignments

1.	Apply 1-D DFT to observe spectral leakage and frequency analysis of different window sequences, plot the frequency spectrums.
2.	Adaptive FIR and IIR filter design: A] Steepest descent and Newton method, LMS method, B] Adaptive IIR Filter design: Pade Approximation, Least square design
3.	Power spectrum estimation and analysis: Take a speech signal and perform A] Non parametric method: DFT and window sequences B] Parametric methods: AR model parameters
4.	Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion A] Take a speech signal with specified sampling frequency. Decimate by factor D(e.g. factor B] Take a speech signal with specified sampling frequency. Interpolate by factor I(e.g. factor) C] Sampling rate conversion by factor of I/D
5.	Write a program to calculate LPC coefficients, reflection coefficients using Levinson Durbin algorithm

6.	Feature Extraction of speech signal A] Using LPC and other methods B] Apply different coding methods: harmonic coding, vector quantization
Group 2:	
7	**Mini-Project** : Discrete Cosine Transform (DCT) A] To find DCT of NxN image block B] To plot spectrum of the speech signal using DCT and find the correlation of DCT transformed signal C] Image filtering using DCT : LPF, edge detection D] Image compression using DCT, Image resizing OR **Mini-Project** : Image Processing A] Histogram and Equalization B] Image Enhancement Techniques C] Image Filtering: LPF, HPF, Sobel/Prewitt Masks D] Image Smoothing with special filters: Median, Weiner, Homomorphic filters
410252(E) : Open Elective	
1.	Suitable set of programming assignments/Mini-projects for open elective Opted.
PART II 410253 : Elective VI	
410253(A) Pattern Recognition	
Any 5 Assignments and 1 Mini Project are mandatory	
Group 1	
1	Extraction of features using structural and feature space methods for Indian Fruits
2	Face Recognition using PCA and multiclass LDA.
3	Fruit shape recognition using Eigen Faces and Fisher Faces
4	Perform sentiment analysis on the IMDB movie reviews dataset
5	Perform a classification task on a dataset of modulated radio signals.
6	Perform image segmentation on the Berkley Segmentation dataset
Group 2	
6	**Mini Project** - Real-time face detection in multi-scale images with an attentional cascade of boosted classifiers.

7	**Mini Project** - Printed Devanagari Text Recognition using structural approach.
410253(B) : Soft Computing	
Any 5 Assignments and 1 Mini Project are mandatory	
Group 1	
1	Design an X-OR Gate with feed-forward neural network (also popularly known as a Multilayer Perceptron) classifier.
2	Symmetric and Asymmetric implementation of Particle Swarm Optimization for Traveling Salesman Problem.
3	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
4	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
5	Implement genetic algorithm for benchmark function (eg. Square, Rosenbrock function etc) Initialize the population from the Standard Normal Distribution. Evaluate the fitness of all its individuals. Then you will do multiple generation of a genetic algorithm. A generation consists of applying selection, crossover, mutation, and replacement. Use: • Tournament selection without replacement with tournament size s • One point crossover with probability Pc • bit-flip mutation with probability Pm • use full replacement strategy
Group 2	
6	**Mini Project** - Create a small hybrid system for solving a chosen problem by following the given steps below. 1. Explain on one page the main characteristics of hybrid systems. 2. For the task chosen from the list below, create a multimodular block diagram of a possible solution to the problem. 3. Choose appropriate techniques for solving each sub problem represented as a module. What alternatives are there for each of them? 4. Create subsystems for solving each of the sub problems. Compile the whole hybrid system. 5. Make experiments with the hybrid system and validate the results.

	Mini Project: Handwritten digits recognition **Mini Project**: Bank loan approval decision-making system **Mini Project**: Stock market prediction **Mini Project**: Unemployment prediction **Mini Project**: Spoken words recognition, for example, "on"/"off"; "yes"/"no"; "stop"/ "go." **Mini Project**: Loan approval
410253(C) : Business Intelligence	
Any 5 Assignments and 1 Mini Project are mandatory	
Group 1	
1	Import the legacy data from different sources such as (Excel , Sql Server, Oracle etc.) and load in the target system. (You can download sample database such as Adventure works, Northwind, foodmart etc.)
2	Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sql server.
3	Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.
4	Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart
5	Perform the data classification using classification algorithm. Or Perform the data clustering using clustering algorithm.
Group 2	
6	**Mini Project**: Each group of 4 Students (max) assigned one case study for this; A BI report must be prepared outlining the following steps: a) Problem definition, identifying which data mining task is needed. b) Identify and use a standard data mining dataset available for the problem.
410253(D):Quantum Computing	
Any 4 Assignments and 1 Mini Project are mandatory	
Group 1	
1	Analyze simple states of superposition and the effect of doing the measurement in different basis states .
2	Build simple quantum circuits with single and two-qubit gates
3	Install Setup for running quantum programs on IBM machines.

4	Analyze the effectiveness of simple error correction scheme
5	Implement quantum programs in NISQ model of computing
6	Make a script for visualizing the energy levels of Hamiltonians.
Group 2	
6	**Mini Project:** Build a Quantum Random Number Generator.
7	**Mini Project:** Implement Grover's Search Algorithm.
7	**Mini Project:** Use Shor's Algorithm to Factor a Number.
410253(E) : Open Elective	
1.	Suitable set of programming assignments/Mini-projects for open elective Opted.

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	3	-	-	-
CO4	2	-	2	-	-	3	-	-	-	-	-	-

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410256: Project Work Stage II

Teaching Scheme:	Credit	Examination Scheme:
TH: 06 Hours/Week	06	Term work: 100 Marks Presentation: 50Marks

Prerequisite Courses: Project Stage I(410248)

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report

Course Outcomes:

On completion of the course, student will be able to–

CO1: Show evidence of independent investigation

CO2: Critically analyze the results and their interpretation.

CO3: Report and present the original results in an orderly way and placing the open questions in the rightperspective.

CO4: Link techniques and results from literature as well as actual research and future research lines withthe research.

CO5: Appreciate practical implications and constraints of the specialist subject

Guidelines

In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
AC8-I	Usability Engineering
AC8- II	Conversational Interface
AC8-III	Social Media and Analytics
AC8-IV	MOCC-Learn New Skills
AC8-V	Emotional Intelligence

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8
AC8 – I: Usability Engineering

In this course you will have a hands-on experience with usability evaluation and user-centered design. This course will not help to learn how to implement user interfaces, but rather how to design based on the needs of users, which you will determine, and learn how to evaluate your designs rigorously. This help in knowing more about the usability; human computer interaction, the psychological aspects of computing, evaluation.

Course Objectives:

- To understand the human centered design process and usability engineering process andtheir roles in system design and development.
- To know usability design guidelines, their foundations, assumptions, advantages, and weaknesses
- Understand the user interface based on analysis of human needs and prepare a prototype system

Course Outcome:

On completion of the course, learner will be able to–

CO1: Describe the human centered design process and usability engineering process and theirroles in system design and development.
CO2: Discuss usability design guidelines, their foundations, assumptions, advantages, andweaknesses.
CO3: Design a user interface based on analysis of human needs and prepare a prototype system.
CO4: Assess user interfaces using different usability engineering techniques.
CO5: Present the design decisions

Course Contents:

1. What Is Usability?: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences
2. Usability in Software Development : The Emergence of Usability, Human ComputerInteraction, Usability Engineering
3. The usability Engineering Lifecycle: Requirement Analysis, Design, Testing, Development
4. Usability Assessment Methods beyond Testing
5. International User Interfaces

Books:

1. Mary Beth Rosson, John Millar Carroll, “Usability Engineering: Scenario- based Development of Human- Computer Interaction”
2. Jakob Nielsen, “Usability Engineering”
1. Deborah J. Mayhew, “ The usability engineering lifecycle”

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8
AC8 – II: Conversational Interfaces

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

- To understand the basics of conversation
- To know the interactive environments for conversational skills
- To acquaint with the speech to text and text to speech techniques

Course Outcome:

On completion of the course, learner will be able to–

CO1: Develop an effective interface for conversation

CO2: Explore advanced concepts in user interface

Course Contents:

1. **Introduction to Conversational Interface:** Preliminaries, Developing a speech based Conversational Interface, Conversational Interface and devices.
2. **A technology of Conversation:** Introduction, Conversation as Action, The structure of Conversation, The language of Conversation.
3. **Developing a Speech-Based Conversational Interface:** Implementing Text to Speech: Text Analysis, Wave Synthesis, Implementing Speech Recognition: Language Model, Acoustic Model, Decoding. Speech Synthesis Markup Language.
4. **Advanced voice user interface design**

Books:

1. Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences"
2. Michael McTear, ZoraidaCallejas, David Griol, " The Conversational Interface: Talking to Smart Devices"
3. Martin Mitrevski, "Developing Conversational Interfaces for iOS: Add Responsive Voice Control"
4. SriniJanarthanam, " Hands-On Chatbots and Conversational UI Development: Build chatbots"

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering(2019Course)
410257:Audit Course8
AC8–III: Social Media And Analytics

This course aims to create awareness among the students regarding social media and analytics.

Course Objectives:

- Get strategic understanding of Digital Marketing and Social Media Marketing.
- Understand how to use it for branding and sales.
- Understand its advantages& limitations.
- Become familiar with Best Practices, Tools &Technologies.
- Blend digital and social marketing with offline marketing.
- Plan and manage digital marketing budget.
- Manage Reporting & Tracking Metrics.
- Understand the future of Digital Marketing and prepare for it.

Course Outcome:

On completion of the course, learner will be able to–

CO1: Develop a far deeper understanding of the changing digital land scape.

CO2: Identify some of the latest digital marketing trends and skill sets needed for today's marketer.

CO3: Successful planning, prediction, and management of digital marketing campaigns

CO4: Assessuserinterfacesusingdifferentusabilityengineeringtechniques.

CO5: Implement smart management of different digital assets for marketing needs.

CO6: Assess digital marketing as a long term career opportunity.

Course Contents:

1. Digital Marketing, History of Digital Marketing, Importance of Digital Marketing, Effective use of Digital Marketing, Effects of wrong Digital Marketing, Digital Marketing to develop brands, Digital Marketing for sales, Digital Marketing for product and service development.
2. Techniques for effective Email Marketing and pitfalls, Various online email marketing platforms such as Campaign Monitor and Mail Chimp, Web content, web usability, navigation and design, Bookmarking and News Aggregators, Really Simple Syndication (RSS),Blogging, Live Chat, User Generated Content (Wikipedia etc),Multi-media - Video (Video Streaming, YouTube etc),Multi-media - Audio & Podcasting (iTunes etc),Multi-media - Photos/Images (Flickr etc),Google Alerts and Giga Alert (Brand, product and service monitoring online),Crowd sourcing,Virtual Worlds.
3. Search Engine Optimization (SEO), Search Engine Optimization (SEO) tips and techniques, Google Adwords, Google various applications such as 'Google Analytics', Maps, Places etc to enhance a brand's products, services and operations.
4. Facebook & LinkedIn and other Social Media for areal marketing, Utilizing Facebook and LinkedIn's Advertising functionality and Applications, Brand reputation management techniques, Systems for 'buzzmonitoring'forbrands, products and services, Effective Public Relations (PR) online and business development.

References:

1. Vandana Ahuja, “Digital Marketing”, OxfordPress, ISBN:9780199455447,1st Edition.
2. Wiley, Jeanniey, Mullen, David Daniels, David Gilmour, “Email Marketing: An Houra Day, -ISBN:978-0-470-38673-6,1st Edition.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8
AC8 – IV: MOOC-learn New Skill

This course aims to create awareness among the students regarding various courses available under MOOC and learn new skills through these courses.

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, , students will be able to

CO1: To acquire additional knowledge and skill.

About Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you'reinterested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effortis to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

4. https://swayam.gov.in/
5. https://onlinecourses.nptel.ac.in/
6. https://www.edx.org

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 8
AC8 – V: Emotional Intelligence

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Expand your knowledge of emotional patterns in yourself and others
CO2: Discover how you can manage your emotions, and positively influence yourself and others
CO3: Build more effective relationships with people at work and at home
CO4: Positively influence and motivate colleagues, team members, managers
CO5: Increase the leadership effectiveness by creating an atmosphere that engages others

Course Contents

1. **Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models,The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. **Know and manage your emotions:** emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize „negative" and „positive" emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing „negative" emotions, Techniques to manage your emotions in challenging situations
3. **Recognize emotions in others :**The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
4. **Relate to others**: Applying EI in the workplace, the role of empathy and trust in relationships,Increase your ability to create effective working relationships with others (peers, subordinates,managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books:

1. Daniel Goleman, "Emotional Intelligence – Why It Matters More Than IQ," , BantamBooks, ISBN-10: 055338371X13: 978-0553383713
2. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
3. Drew Bird , "The Leader"s Guide to Emotional Intelligence" , ISBN: 9781535176002

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Acknowledgement

It is with great pleasure and honor that I share the curriculum for Fourth Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.
It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.
Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!
Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all-inclusive curriculum for Fourth Year of Computer Engineering.
Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Pramod D. Patil (Dr. D. Y. Patil Institute of Technology, Pimpri), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.
I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.
I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!
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Thank you for all your efforts!

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Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University

Task Force at Curriculum Design

1. **Advisors, the Team of Board of Studies-**
   Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil Dr. P. M. Yawalkar, and Dr. Swati A. Bhavsar.

2. **Team Leader- Dr. Pramod D. Patil, Dr. D. Y. Patil Institute of Technology, Pimpri**

3. **Teams, Course Design -**

Name of Course	Team Coordinator	Team Members	
Design and Analysis of Algorithms	**Dr. Santosh V. Chobe**	Dr. Sunil Dhore Dr. Rachna Somkunwar Prof. S. P. Pingat	Mrs.Pragati Chaudhari Dr.Vaihsali Tidake
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Elective III : Multimedia Techniques	**Dr. B.A.Sonkamble**	Dr.Madhuri P. Borawake Prof Gosavi	Mr. Ranjit M. Gawande Prof.Shweta Koparde
Elective III : Cyber Security and Digital Forensics	**Dr. Girija G. Chiddarwar**	Prof. B.L.Dhote Prof. N. D. Kale Dr.Nikita Kulkarni Dr.Uma Godase	Prof. P.A. jain
Elective III: Object Oriented Modeling and Design	**Prof. Rahul Patil**	Mr.Balasaheb S. Tarle Mr.Kishor R. Pathak Mr. Santosh Sambare	Prof.Ashwini A. Jarali Mrs.Neelam Patil
Elective III: Digital Signal Processing	**Prof. M.S. Wakode**	Prof. P.A. Jain Prof.Yogesh S. Sapnar	
Elective IV:Information Retrieval	**Dr. Sharmila Wagh**	Dr. Jayadevan R. Mr. Prashant Ahire Dr. Dinesh Hanchate	Mr.Devidas Thosar Dr.S. B . Tambe
Elective IV:GPU Programming and Architecture	**Mrs.Jayshree R. Pansare**	Mr. S. A. Thanekar Mrs.Asha Sathe Dr.sandip kadam	Dr.Deepak Mane Mr. D.D.Sapkal Prof. Manisha V. Marathe

Elective IV:Mobile Computing	**Dr. Manisha Bhende**	Dr.R. M. Wahul Dr.Archana Kale Ms. S. V. Bodake	Dr. D. P. Gaikwad Mrs.Nadaph A. Gulab Dr.M.L. Dhore Prof.Yogesh S. Sapnar
Elective IV:Software Testing and Quality Assurance	**Dr. Uday C. Patkar**	Dr.S.K.Sonkar Dr. S. U. Kadam Mr.Rahul G. Teni Prof. Vina M. Lomte	Dr. Sunil Khatal Ms. Ila Shridhar Savant Prof. Vandana S. Rupnar Prof.Yogesh S. Sapnar
Elective IV:Quantum Computing	**Dr. M. U. Kharat**	**Dr. M. U. Kharat**	Prof.Yogesh S Sapnar
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Audit Course 7	**Prof.Satish S. Banait**	**Prof.Satish S. Banait**	
High Performance Computing	**Dr. Rachna Somkunwar**	Mrs. Archana S. Vaidya Mrs. Rushali Patil Prof.S.P.Khedkar	Dr. G.R.Shinde Mrs.B.Mahalakshmi
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Compiler Construction	**Prof.Yogesh S Sapnar**	Dr. Swati A. Bhavsar Ms. Kainjan Sanghavi	
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		Dr.Sandeep Chaware	
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Lab Practice V	**Dr. G. R. Shinde**	Dr. Rachna Somkunwar Dr. Archana Chaugule	
Lab Practice VI	**Dr.Kamini A. Shirsath**	Dr. M.S.Takalikar Dr. Sudeep D. Thepade Dr. Sonali Patil Dr. S. D. Babar	Dr. A.S.Ghotkar Dr. Sulochana Sonkamble Dr. Madhuri A. Potey Prof. Dr. K. Rajeswari
Project Stage II	**Dr. Swati A. Bhavsar**	**Dr. Swati A. Bhavsar**	
Audit Course 8	**Dr. Shaikh Nuzhat Faiz**	**Dr. Shaikh N. Faiz**	

Faculty of Engineering
Savitribai Phule Pune University, Pune

Syllabus

Master of Computer Engineering
(Course 2017)

(with effect from Year 2017-18)

Prologue

It is with great pleasure and honor that I present the syllabus for Master of Computer Engineering (2017 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune curriculum for post graduate program in Computer Engineering in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University- Savitribai Phule Pune University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

The basic motives of designing the contents of various courses is to focus on independent learning convergence to special domains, development of research attitude and comprehensive coverage of technologies. Elective courses with choice for module selection provide flexibility and opportunity to explore the domain specific knowledge.

The open elective is to invite the attention to multidisciplinary, interdisciplinary, exotic, employability or update to technology course. The institute may design the syllabus accordingly. However such designed syllabus needs to be approved by SPPU authority before implementation.

While framing each course contents, Course advisor, Course Coordinators and Team Members have put arduous efforts in meeting the standards of the Courses at PG level. Everybody in the team has meticulously stuck to the guidelines and recommendations to materialize the team efforts. The fruition is only due to sincere efforts, active participation, expert opinions and suggestions from domain professionals.

I am sincerely indebted to all the minds and hands who work dexterously and synchronously to materialize the huge task.

Thanks.

Dr. Varsha H. Patil
Coordinator, Board of Studies (Computer Engineering), SPPU, Pune
Tuesday, March 28, 2017. Mail-id: vh_patil2003@yahoo.com

[This document includes Program Educational Objectives - Program Outcomes, Program Specific Outcomes (page 3-4), Semester-wise Courses (teaching scheme, examination, marks and credit) (page 5-6), Courses syllabi (page 7-63)] and Non Credit Course Contents [64-70].

Program Educational Objectives

PEO1: To prepare globally competent post graduates with enhanced domain knowledge and skills attaining professional excellence and updated with modern technology to provide effective solutions for engineering and research problems.

PEO2: To prepare the post graduates to work as a committed professionals with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.

PEO3: To prepare motivated post graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking to succeed in the career in industry/academia/research

PEO4: To prepare post graduates with strong managerial and communication skills to work effectively as an individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

PO1: Scholarship of Knowledge

Acquire in-depth knowledge of Computer Science and Engineering, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2: Critical Thinking

Analyze complex engineering problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3: Problem Solving

Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4: Research Skills

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5: Usage of Modern Tools

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

PO6: Collaborative and Multidisciplinary work

Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7: Project Management and Finance

Demonstrate knowledge and understanding of Computer Science & Engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8: Communication

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: Life-long Learning

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10: Ethical Practices and Social Responsibility

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11: Independent and Reflective Learning

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

Program Specific Outcomes (PSO)

A post graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills

The ability to understand, analyze and develop software in the areas related to system software, multimedia, web design, big data analytics, networking, and algorithms for efficient design of computer-based systems of varying complexities.

PSO2: Problem-Solving Skills

The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship

The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, with zest for research.

PSO4: Research Skills

The ability to study, experiment, interpret, analyze and explore the solutions to the engineering problems which are effective, efficient, optimized and feasible.

Savitribai Phule Pune University, Pune
Master of Computer Engineering (2017 Course)
(with effect from June 2017)

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/ PRE	Total	TH	PR
510101	Research Methodology	04	--	50	50	--	--	100	04	--
510102	Bio-Inspired Optimization Algorithms	04	--	50	50	--	--	100	04	--
510103	Software Development and Version Control	04	--	50	50	--	--	100	04	--
510104	Embedded and Real Time Operating Systems	04	--	50	50	--	--	100	04	--
510105	Elective I	05	--	50	50	--	--	100	05	-
510106	Laboratory Proficiency I	--	08	--	--	50	50	100	--	04
	Total Credit								21	04
	Total	**21**	**08**	**250**	**250**	**50**	**50**	**600**	**25**	
510107	Non-Credit Course I								Grade	

Elective I

510105A	Advanced Digital Signal Processing	510105B	Data Mining
510105C	Network Design and Analysis	510105D	Data Algorithms
510105E	Open Elective		

Semester II

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/ PRE	Total	TH	PR
510108	Operations Research	04	--	50	50	--	--	100	04	--
510109	System Simulation and Modeling	04	--	50	50	--	--	100	04	--
510110	Machine Learning	04	--	50	50	--	--	100	04	--
510111	Elective II	05	--	50	50	--	--	100	05	--
510112	Seminar I		04	--	--	50	50	100	--	04
510113	Laboratory Proficiency II	--	08	--	--	50	50	100	--	04
	Total Credit								17	08
	Total	**17**	**12**	**200**	**200**	**100**	**100**	**600**	**25**	
510114	Non-Credit Course II								Grade	

Elective II

510111A	Image Processing	510111B	Web Mining
510111C	Pervasive and Ubiquitous Computing	510111D	Network Security
510111E	Open Elective		

Abbreviations: TW: Term Work , **TH:** Theory, **OR:** Oral, **PRE**: Presentation, **Sem:** Semester

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Semester III

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/ PRE	Total	TH	PR
610101	Fault Tolerant Systems	04	--	50	50	--	--	100	04	--
610102	Information Retrieval	04	--	50	50	--	--	100	04	--
610103	Elective III	05	--	50	50	--	--	100	05	--
610104	Seminar II	--	04	--	--	50	50	100	--	04
610105	Dissertation Stage I	--	08	--	--	50	50	100	--	08
	Total Credit								13	12
Total		13	12	150	150	100	100	500	25	
610106	Non-Credit Course III								Grade	

Elective III

610103A	Cloud Security	610103B	Speech Signal Processing		
610103C	Mobile Ad-hoc Network	610103D	Pattern Recognition	610103E	Open Elective

Semester IV

Course Code	Course	Teaching Scheme Hours / Week	Examination Scheme and Marks			Credit
		Practical	TW	OR/PRE	Total	PR
610107	Seminar III	05	50	50	100	05
610108	Dissertation Stage II	20	150	50	200	20
Total		25	200	100	300	25

Non-Credit Courses

Typically curriculum is constituted by credit, non-credit and audit courses. These courses are offered as compulsory or elective. Non Credit Courses are compulsory. No grade points are associated with non-credit courses and are not accounted in the calculation of the performance indices SGPA & CGPA. However, the award of the degree is subject to obtain a PP grade for non credit courses. Conduction and assessment of performance in said course is to be done at institute level. The mode of the conduction and assessment can be decided by respective course instructor. Recommended but not limited to- (one or combination of) seminar, workshop, MOOC Course certification, mini project, lab assignments, lab/oral/written examination, field visit, field training. Examinee should submit report/journal of the same. Reports and documents of conduction and assessment in appropriate format are to be maintained at institute. Result of assessment will be PP or NP. Set of non-credit courses offered is provided. The Examinee has to select the relevant course from pool of courses offered. Course Instructor may offer beyond this list by seeking recommendation from SPPU authority. The selection of 3 distinct non-credit courses, one per semester (Semester I, II & III). The Contents of Non Credit Courses are Provided at page 63 onwards.

Open Elective: The open elective is to invite the attention to multidisciplinary, interdisciplinary, exotic, employability or update to technology course. The institute may design the syllabus accordingly. However such designed syllabus needs to be approved by SPPU authority before implementation.

Recommended Set of Non-Credit Courses(510107, 510114, 610106):

NCC1: Game Engineering **NCC2:**Advanced Cognitive Computing
NCC3: Reconfigurable Systems **NCC4:** Convergence Technology
NCC5: Machine Learning **NCC6**:Storage Area Networks
NCC7: Search Engine Optimization **NCC8:**Virtual Reality
NCC9: Machine Translation **NCC10:** Infrastructure Management

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Master of Computer Engineering (2017 Course)
510101: Research Methodology

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives :

- To understand the philosophy of research in general
- To understand basic concepts of research and its methodologies
- To learn the methodology to conduct the Literature Survey
- To acquaint with the tools, techniques, and processes of doing research
- To learn the effective report writing skills and allied documentations
- To become aware of the ethics in research, academic integrity and plagiarism

Course Outcomes:

After completion of the course, students should be able to

- Carry out Literature Survey
- Identify appropriate topics for research work in computer engineering
- Select and define appropriate research problem and parameters
- Design the use of major experimental methods for research
- Use appropriate tools, techniques, and processes of doing research in Computer science
- Demonstrate own contribution to the body of knowledge
- Become aware of the ethics in research, academic integrity and plagiarism
- Write a research report and thesis

Course Contents

Unit I	Introduction	08 Hours

Evolution of Research Methodology: Meaning, nature, scope, and significance of research; Research paradigm; The purpose and outcomes of Research; Objectives of research, Motivation for research; Postulates underlying scientific investigations; Types of research; Research process and work flow.

Engineering Research-Why? Research Questions, Engineering Ethics, conclusive proof-what constitutes, A research project-Why take on?

Case Study- Code of Ethics, IEEE Code of Ethics, ACM Software Engineering Code of Ethics and Professional Practice, Code of Ethics especially covering Engineering discipline, various aspects-environment, sustainable outcomes, employer, general public, and Nation, Engineering Disasters.

Unit II	Literature Search and Review, Developing Research Plan	08 Hours

Archival Literature, Why should engineers be ethical? Types of publications- Journal papers, conference papers, books, standards, patents, theses, trade magazine, newspaper article, infomercials, advertisement, Wikipedia & websites, Measures of research impact, Literature review, publication cost.

Case Study- Engineering dictionary, Shodhganga, The Library of Congress, Research gate, Google Scholar, Bibliometrics, Citations, Impact Factor, h-index, I-index, plagiarism, copyright infringement.

Developing Research Plan: Research Proposals, Finding a suitable research questions, The

elements of research proposals-title, details, budget, Design for outcomes-1D data, 2D data, 3D data, N-D data, The research tools- Experimental measurements, numerical modeling, theoretical derivations & Calculations, curve matching. **Case Study-** Various Research grants and funding resources		
Unit III	**Statistical Analysis**	**08 Hours**
Statistical Analysis: Introduction, Sources of error and uncertainty, One-Dimensional Statistics: combining errors and uncertainties, t-test, ANOVA statistics, example, Two-Dimensional Statistics: example, Multi-Dimensional Statistics: partial correlation coefficients, example, Null hypothesis testing. **Case Study-** GNU PSPP Tool, SOFA, NOST-Dataplot		
Unit IV	**Optimization Techniques**	**08 Hours**
Optimization Techniques: Introduction, Two-parameter optimization methods: sequential uniform sampling, Monte Carlo optimization, Simplex Optimization method, Gradient Optimization method, Multi-parameter optimization methods, The cost function. **Case Study-** Google Optimization Tools, OpenMDAO		
Unit V	**Survey Research Methods**	**08 Hours**
Survey Research Methods: Why undertake a survey, Ergonomics and human factors, Ethics approval, General survey guidelines, Survey statements, Survey delivery, Respondent selection, Survey timelines, Statistical analysis, Reporting. **Case Study-** Qualitative Analysis Tools- AQUAD, CAT		
Unit VI	**Research Presentation**	**08 Hours**
Research presentation: Introduction, Standard terms, Standard research methods and experimental techniques, Paper title and keywords, Writing an abstract, Paper presentation and review, Conference presentations, Poster presentations, IPR, Copyright, Patents. **Reporting Research:** Thesis, Structure and Style for writing thesis, Dissemination of research findings; Reporting and interpretation of results; cautions in interpretations, Type of reports, Typical report outlines. **The path forward:** Publication trends, Getting started in research, Quality assurance (QA) Occupational health and safety. **Case Study:** Intellectual Property India- services, InPASS - Indian Patent Advanced Search System, US patent, IEEE / ACM Paper templates. **A glimpse into the future of Engineering Research.**		
Books:		

Text:

1. David V Thiel, “Research Methods- for Engineers”, Cambridge University Press, ISBN:978-1-107-61019-4
2. Kothari C.R., “Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978-81-224-1522-3.

References:

1. Caroline Whitbeck, “Ethics in Engineering Practice and Research”, 2nd Ed., Cambridge University Press; ISBN :978-1-107-66847-8
2. Gordana DODIG-CRNKOVIC, “Scientific Methods in Computer Science”, Department of Computer Science Malardalen University, Vasteas, Sweden; ISBN: 91-26-97860-1

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510102 : Bio-Inspired Optimization Algorithms

Teaching Scheme:	Credit	Examination Scheme :
TH: 04 Hours/Week	04	In-Sem: 50 Marks End-Sem : 50 Marks

Course Objectives :

- To learn how natural and biological systems influence computational field
- To understand the strengths and weaknesses of nature-inspired algorithms
- To learn the functionalities of various Bio-inspired optimization algorithms

Course Outcomes:

On completion of the course, student will be able to–

- Describe the natural phenomena that motivate the algorithms
- Apply nature-inspired algorithms to optimization
- Select the appropriate strategy or optimal solution based on bio-inspired algorithms

Course Contents

Unit I	Natural Computing	08 Hours

From nature to natural computing, sample idea, Philosophy of natural computing, Natural computing approaches, Conceptualization – general concept, Problem solving as a search track, Hill climbing, Simulated annealing

Unit II	Evolutionary Computing	08 Hours

Evolutionary computing : Evolutionary biology, Evolutionary computing – standard evolutionary algorithm; Genetic algorithm, evolutionary strategies, Evolutionary programming

Unit III	Swarm Intelligence	08 Hours

Swarm intelligence-biological motivation, from natural to artificial, standard algorithm of Ant colony optimization, Ant clustering algorithm, Particle swarm optimization

Unit IV	Biological Motivation	08 Hours

Biological motivation, from natural to artificial, standard algorithm of cuckoo search, bat algorithm, flower pollination, firefly algorithm, framework for self tuning algorithms - case study of firefly algorithm

Unit V	Immune Systems	08 Hours

Immune system, Artificial immune systems - biological motivation, Design principles, main types of algorithms - Bone marrow, Negative selection, Clonal selection, Continuous immune network models, Discrete immune network models, Scope of artificial immune systems

Unit VI	Artificial Life	08 Hours

The essence of life, Examples of ALife projects- flocks, herds and schools, computer viruses, synthesizing emotional behavior, AIBO robot, Turtles, termites, and traffic jams, framsticks, Scope of artificial life, Current trends and open problems.

Books:

Text:

1. L. N. de Castro, "Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications", 2006, CRC Press, ISBN-13: 978-1584886433

2. D. Floreano and C. Mattiussi, " Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", 2008, MIT Press, ISBN-13: 978-0262062718

References:

1. Sam Jones (Editor), "Bio Inspired Computing-Recent Innovations and Applications", Clanrye International; 2 edition (2 January 2015), ISBN-10: 1632400812
2. Yang Xiao (Editor), "Bio-Inspired Computing and Networking", CRC Press,
3. "Machine Nature: The Coming Age of Bio-Inspired Computing", New York: McGraw-Hill, 2002)
4. Adries Engelbrecht, " Computational Intelligence", Wiley, ISBN:978-0-470-03561-0
5. D.Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", 2008, MIT Press, ISBN-13: 978-0262062718
6. Russell C. Eberhart , Yuhui Shi , James Kennedy, " Swarm Intelligence: The Morgan Kaufmann Series in Evolutionary Computation", 1st Edition, ISBN-13: 978-1558605954
7. M. Goodrich, Tamassia, "Algorithm Design & Applications", Wiley, ISBN:978-1-118-33591-8

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510103 : Software Development and Version Control

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem: 50 Marks End-Sem : 50 Marks

Course Objectives:

- To enable students to understand software design issues
- To understand software architectures and patterns
- To acquaint software solutions to engineering Problems.
- To learn the significance of Version Control.
- To know and utilize version controls.

Course Outcomes:

After completion of the course, students should be able to

- Select and apply the design patterns to software development.
- Design software for real engineering Problems.
- Demonstrate team work for development of software in collaborative environment.
- Use of open source version control tool.

Course Contents

Unit I	Software Development	08 Hours

Design in the software development process, quality attributes of the design product, describing the design solution, design representations, design processes and design strategies. Design practices- incremental, object based and component based.
Case study – Software design of a Social Networking site like Linkedin, Twitter, Facebook.

Unit II	Software Architecture Design	08 Hours

Models of Software architecture design, Data centered architecture, Hierarchical architecture, Distributed architecture, heterogeneous architecture, product line architecture, product line engineering, and software technology for systematic reuse.
Case study – Software architecture of a Mobile Robot System (with specific focus on External sensors and actuators, Real-time responsiveness, Acquire sensor Input, control motion and plan future paths).

Unit III	Software Architecture Quality	08 Hours

Software Architecture - quality attributes, architecture in agile projects, documenting software architectures, architecture implementation and testing, architecture reconstruction and conformance.
Case study – Architecting in cloud environment for multi-tenancy.

Unit IV	Software Configuration Management	08 Hours

Software Configuration Management - Scope of SCM, source code management core concepts,

Build Engineering core concepts, Build tools evaluation and selection, Environment configuration control - goals, principles and importance, release management, deployment, configuration management-driven development, compliance, standards and frameworks for configuration management. **Case study** – Case Study of Improving Quality of Processes by System Virtualization		
Unit V	**Software Version Control**	**08 Hours**
Software Version Control -Introduction, Version control types, centralized & Distributed, Centralized Version Control - Basics, Subversion Distributed Version Control - Basics, Advantages, Weaknesses, **Case Study :** Version Control Best Practices on Git (for Management of Files)		
Unit VI	**Software Version Control Tools**	**08 Hours**
Software Version Control tools - Basic introduction to open source version control tools like GIT, GitHub, CVS, Apache Subversion, SVN, Mercurial, Bazaar. Case Study - Setup of a version control tool like Git with understanding Basic configuration, Commits, Branching, Merging, Naming, History. **Case Study** - Setup of a version control tool like Git with understanding Basic configuration, Commits, Branching, Merging, Naming, History		
Books :		

Text:

1. David Budgen, “Software Design” , Pearson - 2nd Edition, ISBN13: 9780201722192
2. Bob Aiello, Leslie Sachs, “Configuration Management Best Practices: Practical Methods that work in the real world “, Addison Wesley Professional (2010)
3. Eric Sink, “Version Control by Example”, Pyrenean Gold Press, ISBN13: 9780983507901

Reference :

1. Ian Gorton**, “**Essential Software Architecture”, Springer, ISBN 13: 9783642191763.
1. Jorge Luis Ortega-Arjona, “Patterns for Parallel Software Design”, Wiley Series, ISNB:978-0-470-69734-4
2. Kai Qian et al., “ Software Architecture and Design Illuminated”, Jones and Bartlett Publishers International, ISBN 13: 9780763754204.
3. Len Bass, Paul Clements, Rick Kazman, “Software architecture in practice” , 3rd edition, Addison Wesley, ISBN 13: 9780321815736
4. Ben Collins-Sussman, Brian William Fitzpatrick, C. Michael Pilato, “Version Control with Subversion” , O'Reilly Media , ISBN 13: 9781440495878
5. Scott Chacon and Ben Straub, “ Pro Git”, Apress, ISBN 13: 9781484200766
6. Richard E. Silverman, “ Git Pocket Guide: A Working Introduction”, O'Reilly Media, ISBN13: 9781449325862
7. 828-2012 - IEEE Standard for Configuration Management in Systems and Software Engineering
8. Software Engineering Competency Model Version 1.0 SWECOM by IEEE computer society

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Master of Computer Engineering (2017 Course)
510104 : Embedded and Real Time Operating Systems

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To understand embedded system, its constituents and the selection process of processor and memory for the embedded systems
- To learn communication buses and protocols used in the embedded and real-time systems
- To understand real-time operating system (RTOS), types of RTOS, temporal, functional and resource parameters of an RTOS process
- To learn various approaches to real-time scheduling and scheduling algorithms and multiprocessor scheduling
- To understand resource access control and inter-process communication for RTOS tasks
- To understand software development process, tools and debugging for RTOS applications
- To learn designing of RTOS based applications

Course Outcomes:

On completion of the course, student will be able to–

- Recognize and classify embedded and real-time systems
- Explain communication bus protocols used for embedded and real-time systems
- Classify and exemplify scheduling algorithms
- Apply software development process to a given RTOS application
- Design a given RTOS based application

Course Contents

Unit I	Embedded Systems	08 Hours

Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, hardware Unit s and devices in an embedded system – Power source, memory, real-time clocks, timers, reset circuits, watchdog-timer reset, Input-output ports, buses and interfaces, ADC, DAC, LCD, LED, Keypad, pulse dialer, modem, transceivers. embedded software, software are tools for designing an embedded system

Unit II	Embedded System On Chip (SOC)	08 Hours

Embedded SOC, ASIC, IP core, ASIP, ASSP, examples of embedded systems. Advanced architectures/processors for embedded systems- ARM, SHARC, DSP, Superscalar Units. Processor organization, Memory organization, Performance metrics for a processor, memory map and addresses, Processor selection and memory selection for real-time applications
Networked embedded systems- I2C, CAN, USB, Fire wire. Internet enabled systems- TCP, IP, UDP. Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee

Unit III	I/O Communication	08 Hours

Devices and communication buses: Types of I/O communication, types of serial communication, Serial protocols, Devices and buses- RS-232C, RS-485, HDLC, SPI, SCI, SI, SDIO. Parallel ports and interfacing. Parallel device protocols: ISA, PCI, PCI/X, ARM bus, Wireless devices.

Case Study: Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee

Unit IV	Real Time Operating System	08 Hours

Introduction to real-time operating systems. Hard versus soft real-time systems and their timing constraints. Temporal parameters of real-time process: Fixed, Jittered and sporadic release times, execution time. Types of real-time tasks, Precedence constraints and data dependency among real-time tasks, other types of dependencies for real-time tasks. Functional parameters and Resource parameters of real-time process, Real-time applications: Guidance and control, Signal processing, Multimedia, real-time databases

Real-time task and task states, task and data. Approaches to real-time scheduling: clock driver, weighted round-robin, priority-driven- Fixed priority and dynamic priority algorithms –Rate Monotonic (RM), Earliest-Deadline-First (EDF), Latest-Release-Time (LRT), Least-Slack-Time-First (LST). Static and Dynamic systems, on-line and off-line scheduling, Scheduling aperiodic and sporadic real-time tasks

Unit V	Inter-process communication	08 Hours

Resources and resource access control-Assumption on resources and their usage, Enforcing mutual exclusion and critical sections, resource conflicts and blocking, Effects of resource contention and resource access control - priority inversion, priority inheritance.

Inter-process communication-semaphores, message queues, mailboxes and pipes. Other RTOS services-Timer function, events, Interrupts - enabling and disabling interrupts, saving and restoring context, interrupt latency, shared data problem while handling interrupts. Interrupt routines in an RTOS environment

Unit VI	Multiprocessor Scheduling	08 Hours

Multiprocessor Scheduling, resource access control and synchronization in Real-time Operating system. Real-time communication: Model, priority-based service disciplines for switched networks, weighted round-robin service disciplines, Medium access-control protocols for broadcast networks, internet and resource reservation protocols, real-time protocols. Software development process for embedded system: Requirements engineering, Architecture and design of an embedded system, Implementation aspects in an embedded system, estimation modeling in embedded software. Validation and debugging of embedded systems. Embedded software development tools. Debugging techniques.

Real-time operating systems: Capabilities of commercial real-time operating systems, QNX/Neutrino, Microc/OS-II, VxWorks, Windows CE and RTLinux

Books:

Text :

1. Raj Kamal, “Embedded Systems: Architecture, programming and Design”, 2^{nd} Edition, McGraw-Hill, ISBN: 13: 9780070151253
2. Jane W. S. Liu, “Real-Time Systems”, Pearson Education, ISBN: 10: 0130996513
3. David E. Simon, “An Embedded Software Primer”, Pearson Education, ISBN: :8177581546

References:

1. Sriram V. Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming”, Tata McGraw-Hill, ISBN: 13: 9780070482845
2. Dr. K. V. K. K. Prasad, “Embedded Real-Time Systems: Concepts: Design and Programming”, Black Book, Dreamtech Press, ISBN: 10: 8177224611,13: 9788177224610

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective I
510105A : Advanced Digital Signal Processing

Teaching Scheme:	Credits	Examination Scheme:
TH: 05 Hours/Week	05	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To learn theory behind signal processing
- To Understand mathematics of signal processing
- To know the significance and use of filters
- To explore the applications DSP

Course Outcomes:

After completion of the course, students should be able to-

- Apply various transforms for Digital signal Processing
- Use appropriate filters to suit to the DSP application
- Choose the best DS Processor for the application development
- Design the DSP application for the practical use

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from module number-3 to 7.

Course Contents

Module No	Module Title	Credit
1	DSP Preliminaries	01
Signals, Systems, and Signal Processing, Classification of Signals, Sampling of Analog Signals, The Sampling Theorem, Response of LTI Systems to Arbitrary Inputs: The Convolution Sum, Causal Linear Time-Invariant Systems, Stability of Linear Time-Invariant Systems, System with Finite-Duration and Infinite-Duration Impulse.		
2	Transforms	01
Efficient Computation of the DFT: FFT Algorithms, The Z-Transform, Properties of Z-Transform, Overview of Real World Applications of DSP, Audio Applications of DSP.		
3	FIR Filter Design	01
Introduction, FIR Filter Design, FIR Filter Specifications, FIR Coefficient Calculation Methods, Window Method, Direct-Form Structure, Cascade-Form Structures, Finite word length effects in FIR Digital Filters.		
4	IIR Filter Design	01
IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation, Characteristics of Commonly Used Analog Filters, Design of IIR Filter From Analog Filter, Direct-Form Structures, Cascade-Form Structures, Parallel-Form Structures.		
5	Power Spectrum Estimation	01

Estimation of Spectra From Finite-Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Relationships Between Autocorrelation and the Model Parameters, The Yule-Walker Method for the AR Model Parameters.		
6	**Multi rate Signal Processing**	**01**
Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I / D, Implementation of Sampling Rate Conversion, Multistage Implementation of Sampling Rate Conversion, Sampling Rate Conversion by Arbitrary Factor, Applications of Multi rate Signal Processing, Digital Filter Banks.		
7	**Special Purpose Digital Signal Processor**	**01**
Introduction, Computer Architectures for signal processing, General-purpose digital signal processors, Selecting digital signal processors, Implementation of DSP algorithms on general purpose digital signal processors, Special-purpose DSP hardware.		

Books:

Text:

1. Alan V. Oppenheim and Ronald W. Schafer, " Digital Signal Processing", Pearson, ISBN-10: 0132146355, 13: 978-0132146357
2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing – A Practical Approach", 2nd Edition, Pearson Education, ISBN 10: 020154413X ISBN 13: 9780201544138

References:

1. R. E. Crochiere and L. R. Rabiner, "Multirate Digital Signal Processing", Pearson, ISBN 0-13-605162-6
2. A. Rabiner and Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, ISBN 10: 0139141014, 13: 9780139141010.
3. William D. Stanley, "Digital Signal Processing", Reston, ; ISBN-10: 083591321X, 13: 978-0835913218
4. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms, and Applications", 4th Edition, Pearson Prentice Hall, ISBN: 9788131710005, 8131710009
5. Steven W. Smith., "The Scientist and Engineer's and Guide", California Technical Pub, ISBN: 10: 0966017633
6. Dale Grover and John R. (Jack) Deller, "Digital Signal Processing and the Microcontroller", Prentice Hall, ISBN 0-13-754920-2

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective I
510105B : Data Mining

Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives:

- To understand the fundamentals of Data Mining
- To identify the appropriateness and need of mining the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course the student should be able to-

- Apply basic, intermediate and advanced techniques to mine the data
- Analyze the output generated by the process of data mining
- Explore the hidden patterns in the data
- Optimize the mining process by choosing best data mining technique

Selection of Modules:

Kindly note that modules 1, 2, 3 are compulsory and select any one module from module number- 4 to 10.

Course Contents

Module No.	Module Title	Credit
1	Introduction	01

Data: Data, Information and Knowledge, Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes, Introduction to Data Preprocessing, Data Cleaning, Data integration, data reduction, transformation and Data Descritization.

Concept of class: Characterization and Discrimination, basics /Introduction to: Classification and Regression for Predictive Analysis, Mining Frequent Patterns, Associations, and Correlations, Cluster Analysis.

Module No.	Module Title	Credit
2		01

Measuring the Central Tendency: Basics of Mean, Median, and Mode, Measuring the Dispersion of Data, Variance and Standard Deviation. Measuring Data Similarity and Dissimilarity, Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes and Binary Attributes

Module No.	Module Title	Credit
3		01

Dissimilarity of Numeric Data: Minkowski Distance, Euclidean distance and Manhattan distance, Proximity Measures for Ordinal Attributes, Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Book:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition/Second Edition, ISBN: 9780123814791, 9780123814807

4	Classification	02

Basic Concepts, General Approach to Classification, Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction, Bayes Classification Methods, Baye's Theorem, Naive Bayesian Classification, Rule-Based Classification, Using IF-THEN Rules for Classification, Rule Extraction from a Decision Tree, Rule Induction Using a Sequential Covering Algorithm, Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves, Techniques to Improve Classification Accuracy: Introducing Ensemble Methods, Bagging, Boosting and Ada Boost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data.
Study of open source/Commercial tool (WEKA/MEKA/Mulan/Panthalo), open source is desirable)

Book:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807.

5	Content Classification	02

Bayesian Belief Networks, Concepts and Mechanisms, Training Bayesian Belief Networks, Classification by Back propagation, A Multilayer Feed-Forward Neural Network, Defining a Network Topology, Back propagation, Inside the Black Box: Back propagation and Interpretability, Support Vector Machines: The Case When the Data Are Linearly Separable, The Case When the Data Are Linearly Inseparable, Classification Using Frequent Patterns, Associative Classification, Discriminative Frequent Pattern–Based Classification, Lazy Learners (or Learning from Your Neighbors), k-Nearest-Neighbor Classifiers, Case-Based Reasoning, Other Classification Methods, Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches, Additional Topics Regarding Classification: Multiclass Classification, Semi-Supervised Classification Active Learning, Transfer Learning, Reinforcement learning, Systematic Learning, Holistic learning and multi-perspective learning.
Study of open source/Commercial tool (WEKA/MEKA/ Mulan/ Panthalo), open source is desirable)

Book:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition/Second Edition, ISBN: 9780123814791, 9780123814807
2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making." Wiley-IEEE Press, ISBN: 978-0-470-91999-6.

6	ANN and Data Mining	02

Deep Feed forward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms. Convolution Networks: The Convolution Operation, Pooling, Variants of the Basic Convolution Function. Recurrent Neural Networks: Recurrent Neural Networks, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and RNNs. Auto-Encoders: Under complete Auto encoders, Regularized Auto encoders, Stochastic Encoders and Decoders, Denoising Auto encoders Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.
Study of open source/Commercial tool (like Tensor Flow Lib., Caffé Lib., Theano.), open source is desirable)

References:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville , "Deep Learning ", MIT Press, ISBN: 9780262337434
2. Online Course: http://cs224d.stanford.edu/syllabus.html

7	Parallel and Distributed Data Mining	02

Parallel and Distributed Data Mining: Introduction Parallel and Distributed Data Mining, Parallel Design Space: Distributed Memory Machines vs. Shared Memory Systems, Task vs. Data Parallelism, Static vs. Dynamic Load Balancing, Horizontal vs. Vertical Data Layout, Complete vs. Heuristic Candidate Generation.
Algorithms in parallel and distributed data mining: Count Distribution, Data Distribution, Candidate Distribution, Eclat,
Algorithms: Parallel Association Rule Mining: a priori-based Algorithms, Vertical Mining, Pattern-Growth Method,
Parallel Clustering Algorithms: Parallel k-means, Parallel Hierarchical Clustering, Parallel HOP: Clustering Spatial Data, Clustering High-Dimensional Data,
Research Issues and Challenges: High dimensionality, Large size, Data Location, data Types, Data Skew, Dynamic Load Balancing, Incremental Methods, Multi-table Mining, Data Layout, and Indexing Schemes, Parallel DBMS/File systems, Interaction, Pattern Management, and Meta-level Mining.
Distributed Mining Frameworks/Architectures: JAM, PADMA, BODHI, APACHE SPARK.
Introduction to CUDA Parallel programming language: Parallel Programming in CUDA C - CUDA Parallel Programming, Splitting Parallel Blocks, Shared Memory and Synchronization, Constant Memory, Texture Memory, CUDA events, Measuring Performance with Events, Parallel Matrix multiplication, Cuda KNN.

Books:

1. Mohammed J. Zaki, Ching-Tien Ho, "Large-Scale Parallel Data Mining", LCNS, Springer Publishers, ISBN: 978-3-540-46502-7
2. Sanguthevar Rajasekaran and John Reif, "Handbook of Parallel Computing Models Algorithms and Applications", CRC Book Press**, ISBN 9781584886235**
3. Liu, Wei-keng Liao, Alok Choudhary, and Jianwei Li, "Parallel Data Mining Algorithms for Association Rules and Clustering"
4. Kimito Funatsu, "New Fundamental Technologies in Data Mining" , 978-953-307-547-1
5. Jason Sanders ,Edward Kandrot, "CUDA by Example - An Introduction to General-Purpose GPU Programming", ISBN-10: 0-13-138768-5
6. Addison Wesley, Shane cook,, " CUDA Programming: A Developer's Guide to Parallel Computing with GPUs by, Elsevier Publishers, ISBN: 978-0201000238

8	Spatial and Multimedia Data Mining	02

Data Objects: Generalization of Structured Data, Aggregation and Approximation in Spatial and Multimedia Data Generalization, Generalization of Object Identifiers and Class/Subclass, Hierarchies, Generalization of Class Composition Hierarchies, Construction and Mining of Object Cubes, Generalization-Based Mining of Plan Databases by Divide-and-Conquer.
Spatial Data Mining: Spatial Data Cube Construction and Spatial OLAP, Mining Spatial Association and Co-location Patterns, Spatial Clustering Methods, Spatial Classification and Spatial Trend Analysis, Mining Raster Databases,
Multimedia Data Mining: Similarity Search in Multimedia Data, Multidimensional Analysis of Multimedia Data, Classification and Prediction Analysis of Multimedia Data, Mining Associations in Multimedia Data, Audio and Video Data Mining

Book:

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques” Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.

9	Data Mining Applications	02

Mining Complex Data Types, Mining Sequence Data: Time-Series, Symbolic Sequences, and Biological Sequences, Mining Graphs and Networks, Mining Other Kinds of Data, Other Methodologies of Data Mining, Statistical Data Mining, Views on Data Mining Foundations, Visual and Audio Data Mining, Data Mining Applications, Data Mining for Financial Data Analysis, Data Mining for Retail and Telecommunication Industries, Data Mining in Science and Engineering, Data Mining for Intrusion Detection and Prevention, Data Mining and Recommender Systems, Data Mining and Society, Ubiquitous and Invisible Data Mining, Privacy, Security, and Social Impacts of Data Mining, Data Mining Trends.

Book:

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and techniques” Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.

10	Pattern Discovery and Social Networks Mining	02

Graph Mining: Methods for Mining Frequent Subgraphs: A priori-based Approach, Pattern-Growth Approach, Mining Variant and Constrained Substructure Patterns: Mining Closed Frequent Substructures Extension of Pattern-Growth Approach: Mining, Alternative Substructure Patterns, Constraint-Based Mining of Substructure Patterns, Mining Approximate Frequent Substructures, Mining Coherent Substructures Mining Dense Substructures, Applications: Graph Indexing with Discriminative Frequent Substructures Substructure Similarity Search in Graph Databases Classification and Cluster Analysis Using Graph Patterns

Social Network Analysis: Introduction Social Network, Characteristics of Social Networks, Link Mining: Tasks and Challenges, Mining on Social Networks: Link Prediction, Mining Customer Networks for Viral Marketing, Mining Newsgroups Using Networks, Community Mining from Multi relational Networks Multi relational Data Mining: Introduction Multi relational Data Mining ILP Approach to Multi relational Classification Tuple ID Propagation, Multi relational Classification Using Tuple ID Propagation Multi relational Clustering with User Guidance.

Books:

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques”, Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.
2. Matthew A. Russell, "Mining the Social Web,:Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition
3. Maksim Tsvetovat,Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective I
510105C : Network Design and Analysis

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In- Sem: 50 Marks End- Sem: 50 Marks

Course Objectives :

- To develop a comprehensive understanding of computer Networks
- To study design issues in networks.
- To learn estimation of network requirements.
- To learn Enterprise network design.
- To understand various issues hindering the performance of the network.

Course Outcomes: After completion of the course, students should be able to

- Apply the knowledge to design computer networks
- Analyze the performance of networks based on chosen metrics
- Design routing schemes for optimized routing
- Choose appropriate and advanced techniques to build the computer network

Selection of Modules: All modules 1 to 5 are compulsory.

Course Contents

1	Introduction	01

Overview of network analysis and design process, Network design issues, requirement analysis (user, application, device, network) concepts, Routing and forwarding, resource allocation, general principles of network design, network characteristics, performance metric in networks

2	Physical and Logical network design	01

Topologies, Physical addressing, switching, IP packet format, IP routing method, routing using masks, fragmentation of IP packet, IPv6, advanced features of IP routers: filtering, IP QoS, NAT, routers

3	Queuing Theory	01

Delay Models in Data Networks, Queuing Models- Little's Theorem, Application of Little's Theorem, Queuing Systems: M/M/1, M/M/2, M/M/m, M/M/∞, M/M/m/m, M/M/m/q, M/M/1/N, D/D/1, M/G/1 System, M/G/1 Queues with Vacations, Priority Queuing.

4	Modelling N/W as Graph	01

Graph terminology, representation of networks, fundamental graph algorithms, shortest path, link prediction algorithms-Dijkstra's, Bellman's, Floyd's, Incremental shortest path algorithm.

5	Methods of Ensuring Quality of Service	01

Methods of ensuring quality of service – introduction, applications and QoS, QoS mechanisms, Queue management algorithms, feedback, resource reservation, traffic engineering, IP QoS
Next generation networks, cyber physical systems, smart mobiles, cards and device networks, smart devices and services, network testing, testing tool – wireshark

Books:

1. Aaron Kershenbaum, "Telecommunications Network Design Algorithm", McGraw Hill education (India), Edition 2014, ISBN-10: 0070342288
2. James McCabe, "N/W analysis, Architecture and Design", Elsevier, 978-0-12-370480-1
3. Pablo Pavon Marino, "Optimization of Computer Networks : Modeling and algorithms – A hands on approach", Wiley Publication, ISBN: 9781119013358
4. Olifer, Victor Olifer, "Computer Networks, Principles, Technologies and Protocols for network design", Wiley India, ISBN: 13: 9788126509171.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective I
510105 D : Data Algorithms

Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: Internal Assessment : 50 Marks End- Sem: 50 Marks

Course Objectives :

- To study concepts of sorting and searching for voluminous data
- To learn functionalities of advanced network algorithms
- To understand the means for data and market prediction
- To study various performance parameters for algorithmic

Course Outcomes:

After completion of the course, students should be able to-

- Apply the concept of advanced algorithms for searching, sorting and network algorithms
- Estimate the complexity of various algorithms and Measure the Choose appropriate algorithm to solve data centric problems

Selection of Modules: Modules 1 to 4 are compulsory and select any one from modules 5 and 6.

Course Contents

Module No	Module Title	Credit
1	Secondary Sorting Algorithm	01
Secondary Sort: Introduction, Solutions to the Secondary Sort Problem, Map Reduce Solution to Secondary Sort, Spark Solution to Secondary Sort, Secondary Sorting Technique, Complete Example of Secondary Sorting, Top N, Formalized Map Reduce Implementation: Unique Keys & Non unique Keys, Spark Implementation: Unique Keys, Non unique Keys.		
2	Left Outer Join Algorithms	01
Left Outer Join: Implementation of Left Outer Join in Map Reduce with Example, Spark Implementation of Left Outer Join().		
3	Order Inversion	01
Order Inversion : Example of the Order Inversion Pattern, Map Reduce Implementation of the Order Inversion Pattern, Formal Definition of Moving Average.		
4	Market Basket Analysis	01
Market Basket Analysis : MBA Goals, Application Areas for MBA, Market Basket Analysis Using MapReduce, Spark Solution, POJO Common Friends Solution.		
5	Scatter Search Algorithms	01
Introduction of SS algorithms, working principle of SS algorithms / scatter search methodology and basic scatter search design and advance designs, SS Algorithm, Diversification Method, Reference set update method, Improvement Methods, Subset Generation, training method.		
6	Network Algorithms	01
Bellman's equation and acyclic networks, The Network Simplex Algorithm - The minimum cost flow problem, Tree solutions, Constructing an admissible tree structure.		

Books :

1. Mahmoud Parsian, "Data Algorithms", O'Reilly, ISBN: 10 1491906189
2. Manuel Laguna, Rafael Martí, "Metaheuristic Procedures for Training Neutral Networks" Springer (2006) ISBN - 978-0-387-33415-8
3. Dieter Jungnickel, "Graphs, Networks and Algorithms", Springer, 978-3-540-72779-8

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510206 : Laboratory Proficiency I

Teaching Scheme:	Credit	Examination Scheme:
Practical: 08 Hours/Week	04	Presentation: 50 Marks TW: 50 Marks

Laboratory Proficiency I (LP I) is companion course of theory courses (core and elective) in Semester I. It is recommended that set of assignments or at least one mini-project/study project per course is to be completed. Set of problem statements are suggested. Course/ Laboratory instructor may frame suitable problem statements. Student has to submit a report/Journal consisting of appropriate documents - prologue, Certificate, table of contents, and other suitable write up like (Introduction, motivation, aim and objectives, outcomes, brief theory, requirements analysis, design aspects, algorithms, mathematical model, complexity analysis, results, analysis and conclusions). Softcopy of report /journal and code is to be maintained by department/ institute in digital repository.

Suitable platform/framework/language is to be used for completing mini-project/assignments.

Guidelines for Term Work Assessment

Continuous assessment of laboratory work is done based on performance of student. Each assignment/ mini project assessment is to be done based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as mini project assessment include- timely completion, performance, innovation, efficient codes, usability, documentation and adhering to SDLC comprehensively.

Guidelines for Examination

It is recommended that examination should be conducted as presentation by student based on one of the mini projects completed and the content understanding of laboratory work.

Suggested List of Laboratory Assignments

A. Research Methodology

1. Use an academic web search to locate a journal paper which describes a design outcome in your field of interest (i.e. your engineering discipline).You must enter several keywords which relate to your topic. Read the paper and, using your own words, demonstrate your understanding of the paper by:

- Brief Contribution
- Performance metric, data set, comparative analysis and outcomes
- Writing out the major conclusions of the paper;
- Outlining the verification method(s) used to support these conclusions
- Describing the author's reflective comments on the quality of the design (positive and negative).
- The positive and negative environmental impacts;

After reading a published research paper, write down the research question you think the author have addressed in undertaking this research. Do you think the paper adequately supports the conclusions reached in addressing the question?

2.	Consider a journal article in your discipline that was published approximately five years ago. Note the keywords and type them into one of the web-based academic search engines (e.g. googlescholar.com). Does the original article appear in the search results? How many citations does this article have? Have the same authors published further work in this field? Compare the citations of this paper with those from the most highly cited paper in the search results? How many citations does this highly cited article have? If this paper was published before your original article, is it cited in your article? Do you think this high-cited paper should have been listed as a reference in your original article? Give reasons for your decision. Read a journal paper from your discipline. Following the format of patents, write out one or more important outcomes from the paper in terms of one or more Patent Claims 1, 2…. .These claims must not only be new, they must be not-obvious from previous work
3.	a) Literature Review Quality: Using a Journal paper selected in your engineering discipline of interest, write a 400 word evaluation of the quality of Literature Review. In particular, review the quality and relevance of cited papers, the comments made on those papers contribution to the general field, and any omission of papers which are of major importance in the field. b) Develop a new research proposal from a published paper: From selected published Journal paper, read the paper. In particular read the discussion and conclusion section and find Suggestions for further work. Apply one of the question words(How?, Why?, What?, When?) and write one or more research questions arising from this paper. This can be used as guide to help you to develop your own research project proposal
4.	a) Download a set of weather data from the Internet covering the temperature and atmospheric pressure over a four day period. Present the data using 2D and 3D plots, and so deduce if the weather conditions are trending either higher or lower over this four day period. (Possible web sites include http://www.bom. gov.au/climate/ data/ and http://www.silkeborg-vejret.dk/english/ regn.php). b) Numerical modeling: Find a paper in which nunicricil modeling has been used to verify the experimental results. Comment on the differences between the experimental and modeling results. Have the authors commented on the accuracy of the experimental and modeling procedures? What suggestions do you have to improve the quality of the modeling reported in the paper? c) Statistical review: In your engineering discipline review a published paper which includes a statistical analysis. Write a brief report on the statistical methods used. Can you suggest an improved statistical analysis? Suggest some additional parameters that might have been measured during the data acquisition stage and so explain how you would analyze the total data set to deduce the influence (and statistical significance) of these additional measurements.

B. Bio-Inspired Algorithms	
1.	**Ant Colony Algorithm:** The Traveling Salesman Problem is a problem of a salesman who, starting from his hometown, wants to find the shortest tour that takes him through a given set of customer cities and then back home, visiting each customer city exactly once." Each city is accessible from all other cities.. Use ant colony algorithm for generating good solutions to both symmetric and asymmetric instances of the Traveling Salesman Problem. Use appropriate representation for graph and an appropriate heuristic that defines the distance between any two nodes of the graph. Use parallel approach to optimize solution
2.	Job Scheduling using PSO, Optimization techniques for N-Queen's problem, Management and allocation of resources in a safety division of any pharmaceutical company, To automate the strategic planning process in an industry., Optimize Staff allocation problem in an organization, Railway Transportation/ Air Transportation : A case study of Transportation problem, Time table generation.
C. Software Development & Version Control	
1.	Study of any open source system/application software like Version Control in Linux Kernel
D. Embedded and Real Time Operating Systems	
1.	Simulation/ Design, planning and modeling of a Real-Time / Embedded System for-(any one) • Alarm system for elderly people (Fall detection, Heart attack) • Medication machine for patients in ICU • Smart traffic control • Autonomous car • Smart home (sound system, temperature, light) • Control of an autonomous quadrocopter (e.g. for surveillance tasks) • Control of a rail station • Video conference system • Washing machine
E. Elective I	
	Course instructor is authorized to frame suitable problem statement for Assignments/ mini project

Semester II

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510108 : Operations Research

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives:

- To introduce students to use quantitative methods and techniques for effective analysis of decisions making
- To understand the model formulation and applications that is used in solving business decision problems.
- To introduce students to optimization approaches and fundamental solution.
- To learn a variety of ways in which deterministic and stochastic models in Operations Research can be used

Course Outcomes:

After completion of the course, students should be able to-

- Identify the characteristics of different types of decision-making environments
- Use appropriate decision making approaches and tools
- Build various dynamic and adaptive models
- Develop critical thinking and objective analysis of decision problems
- Apply the OR techniques for efficacy

Course Contents

Unit I	Linear Programming	08 Hours

Introduction, Modeling with Liner Programming, Two variable LP model, Graphical LP solutions for both maximization and minimization models with various application examples, LP model in equation form, simplex method, special case in simplex method, artificial starting solution, Degeneracy in LPP, Unbounded and Infeasible solutions.

Unit II	Duality in Linear Programming	08 Hours

Duality theory: a fundamental insight. The essence of duality theory, Economic interpretation of duality, Primal dual relationship; Adapting to other primal forms, The revised simplex method- development of optimality and feasibility conditions, Revised Simplex Algorithms.

Unit III	The Transportation Problem and Assignment Problem	08 Hours

Finding an initial feasible solution - North West corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem. Assignment Problem: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Unit IV	Game Theory and Dynamic Programming	08 Hours

Introduction, 2 person zero sum games, Maximi - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games. Recursive nature of computations in Dynamic Programming, Forward and backward recursion, Dynamic Programming Applications – Knapsack, Equipment replacement, Investment models

Unit V	Integer Programming Problem and Project Management	08 Hours
Integer Programming Algorithms – B&B Algorithms, cutting plane algorithm, Gomory's All-IPP Method, Project Management: Rules for drawing the network diagram, Application of CPM and PERT techniques in project planning and control; Crashing and resource leveling of operations Simulation and its uses in Queuing theory & Materials Management.		
Unit VI	**Decision Theory and Sensitivity Analysis**	**08 Hours**
Decision making under certainty, uncertainty and risk, sensitivity analysis, Goal programming formulation and algorithms – The weights method, The preemptive method.		

Books:

Text:

1. Hamdy A. Taha "Operations Research" Pearson Education, 8th Edition, ISBN: 978-81-317-1104-0
2. Gillett, "Introduction to Operation Research", TMH, ISBN: 0070232458

References:

1. S.D. Sharma, , Kedarnath, Ramnath & Co., "Operations Research" Meerut,2009, ISBN: 978-81-224-2288-7
2. Hrvey M. Wagner, Principles of Operations Research, Second Edition, Prentice Hall of India Ltd., 1980, ISBN: 10: 0137095767 ,13: 9780137095766 ..
3. V.K. Kapoor, Operations Research, S. Chand Publishers, New Delhi, 2004, ISBN: 9788180548543, 8180548546 .
4. R. Paneer Selvam, Operations Research, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008, ISBN: 10: 8120329287,: 9788120329287.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510109 : System Simulation and Modeling

Teaching Scheme:	Credit	Examination Scheme:
TH: 5 Hours/Week	05	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To learn the concepts of Systems behavior
- To understand various Modeling schemes
- To acquaint with the theory of simulation
- To learn applications to simulate the systems

Course Outcomes:

After completion of the course, students should be able to-

- To apply modeling to understand system behavior
- To design the simulation scheme for particular system
- To analyze the modeled and simulated systems
- To compare the results of simulations confined to real world application

Course Contents

Unit I	Introduction	08 Hours

The Nature of Systems, Event-Driven Model, Characterizing Systems, Simulation Diagrams, The Systems Approach. **Dynamical Systems:** Initial-Value Problems, Higher-Order Systems, Autonomous Dynamic Systems, Multiple-Time-Based Systems, Handling Empirical Data.

Unit II	Stochastic Data Representation	08 Hours

Uniformly Distributed Random Numbers, Statistical Properties of U [0,1] Generators, Generation of Non-Uniform Random Variates, Generation of Arbitrary Random Variates, Random Processes, Characterizing Random Processes, Generating Random Processes, Random Walks, White Noise. **Stochastic Data Representation:** Random Process Models, Moving-Average (MA) processes, Autoregressive (AR) processes, Big-Z notation, Autoregressive Moving-Average (ARMA) models, additive noise.

Unit III	Sampled Systems	08 Hours

Sampled Systems, Spatial Systems, Finite-Difference Formulae, Partial Differential Equations, Finite Differences for Partial Derivatives, Constraint Propagation. **Exhogenous Signals and Events:** Disturbance Signals, State Machines, Petri Nets, Analysis of Petri Nets, System Encapsulation.

Unit IV	Stochastic Data Representation	08 Hours

Modeling Input Signals, Nomenclature, Discrete Delays, Distributed Delays, System Integration, Linear Systems, Motion Control Models, Numerical Experimentation. **Event-Driven Models:** Simulation Diagrams, Queuing Theory, M/M/1 Queues, Simulating Queuing Systems, Finite-Capacity Queues, Multiple Servers, M/M/c Queues.

Unit V	Behavior of a Stochastic Process	08 Hours
Transient and Steady-State Behavior of a Stochastic Process, Types of Simulations with Regard to Output Analysis, Statistical Analysis for Terminating Simulations, Statistical Analysis for Steady-State Parameters, Statistical Analysis for Steady-State Cycle Parameters, Multiple Measures of Performance, Time Plots of Important Variables		
Unit VI	**Simulation of Manufacturing System**	**08 Hours**
Simulation of Manufacturing System: Introduction, Objectives of Simulation in Manufacturing, Simulation Software for Manufacturing, Modeling System Randomness with extended example, A simulation case study of a Metal-Parts Manufacturing Facility.		

Books

Text:

1. Frank L. Severance, "System Modeling and Simulation a Introduction", Severance, John Wiley & Sons Ltd, ISBN 9812-53-175-0.
2. Averill M Law, "Simulation Modeling and Analysis", McGraw Hill Education, ISBN-13: 978-0-07- 066733-4.

Reference:

1. Daniele Gianni, Andrea D'Ambrogio, and Andreas Tolk (editors), Modeling and Simulation-Based Systems Engineering Handbook, CRC Press, 2014, ISBN:9781138748941
2. Gould, H. and Tobochnik, J., Computer Simulation Methods part I and II (Addison Wesley, 1987)

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510110 : Machine Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives :

- To understand Human learning aspects
- To learn the primitives in learning process by computer
- To Understand nature of problems solved with Machine Learning
- To acquaint with the basic concepts and techniques of Machine Learning.
- To learn the means for categorization of the information

Course Outcomes :

After completion of the course, students should be able to-

- Acquire fundamental knowledge of learning theory
- Design and evaluate various machine learning algorithms
- Use machine learning methods for multivariate data analysis in various scientific fields
- Choose and apply appropriate Machine Learning Techniques for analysis, forecasting, categorization and clustering of the data

Course Contents

Unit I	Machine Learning Concepts	09 Hours

Introduction to Machine Learning, Machine Learning applications, Types of learning: Supervised, Unsupervised and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models, Predictive and descriptive learning, Classification concepts, Binary and multi-class classification

Unit II	Learning Theory	09 Hours

Features: Feature Extraction, Feature Construction and Transformation, Feature Selection, Dimensionality Reduction: Subset selection, the Curse of dimensionality, Principle Components analysis, Independent Component analysis, Factor analysis, Multidimensional scaling, Linear discriminant analysis, Bias/Variance tradeoff, Union and chernoff/Hoeffding bounds, VC dimension, Probably Approximately Correct (PAC) learning, Concept learning, the hypothesis space, Least general generalization, Internal disjunction, Paths through the hypothesis space, model Evaluation and selection

Unit III	Geometric Models	09 Hours

Regression, Logistic regression , Assessing performance of regression - Error measures, Overfitting, Least square method, Multivariate Linear regression, Regression for Classification, Perceptron, Muli-layer perceptron, Simple neural network, Kernel based methods, Support vector machines(SVM), Soft margin SVM, Support Vector Machines as a linear and non-linear classifier, Limitations of SVM, Concept of Relevance Vector, K-nearest neighbor algorithm

Unit IV	Logical, Grouping And Grading Models	09 Hours

Decision Tree Representation, Alternative measures for selecting attributes, Decision tree algorithm: ID3, Minimum Description length decision trees, Ranking and probability estimation trees, Regression trees, Clustering trees, Rule learning for subgroup discovery, Association rule mining, Distance based clustering- K-means algorithm, Choosing number of clusters, Clustering around medoids – silhouettes, Hierarchical clustering, Ensemble methods: Bagging and Boosting

Unit V	Probabilistic Models	09 Hours

Uncertainty, Normal distribution and its geometric interpretations, Baye's theorem, Naïve Bayes Classifier, Bayesian network, Discriminative learning with maximum likelihood, Probabilistic models with hidden variables, Hidden Markov model, Expectation Maximization methods, Gaussian Mixtures and compression based models

Unit VI	Case Studies on Advanced Machine Learning Techniques	09 Hours

Profiling the online storefronts of counterfeit merchandise, Detecting malicious websites in adversarial classification, Credit card fraud detection, Topic models of the underground Internet economy, Learning to rate vulnerabilities and predict exploits.

Books:

Text:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Cambridge University Press, 1st Edition, 2012, ISBN No.: 978-1-316-50611-0
2. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2nd edition, 2013, 978-0-262-01243-0
3. Kevin Murphy, Machine Learning: a Probabilistic Approach, MIT Press, 1st Edition, 2012, ISBN No.: 978-0262-30616-4

Reference:

1. C.M. Bishop, Pattern Recognition and Machine learning, Springer, 1st Edition, 2013, ISBN No.: 978-81-322-0906-5
2. Hastie, Tibshirani, Friedman, Introduction to statistical machine learning with applications in R, Springer, 2nd Edition, 2013, ISBN No.: 978-1-4614-7138-7
3. Tom Mitchell, Machine Learning, McGraw Hill, 1997, 0-07-042807-7
4. Parag Kulkarni, Reinforcement and Systemic Machine learning for Decision Making, Wiley-IEEE Press, 2012, 978-0-470-91999-6
5. M. F. Der, L. K. Saul, S. Savage, and G. M. Voelker (2014). Knock it off: profiling the online storefronts of counterfeit merchandise. In Proceedings of the Twentieth ACM Conference on Knowledge Discovery and Data Mining (KDD-14), pages 1759-1768. New York, NY.
6. J. T. Ma, L. K. Saul, S. Savage, and G. M. Voelker (2011). Learning to detect malicious URLs. ACM Transactions on Intelligent Systems and Technology 2(3), pages 30:1-24.
7. D.-K. Kim, G. M. Voelker, and L. K. Saul (2013). A variational approximation for topic modeling of hierarchical corpora. To appear in Proceedings of the 30th International Conference on Machine Learning (ICML-13). Atlanta, GA.
8. M. Bozorgi, L. K. Saul, S. Savage, and G. M. Voelker (2010). Beyond heuristics: learning to classify vulnerabilities and predict exploits. In Proceedings of the Sixteenth ACM Conference on Knowledge Discovery and Data Mining (KDD-10), pages 105-113. Washington, DC

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111A : Image Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives :

- To study image processing concepts
- To study mathematics and algorithms for image processing
- To study various methods of image processing in spatial and frequency domain
- To understand various image processing applications

Course Outcomes :

After completion of the course, students should be able to-

- Apply relevant mathematics required for image processing
- Perform and analyze various image processing methods using appropriate tools
- Use various image processing methods in spatial and frequency domain
- Explore current trends and future scope in image processing applications

Selection of Modules:

Kindly note that modules 1, 2are compulsory and select any three (03) modules from remaining modules 3 to 11.

Course Contents

Module No.	Module Title	Credit
1	Image Processing Fundamentals	01
Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and Quantization, Image types, Image file formats, Human visual system, Elements of an image processing system, Fundamental steps in image processing, Component labeling algorithm, Morphological image processing		
2	Image Processing Fundamentals	01
Image Enhancement by Spatial domain image enhancement: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian **Image Enhancement by Frequency domain Image enhancement :** Low pass filtering in frequency domain (Ideal, Butterworth, Gaussian), High pass filter in frequency domain (ideal, Butterworth, Gaussian)**.** **Case Study: Open Source image processing software**: Octave, OpenCV, Scilab		
3	Image segmentation	01
Classification of image segmentation techniques, thresholding based image segmentation, edge based segmentation, edge detection, edge linking, Hough transform, watershed transform, clustering techniques, region approach		
4	Image restoration	01
Image degradation, Image restoration model, linear and non-linear image restoration, image denoising		
5	Multi resolution analysis	01
Image Pyramids, Multi resolution expansion ,Fast Wavelet Transforms, Lifting scheme		
6	Feature extraction	01

Shape Descriptors- Classification of shape descriptor techniques, contour based (Boundary following , chain code, signature, Polygon approximation), region based- (Euler number, shape matrix, statistical moments), feature extraction in transform domain(Fourier descriptor) Relational descriptor, Use of Principal components for description		
7	**Image Compression**	**01**
Need and classification of image compression techniques, run-length coding, Shannon Fano coding, Huffman coding, Scalar and vector quantization, Compression Standards-JPEG/MPEG, Video compression		
8	**Steganography and Watermarking**	**01**
Information hiding, Steganography: introduction, properties, models, stegnoanalysis, Watermarking : introduction, properties, models, security, content authentication		
9	**Satellite Image Processing**	**01**
Concepts and Foundations of Remote Sensing, GPS, GIS, Elements of Photographic Systems, Basic Principles of Photogrammetry, Multispectral, Thermal, and Hyper spectral Sensing, Earth Resource Satellites Operating in the Optical Spectrum		
10	**Medical Image Processing**	**01**
Introduction, Medical Image Enhancement, Segmentation, Medical Image Analysis (Images of Brain MRI or Cardiac MRI or Breast Cancer Risk) Validation of registration accuracy		
11	**Object Recognition**	**01**
Introduction, Computer Vision, Tensor Methods in Computer Vision, Classifications Methods and Algorithm, Object Detection and Tracking, Object Recognition		

Books :

Text:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image processing”, Pearson Education , Fourth Impression, 2008, ISBN: 978-81-7758-898-9.
2. A. K. Jain, “Fundamentals of Digital Image Processing”, PHI, ISBN-978-81- 203-0929-6.
3. S. Annadurai, R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, First Edition, 2007, ISBN-8177584790.
4. Boguslaw Cyganek, “Object Detection and Recognition in Digital Images: Theory and Practice”, Wiley, First Edition, 2013, ISBN: 978-0-470-97637-1.
5. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, “Digital Watermarking and Steganography”, Morgan Kaufmann (MK), ISBN : 978-0-12-372585-1.
6. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman,” Remote Sensing and Image Interpretation”, Wiley, Seventh Edition, 2015, ISBN: 978-1-118-91947-7

Reference:

1. Isaac Bankman, “Handbook of Medical Imaging”, Academic Press, Second Edition, 2008, ISBN: 9780080559148.
2. Jayaraman, Esakkirajan,Veerakumar,” Digital image processing”, Mc Graw Hill, Second reprint- 2010, ISBN(13): 978-0-07-01447-8, ISBN(10):0-07-014479-6
3. NPTEL Video Lecturers: Title: Digital Image Processing, Prof. P. K. Biswas, IIT Khargapur, A joint venture by IISc and IITs, funded by MHRD, Govt of India, url: http://nptel.ac.in/courses/117105079

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111B : Web Mining

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To study concepts of Web Information Retrieval;
- To understand concepts of Social Network Analysis;
- To know various applications of Web Mining;

Course Outcomes:

After completion of the course, students should be able to-

- Transform Web Information into analytical form;
- Use various means to analyze and synthesize Social Networking information
- Use appropriate tools used in analyzing the web information

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 6.

Course Contents

Module No.	Module Title	Credit
1	Information Retrieval and Social Network Analysis	01

Basic Concepts of Information Retrieval Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression, Latent Semantic Indexing, Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming.

Module No.	Module Title	Credit
2	Social Network Analysis	01

Social Network Analysis, Co-Citation and Bibliographic, Page Rank, HITS, Community Discovery. Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts.

Module No.	Module Title	Credit
3	Structured Data Extraction and Information Integration	01

Wrapper Generation, Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation: Problems, String Matching and Tree Matching, Multiple Alignment, Building DOM Trees, Extraction Based on a Single List Page: Flat Data Records, Extraction Based on a Single List Page: Nested Data Records, Extraction Based on Multiple Pages.

Module No.	Module Title	Credit
4	Schema Matching	01

Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Matching, Domain and Instance-Level Matching, Combining Similarities, 1:m Match, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface.

Module No.	Module Title	Credit
5	Mining and Sentiment Analysis	01

The Problem of Opinion Mining, Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Opinion Mining, Mining Comparative Opinions, Opinion Search and Retrieval, Opinion Spam Detection.		
6	**Web Usage Mining**	**01**
Data Collection and Pre-Processing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender Systems and Collaborative Filtering, Query Log Mining, Computational Advertising.		

Books :

Text:

1. Bing Liu, “Web Data Mining Exploring Hyperlinks, Contents, and Usage Data”, Springer, Second Edition, ISBN 978-3-642-19459-7.
2. Zdravko Markov, Daniel T. Larose "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", Wiley, 2007, ISBN: 978-0-471-66655-4.

Reference :

1. Jesus Mena, "Data Mining Your Website", Digital Press, 1999, ISBN: 1-55558-222-2.
2. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann Publishers, 2002, ISBN-13: 978-1-55860-754-5.
3. Mike Thelwall, "Link Analysis: An Information Science Approach", 2004, Academic Press

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111C : Pervasive and Ubiquitous Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives :

- To understand the characteristics and principles of Pervasive computing
- To introduce to the enabling technologies of pervasive computing
- To understand the basic issues and performance requirements of pervasive computing applications
- To learn the trends of pervasive computing

Course Outcomes :

On completion of the course, student will be able to–

- Design and implement primitive pervasive applications
- Analyze and estimate the impact of pervasive computing on future computing applications and society
- Develop skill sets to propose solutions for problems related to pervasive computing system
- Design a preliminary system to meet desired needs within the constraints of a particular problem space

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 6.

Course Contents

Module No.	Module Title	Credits
1	Pervasive Computing	01

Pervasive Computing, Applications, Pervasive Computing devices and Interfaces, Device technology trends, Connecting issues and protocols. Pervasive Computing- Principles, Characteristics, interaction transparency, context aware, automated experience capture. Architecture for pervasive computing. Charting Past, Present, and Future Research in Ubiquitous Computing.

Module No.	Module Title	Credits
2	Open protocols	01

Open protocols, Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data Synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications- Context aware security. Pervasive Computing and web based Applications - XML and its role in Pervasive Computing, Wireless Application Protocol (WAP) Architecture and Security, Wireless Mark-Up language (WML) – Introduction. Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences

Module No.	Module Title	Credits
3	Voice Enabling Pervasive Computing	01

Voice Enabling Pervasive Computing , Voice Standards , Speech Applications in Pervasive Computing and security. Device Connectivity, Web application Concepts, WAP and Beyond.

Voice Technology – Basis of speech Recognition, Voice Standards, Speech Applications, Speech and Pervasive Computing, Security, The Hitchhiker's Guide to UbiComp: Using techniques from Literary and Critical Theory to Reframe Scientific Agendas.		
4	**Personal Digital Assistant**	**01**
Personal Digital Assistant – History, Device Categories, Device Characteristics, Software Components, Standards. Server side programming in Java, Pervasive Web application Architecture, Example Application, Access via PCs, Access via WAP, Access via PDA, and Access via Voice., PinchWatch: A Wearable Device for One-Handed Micro interactions., Interfaces - Enabling mobile micro-interactions with physiological computing.		
5	**User Interface**	**01**
User Interface Issues in Pervasive Computing, Architecture, Smart Card- based Authentication Mechanisms , Wearable computing Architecture. Touche: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects		
6	**Applications**	**01**
Smart Tokens, Heating Ventilation and Air Conditioning, Set Top Boxes, Appliances and Home Networking, Residential Gateway, Automotive Computing, On Board Computing Systems, In Vehicle networks, Entertainment Systems, Emerging Sites of HCI Innovation: Hacker spaces, Hardware Startups & Incubators		

Books :

Text :

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec & Klaus Rindtorff, " Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addision Wesley, Reading, 2002. ISBN:13: 978-0-201-72215-4
2. Uwe Hansman, Lothat Merk, Martin S Nicklous & Thomas Stober: Principles of Mobile Computing, Second Edition, Springer- Verlag, New Delhi, 2003, ISBN: 9783662043189

References :

1. Mohammads, Obaidait, Denko, Woungang, " Pervasive Computing and Networking", Wiley, ISBN:978-0-470-74772-8
2. Seng Loke, "Context-Aware Computing Pervasive Systems", Auerbach Pub., New York, 2007, ISBN: 978-1-4471-5006-0
3. Uwe Hansmann etl , "Pervasive Computing", Springer, New York,2001., ISBN: 10: 3540002189
4. Jochen Burkhardt, , Stefan Hepper, Klaus Rindtorff, Thomas Schaeck "Pervasive Computing-Technology and Architecture of Mobile Internet Application", Pearson Education, Sixth Edition 2009, ISBN:
5. John Krumm, "Ubiquitous Computing Fundamentals", Shroff Publishers, ISBN: 9781420093605 .

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111D : Network Security

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In Sem :: 50 Marks End-Sem: 50 Marks

Course Objectives:

- To understand the concept of security and its applications.
- To learn various vulnerabilities, threats and attacks
- To know various detection and prevention techniques in diversified environments
- To study different algorithms for network security

Course Outcomes:

After completion of the course, students should be able to

- Design and choose appropriate security model
- Apply security means to various applications
- Apply security algorithms in various environments for network security
- Design network security solutions
- Select appropriate tools to thwart network attacks

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 9.

Course Contents

Module No	Module Title	Credit
1	Classification of Network Attacks	01
Basic Security Concepts, History of Network Security, Data Security Vs. Network Security, Computer And Network Attacks, Introduction To Vulnerabilities, Threats And Attacks, Layers Of Attacks, Counter Measure Of Different Attacks Counter Measures For Various Attacks Case Study: How To Detect And Prevent Black Hole Attack In Mobile Ad Hoc Network		
2	WSN attacks	01
Review of WSN Attacks. Challenges on Detection of WSN Attacks, Approaches for Securing WSN		
3	Hacking & Sniffing	01
Hacking tools, The hacking process, Ethical hacking issues, Current technologies, Recent events and statistics of network attacks, Wi-Fi vulnerabilities What is network sniffing? Why network sniffing is important, Scan a single IP, Scan a host, Scan a range of Ips, Scan a subnet		
4	Port Scanning and Spoofing	01
Nmap port selection : Scan a single port, Scan a range of ports, Scan 100 most common ports (fast), Scan all 65535 ports, Scanning a subnet : Spoofing and decoy scans, Evading firewalls Nmap port scan types : Scan using TCP SYN scan (default), Scan using TCP connect		
5	Browser Exploitation, MITM attacks	01

Gathering version info : UDP scan, The reason switch, Using a list, Output to a file Commands, Starting the listener, Countermeasures, Social Engineering Toolkit and Browser Exploitation: Social engineering , What are web injections? How SQL injections work Cross site scripting (XSS) attacks: Preventative measures against XSS attacks How to reduce your chances of being attacked, Browser exploitation with BeEF : Browser hijacking, BeEF with BetterCap, BeEF with man-in-the-middle framework (MITMF), BeEF with SET		
6	**Advanced Attacks**	**01**
Advanced Network Attacks :What is an MITM attack?Related types of attacks, Examples o MITM, Tools for MITM attacks, Installing MITMF using Kali Linux, Passing and Cracking the Hash, What is a hash? Authentication protocols, Cryptographic hash functions: How do hackers obtain the hash? What tools are used to get the hash? How are hashes cracked? How do pass the hash attacks impact businesses? What defenses are there against hash password attacks?		
7	**Web Content Attacks**	**01**
SQL Injection: Examples of SQL injection attacks, Ways to defend against SQL injection attacks, Attack vectors for web applications, Bypassing authentication, Bypasms blocked and filtered websites, Finding vulnerabilities from a targeted sites, Extracting data with SQLmap, Hunting for web app vulnerabilities with Open Web Application Security Project (OWASP) ZAP		
8	**Specialized Attacks**	**01**
Malformed packets: Ping of death, Teardrop attack (aka Nestea), ARP cache poisoning, ARP poisoning commands, ACK scan, TCP port scanning, VLAN hopping, Wireless sniffing, OS fingerprinting ISN Sniffing, Passive OS detection		
9	**Intrusions and Remedies**	**01**
Web application exploits, What tools are used for web application penetration testing? Evil Twins and Spoofing : What is an evil twin? What is address spoofing? What is DNS spoofing? What tools are used for setting up an evil twin? The dangers of public Wi-Fi and evil twins, How to detect an evil twin? Detection Systems : IDS, IPS, Host based, Network-based, Physical Threat hunting platforms		
Books:		

Text :

1. Dileep Kumar G.; Manoj Kumar Singh; M.K. Jayanthi, “Network Security Attacks and Countermeasures”, IGI Global, ISBN-13: 978-1-4666-8761-5
2. Arthur Salmon, Warun Levesque, Michael McLafferty, “Applied Network Security”, Packt Publishing, ISBN-13**:** 978-1-78646-627-3

Reference:

1. William Stallings, ‘Cryptography and Network Security: Principle and Practice’, 5th Edition, Pearson, ISBN: 978-81-317-6166-3.
2. Bernard Menezes, ‘Network Security and Cryptography’, Cengage Learning, ISBN: 978-81-315-1349-1.
3. Matt Bishop, Sathyanarayana, S. Venkatramanayya, “ Introduction to Computer Security”, Pearson Education, ISBN: 978-81-7758-425-7.
4. Bruce Schneier, “Applied Cryptography”, Wiley, ISBN:978-1-1119-09672-6

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510112 : Seminar I

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hrs/week	04	TW : 50 Marks Presentation : 50 marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms and services.

Course Outcomes:

On completion of the course, student will be able–

- To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,.
- To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication.
- To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across

The student shall have to deliver the seminar I in semester II on a topic approved by guide and authorities. It is recommended to allot guide to the student since the commencement of semester I. The guide allotment preferably needs to be carried out in synchronization with mutual domains of interest. It is recommended that seminar shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected or domain of interest.

It is appreciated and strongly recommended that the student will select the domain of his/her dissertation and identify the literature confined to the domain. Thorough literature study based on the broad identified topic has to be carried out. This practice will eventually lead to convergence of the efforts for the dissertation in Semester III and IV.

The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. Multidisciplinary topics are encouraged. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in seminar logbook approved by Board of Studies.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510113 : Laboratory Proficiency II

Teaching Scheme:	Credit	Examination Scheme:
Practical: 08 Hrs/week	04	Presentation: 50 Marks TW: 50 Marks

Laboratory Proficiency II (LP II) is companion course of theory courses (core and elective) in Semester II. It is recommended that set of assignments or at least one mini-project/study project per course is to be completed. Set of problem statements is suggested. Course/ Laboratory instructor may frame suitable problem statements. Student has to submit a report/Journal consisting of appropriate documents - prologue, Certificate, table of contents, and other suitable write up like (Introduction, motivation, aim and objectives, outcomes, brief theory, requirements analysis, design aspects, algorithms, mathematical model, complexity analysis, results, analysis, and conclusions). Softcopy of report /journal and code is to be maintained at department/institute in digital repository.

Suitable platform/framework/language is to be used for completing mini-project/assignments.

Guidelines for Term Work Assessment

Continuous assessment of laboratory work is done based on performance of student. Each assignment/ mini project assessment to be done based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as mini project assessment include- timely completion, performance, innovation, efficient codes, usability, documentation and adhering to SDLC comprehensively.

Guidelines for Examination

It is recommended that examination should be conducted as presentation by student based on one of the mini projects completed and the content understanding of laboratory work.

Suggested List of Laboratory Assignments

A. Operations Research

1. The Transportation Problem:

Milk in a milk shed area is collected on three routes A, B and C. There are four chilling centers P, Q, R and S where milk is kept before transporting it to a milk plant. Each route is able to supply on an average one thousand liters of milk per day. The supply of milk on routes A, B and C are 150, 160 and 90 thousand liters respectively. Daily capacity in thousand liters of chilling centers is 140, 120, 90 and 50 respectively. The cost of transporting 1000 liters of milk from each route (source) to each chilling center (destination) differs according to the distance. These costs (in Rs.) are shown in the following table:

Routes	Chilling centers			
	P	Q	R	S
A	16	18	21	12
B	17	19	14	13
C	32	11	15	10

The problem is to determine how many thousand liters of milk is to be transported from each route on daily basis in order to minimize the total cost of transportation.

2. **Investment Problem:**

A portfolio manager with a fixed budget of $100 million is considering the eight investment opportunities shown in Table 1. The manager must choose an investment level for each alternative ranging from $0 to $40 million. Although an acceptable investment may assume any value within the range, we discretize the permissible allocations to intervals of $10 million to facilitate the modeling. This restriction is important to what follows. For convenience we define a unit of investment to be $10 million. In these terms, the budget is 10 and the amounts to invest are the integers in the range from 0 to 4. Following table provides the net annual returns from the investment opportunities expressed in millions of dollars. A ninth opportunity, not shown in the table, is available for funds left over from the first eight investments. The return is 5% per year for the amount invested, or equivalently, $0.5 million for each $10 million invested. The manager's goal is to maximize the total annual return without exceeding the budget

Returns from Investment Opportunities

Amount	*Opportunity*							
Invested ($10 million)	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	4.1	1.8	1.5	2.2	1.3	4.2	2.2	1.0
2	5.8	3.0	2.5	3.8	2.4	5.9	3.5	1.7
3	6.5	3.9	3.3	4.8	3.2	6.6	4.2	2.3
4	6.8	4.5	3.8	5.5	3.9	6.8	4.6	2.8

B. System Simulation & Modeling

1. **Using suitable simulation Tool simulate any one of-**

A. Automobile Manufacturing Model-

The automobile has changed life of man in a way unimaginable before its invention. "The world travels on wheels" is the buzzword of the 20th century. The manufacturing of these automobiles is both a fascinating and challenging task. The simulation team has simulated the manufacturing process of wagons, sedans and convertibles in a Toyota car plant

	The following is the step by step procedure for the manufacturing of cars in the "Toyota Production System": **1.** The manufacturing process begins with the chassis assembly. The chassis is the skeleton of the car. It is the part on which the car is built. **2.** Axle and tires are fitted to the chassis assembly. **3.** In the next stage, the engine is fitted to the chassis. The engine is the power-producing component of the car. The power produced in the engine is use to propel the car. Engines are mostly of the internal combustion type. **4.** The gearbox is then fitted into the chassis. The gearbox is the component that is used to change the speed supplied to the wheels. **5.** The next stage involves the fitting of the radiator into the engine. The radiator helps in cooling the engine, transmitting the excess heat to the surrounding by conduction. **6.** The seats are then fitted to the car in the next stage. **7.** The battery is then fitted and electrical connections are carried out. The electrical connections connect the various components of the car to the battery. **8.** The body of the car is then fitted on the chassis. **9.** The windshield, doors, and wipers are fitted to the car along with the bonnet. **10.** The finishing touches are carried out on the car. **11.** The car is then sent for inspection and testing after which it is taken to the parking lot and kept ready for shipping. **B. Simulation of Inventory Control System** **C. Simulation of Single Server queuing system** **D. Customer Queuing System** **E. Transportation Model**
C. Machine Learning	
The laboratory course teacher has to design the assignment based on the data analysis of the data confined to any of the following domains or similar, <u>**Students need to use R and Python for the assignment**</u> The machine learning algorithms need to be applied to these data. For example if it is the Email data, then the student has to perform following operations, • Based on the occurrence of certain key words like lottery, tonic. the designed spam filter will build the information indicating TP,TN,FP and FN. • The system will plot coverage and ROC plots • The system will plot the scoring tree, ranking tree and grading classifier • Depending on the urgency to reply the email will be regressed on the scale of 1 to 10 • Plot the regression graph and use appropriate clustering algorithm and plot the results **Other sample statements may be as below-**	
1	**Suspicious activity detection from CCTVs** : Use machine learning to make the society a safer place. The idea is to have a machine learning algorithm capturing and analyzing the CCTV video all the time and learn from it the normal activities of people like walking, running. so that if any suspicious activity occurs, say robbery, it alerts the authorities in real time about the incident.

2	**Medical diagnostics for detecting diseases** : Doctors and hospitals are now increasingly getting assisted in detecting diseases like skin cancer faster and more accurately. A system designed by IBM correctly picked the cancerous lesions(damage) in the images with 95% accuracy where a doctor's accuracy is usually between 75% - 84% using manual methods. So, the computing approach will help the doctors make more informed decisions by increasing the efficiency to recognise melanoma and spot the cases where it is difficult for the doctors to identify.
3	**Web Search and Recommendation Engines:** • find recognize input, find relevant searches, predict which results are most relevant to us, return a ranked output • recommend similar products (e.g., Netflix, Amazon,)
4	**Finance:** • predict if an applicant is credit-worthy • detect credit card fraud • find promising trends on the stock market
5	**Text and Speech Recognition:** • handwritten digit and letter recognition at the post office • voice assistants (Siri) • language translation service
6	**Social Networks and Advertisement:** • data mining of personal information • selecting relevant ads to show
7	**Other:** • Web page classification: various spam and junk pages, like soft404, parked domain • Entity extraction from web page and queries, like names, addresses. • Speller correction, running on each queries into Bing. • Search ranking, optimize for NDCG. • Facebook Ads ranking: various events prediction, like CTR, negative feedback, conversion. It serves ~1010 page views daily. • Facebook news feed ranking, with daily ~1011 impression. • Facebook PYMK (People You Might Know), aka friend suggestions.
D. Elective II	
Course instructor is authorized to frame suitable problem statement for Assignments/ mini project	

Semester III

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610101 :Fault Tolerant Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives :

- To identify and understand the need of redundancies in the systems
- To understand reliability and accountability in the systems
- To know the instances where fault tolerance is inevitable
- To understand the concept of fault tolerance in detail

Course Outcomes :

On completion of the course the student should be able to-

- Analyze the system for the requirement of fault tolerance
- Simulate the fault tolerance algorithms
- Implement diagnosis and recovery of the system
- Assess the reliability of the system

Course Contents

Unit I	Fault Tolerance and Reliability Analysis	08 Hours

Introduction, Redundancy Techniques- Hardware Redundancy, Software Redundancy, Information Redundancy, Time Redundancy, Reliability Modeling and Evaluation - Empirical Models, Analytical Techniques.

Unit II	Fault Modeling, Simulation and Diagnosis	08 Hours

Fault Modeling, Fault Simulation, Fault Simulation Algorithms- Serial Fault Simulation Algorithm, Parallel Fault Simulation, Deductive Fault Simulation, Concurrent Fault Simulation, Critical Path Tracing, Fault Diagnosis- Combinational Fault Diagnosis, Sequential Fault Diagnosis Methods.

Unit III	Fault-Tolerant Routing in Multi-Computer Networks	08 Hours

Fault-Tolerant Routing Algorithms in Hypercube- Depth-First Search Approach, Iterative-Based Heuristic Routing Algorithm, Routing in Faulty Mesh Networks- Node Labeling Technique, A FT Routing Scheme for Meshes with Non-convex Faults.

Unit IV	Fault Tolerance and Reliability in Hierarchical Interconnection Networks	08 Hours

Block-Shift Network (BSN)- BSN Edges Groups, BSN Construction, BSN Degree and Diameter, BSN Connectivity, BSN Fault Diameter, BSN Reliability, Hierarchical Cubic Network (HCN)- HCN Degree and Diameter, HINs versus HCNs, The Hyper-Torus Network (HTN).

Unit V	Fault Tolerance and Reliability of Computer Networks	08 Hours

Fault Tolerance in Loop Networks - Reliability of Token-Ring Networks, Reliability of Bypass-Switch Networks, Double Loop Architectures, Multi-Drop Architectures, Daisy-Chain

Architectures, Fault Tolerance in High Speed Switching Networks - Classification of Fault-Tolerant Switching Architectures, Architecture-Dependent Fault Tolerance.		
Unit VI	**Fault Tolerance in Distributed System and Mobile Networks**	**08 Hours**
Faults, Errors and Failures, failure models, process resilience, reliable client-server communication, reliable group communication, Check pointing Techniques in Mobile Networks- Minimal Snapshot Collection Algorithm, Mutable Checkpoints, Adaptive Recovery, Message Logging Based Checkpoints, Hybrid Checkpoints.		
Books:		

Text:

1. Mostafa Abd-El-Barr, "Design and Analysis of Reliable and Fault-Tolerant Computer Systems" , World Scientific Publishing , ISBN 1281867497
2. Andrew Tanenbaum, "Distributed Systems Principles and Paradigms", Pearson Prentice Hall, ISBN: 978-15-302817-5-6

Reference:

2. Dhiraj K. Pradhan, " Fault Tolerant Computer System Design", Prentice Hall, ISBN-13: 978-0130578877
3. Martin L. Shooman, "Reliability of Computer Systems and Networks: Fault Tolerance", ISBN: 471464066
4. Jan Vytopil, "Formal Techniques in Real-Time and Fault-Tolerant Systems", ISBN: 1461532205

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610102: Information Retrieval

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To study concepts of Information Retrieval;
- To understand the data in the form of XML
- To study and Evaluate retrieved information
- To understand classification and clustering

Course Outcomes:

On completion of the course the student should be able to-

- Implement the concept of Information Retrieval
- Evaluate and Analyze retrieved information
- Generate quality information out of retrieved information
- Apply clustering and classification algorithms to analyze the information

Course Contents

Unit I	Dictionaries and tolerant retrieval	08 Hours

Search structures for dictionaries, **Wildcard queries** :General wildcard queries ,k-gram indexes for wildcard queries, **Spelling correction**: Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction

Unit II	Index Construction index compression scoring	08 Hours

. Index compression, Searching, Sequential Searching and Pattern Matching, Hardware basics**,** Types of indexes, **Statistical properties of terms in information retrieval**: Heaps' law: Estimating the number of terms, **Zipf's law:** Modeling the distribution of terms, **Dictionary compression:** Dictionary as a string ,Blocked storage, **Postings file compression :**Variable byte codes, Gamma codes.

Unit III	Scoring, term weighting & the vector space model:	08 Hours

Parametric and zone indexes: Weighted zone scoring, Learning weights, The optimal weighting, **Term frequency and weighting**: Inverse document frequency, Tf- idf weighting, **The vector space model for scoring** :Dot products, Queries as vectors, Computing vector scores, **Variant tf-idf functions**: Sub-linear tf scaling Maximum tf normalization, Document and query weighting schemes, Pivoted normalized document length

Unit IV	XML Retrieval	08 Hours

Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. Language models for information retrieval, Language models, The query likelihood model, Language modeling versus other approaches in IR, Extended language modeling approaches.

Unit V	Language models for information retrieval	08 Hours
Language models: Finite automata and language models, Types of language models, Multinomial distributions over words, **The query likelihood model:** Using query likelihood language models in IR ,Estimating the query generation probability ,Ponte and Croft's Experiments , Language modeling versus other approaches in IR ,Extended language modeling approaches.		
Unit VI	**Classification & clustering searches**	**08 Hours**
Text Classification and Naïve Bayes ,Vector Space Classification, Support vector machines, and Machine learning on documents. Flat Clustering , Hierarchical Clustering ,Matrix decompositions and latent semantic indexing ,Fusion and Meta learning, Searching the Web Structure of the Web IR and web search		

Books :

Text

1. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval" , Cambridge University Press, 2008, -13: 9780521865715
2. Ricardo Baeza -Yates and Berthier Ribeiro – Neto, "Modern Information Retrieval: The Concepts and Technology behind Search" 2nd Edition, ACM Press Books 2011.
3. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009, ISBN: 9780135756324.

Reference :

1. S. Buttcher, C. Clarke and G. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2010, ISBN: 0-408-70929-4.
2. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html)
3. W.R. Hersh, "Information Retrieval: A Health and Biomedical Perspective", Springer, 2002.
4. G. Kowalski, M.T. Maybury. "Information storage and Retrieval System" , Springer, 2005
5. W.B. Croft, J. Lafferty, "Language Modeling for Information Retrieval", Springer, 2003.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective III
610103A : Cloud Security

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In- Sem: 50 Marks End- Sem : 50 Marks

Course Objectives:

- To study concepts of Cloud Computing;
- To learn and Explore Cloud Infrastructures
- To study cloud Security Fundamentals
- To know various issues related to the security of information in cloud environment

Course Outcomes:

- Use various services offered for cloud environment
- Apply computing security fundamentals confined to cloud environment
- Analyze the cloud system for vulnerabilities, threats and attacks
- Propose feasible security solution for cloud security

Course Contents

Selection of Modules: Module 1 is compulsory and select any four(04) modules from 2 to 7.

Module No.	Module Title	Credit
1	Introduction	01
Cloud Computing Fundamentals, Essential Characteristics, Architectural Influences, Technological Influences, Operational Influences, Outsourcing, IT Service Management, Cloud Computing Architecture, Cloud Delivery Models, Cloud Deployment Models, Alternative Deployment Models, Expected Benefits. Understanding Abstraction and Virtualization, Capacity Planning, Exploring Platform as a Service, Using Google Web Services, Using Amazon Web Services, Using Microsoft Cloud Services.		
2	Cloud Security	01
Cloud Information Security Objectives, Confidentiality, Integrity, and Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Approaches to Cloud Software Requirements Engineering, Cloud Security Policy Implementation and Decomposition, Secure Cloud Software Testing, Testing for Security Quality Assurance, Cloud Penetration Testing, Regression Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery		
3	Cloud Computing Risk Issues	01
The CIA Triad, Privacy and Compliance Risks, Threats to Infrastructure, Data, and Access Control, Common Threats and Vulnerabilities, Cloud Access Control Issues, Cloud Service Provider Risks, Cloud Computing Security Challenges, Security Policy Implementation, Policy Types, Computer Security Incident Response Team (CSIRT), Virtualization Security Management.		

4	Cloud Computing Security Architecture	01
Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution Environments and Communications, Identity Management and Access Control, Identity Management, Access Control, Autonomic Security.		
5	**Cloud Computing Life Cycle Issues**	**01**
Standards, The Distributed Management Task Force (DMTF), The International Organization for Standardization (ISO), The European Telecommunications Standards Institute (ETSI), The Organization for the Advancement of Structured Information Standards (OASIS), Storage Networking Industry Association (SNIA), Open Grid Forum (OGF), The Open Web Application Security Project (OWASP), Incident Response, Encryption and Key Management, VM Architecture, Retirement		
6	**Cloud storage Security**	**01**
Who wants your data? Legal issues, criminals and authorization. Government and friends, legal responsibility, US Federal Law and regulations affecting cloud storage. Cloud storage provider and compliance. Laws and regulations of other countries.		
7	**Privacy Tools and Best Practices**	**01**
Privacy Tools and Best Practices, 2-factor authentication, secure email for cloud storage, Deletion of private data, security as service, distributed cloud storage, what are best practices, cloud data security and check list, Future of cloud data security.		

Books:

1. Tim Mather, Shahed Latif, Subra Kumaraswamy, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, O'Reilly Media, SBN-13: 978-0596802769, ISBN-10: 0596802765
2. Ronald L Krutz and Russell Dean Vines , “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, ISBN:0470938943

References:

1. Vic (J.R.) Winkler , “Securing the Cloud: Cloud Computer Security Techniques and Tactics”, ISBN:159749593X
2. Imad M. Abbadi, “Cloud Management and Security”, ISBN: 1118817079
3. Sumner Blount, Rob Zanella, “Cloud Security and Governance: Who's on Your Cloud?”, ISBN: 1849280908
4. Ryan Ko, Raymond Choo, “The Cloud Security Ecosystem: Technical, Legal, Business”, ISBN: 0128017805

Savitribai Phule Pune University
Master of Computer Network Engineering (2017 Course)
Elective III
610103B : Speech Signal Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In-Sem: 50 Marks End-Sem: 50 Marks

Course Objectives:

- To understand basic characteristics of speech signal
- To learn speech signal production and hearing of speech by humans
- To be familiar with the techniques for the analysis of speech signals
- To understand different speech modeling procedures
- To know the applications of speech signal processing

Course Outcomes:

- Inculcate the characteristics of speech signal in relation to production and hearing of speech by humans
- Apply various algorithms of speech analysis common to many applications
- The students will be able to design a simple system for speech processing
- Analyze the performance of speech signal processing system

Selection of Modules:

Kindly note that modules 1, 2, 3 are compulsory and select any two (02) modules from modules 4-8.

Course Contents

Module No.	Module Title	Credit
1	Basic Concepts	01

Introduction, mechanism of speech production. Articulatory Phonetics – Production and Classification of Speech Sounds Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates.; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Module No.	Module Title	Credit
2	Speech Analysis	01

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures–mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Module No.	Module Title	Credit
3	Speech Modeling	01

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Module No.	Module Title	Credit
4	Applications of Speech Processing	01

Brief applications of speech processing in voice response systems, hearing aid design and recognition system.

Module No.	Module Title	Credit
5	Statistical Models for Speech Recognition	01

(i)Vector quantization models and applications in speaker recognition. (ii)Gaussian mixture modeling for speaker and speech recognition. (iii) Discrete and Continuous Hidden Markov modeling for isolated word and continuous speech recognition.

6	Speech Recognition	01
Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word Units; Applications and present status.		
7	Speech Synthesis	01
Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word Units for TTS, intelligibility and naturalness – role of prosody, Applications and present		
8	Linear Predictive Analysis of Speech	01
Formulation of Linear Prediction problem in Time Domain-Basic Principle, Auto correlation method, Covariance method, Solution of LPC equations, Cholesky method, Durbin's recursive algorithm, lattice formation and solutions, comparison of different VELP, CELP		

Books:

Text:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Edu, 2003.
2. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999, isbn: 13: 978-0471977308
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.

References:

1. Steven W. Smith, “The Scientist and Engineer‟s Guide to Digital Signal Processing”, California Technical Publishing, 1997. ISBN:0-9660176-4-**1**
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004, ISBN: 9788129703187.
3. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006, ISBN: 10: 8126508221
4. UdoZolzer, " Digital Audio Signal Processing", Second Edition, John Wiley & sons Ltd, **ISBN**: 9780470680018
5. Lawrence R. Rabiner and R. W. Schaffer," Digital Processing of Speech Signals", Prentice Hall – 1978, ISBN: 0-13-213603-1
6. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective III
610103C :Mobile Ad-hoc Networks

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In-Sem : 50 Marks End-Sem : 50 Marks

Course Objectives :

- To study the concepts of Ad hoc Networks
- To learn the concepts of Mobility and Mobility Prediction
- To understand the functionalities of various Protocols in MANET
- To know the technological advancements in wireless networks

Course Outcomes :

- Assess Quality of Service in MANET
- Evaluate the performance of various Protocols in MANET
- Choose appropriate constituents and parameters to build MANET
- Analyze the performance of MANET

Selection of Modules:

Note that modules 1, 2, 3 are compulsory and select any two (02) from modules 4 to 8.

Course Contents

Module No.	Module Title	Credit
1	Introduction	01

Fundamentals of Wireless Communication, Characteristics of Wireless channel, IEEE 802 Networking Standard, 802.3, 803.11, 802.15, 802.16, HIPERLAN Standard, HIPERACCESS, Wireless Internet, TCP in Wireless Domain, WAP, ADHOC Wireless Network, Issues in ADHOC Wireless Network.

Recent Advances in Wireless Networks: Ultra Wide-Band Radio Communication, Wireless Fidelity, Optical Wireless Networks, Multimode 802.11, Meghadoot Architecture.

Module No.	Module Title	Credit
2	MAC Protocols	01

Design issues, goals and classification. Contention based protocols, Contention based protocols with reservation mechanisms, scheduling mechanisms, protocols using directional antennas, other protocols. Routing Protocols: Design Issues, Classification, Table Driven, On-Demand, Hybrid, Efficient Flooding Mechanism, Hierarchical, Power-Aware Routing Protocols.

Module No.	Module Title	Credit
3	Multicast Routing	01

Design Issues, Architecture Reference Model, Classification, Tree-Based, Mesh-Based, Energy Efficient, Application Dependent, Multicasting with QOS-Guarantees. Transport layer: Design Issues and Design Goals, Classification, TCP over Ad Hoc Networks, Transport Layer protocols. Network Security Attacks, Key Management, Secure Routing.

Module No.	Module Title	Credit
4	Quality of Service	01

Issues and Challenges, Classification, MAC Layer Solutions, Network Layer Solutions, QOS Frame work. Energy Management: Need, Classification, Schemes for: Battery Management, Transmission Power Management, System Power Management.

Module No.	Module Title	Credit
5	Wireless Sensor Networks	01

Introduction, Sensor network Architecture, Data Dissemination, Data Gathering, MAC Protocols for WSN, Quality of WSN. Hybrid Wireless Networks: Introduction, Next Generation Hybrid Wireless Architectures, Routing, Pricing in Multi-hop Wireless Network, Power Control Schemes, Load Balancing.		
6	**Algorithms for Mobile Ad-hoc Networks**	**01**
Hierarchical routing and clustering, routing with virtual coordinates, relative location determination, overview and classification of NWB algorithms, Robustness control, NWB robustness solutions.		
7	**Encoding for Data Distribution& Power Control Protocols**	**01**
Erasure codes, Network coding, Design principles for power control, single layer approach, the systematic approach, energy oriented perspective.		
8	**Vehicular Ad-hoc Networks**	**01**
VANET, characteristics, Connectivity, Dynamic transmission range assignment, routing applications, vehicle mobility, VANET vs MANET.		

Books:

Text:

1. C. Siva Ram Murthy and B.S. Manoj, “Ad hoc Wireless Networks Architectures and protocols”, 2nd edition, Pearson Education. 2007, ISBN: 9788131706886, 8131706885
2. Charles E. Perkins, “Ad hoc Networking”, Addison–Wesley, 2000, ISBN: 0201309769

Reference:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, “Mobile ad hoc networking”, Wiley-IEEE press, 2004, ISBN: 978-0-471-65688-3.
2. Mohammad Ilyas, “The handbook of ad hoc wireless networks”, CRC press, 2002, ISBN: 0-8493-1332-5
3. T. Camp, J. Boleng, and V. Davies “A Survey of Mobility Models for Ad Hoc Network Research”, Wireless Communication. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502, ISBN:
4. Fekri M. Abduljalil, “A survey of integrating IP mobility protocols and Mobile Ad hoc networks”., ISBN: 10 : 0750675993

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective III
610103 D : Pattern Recognition

Teaching Scheme:	Credit	Examination Scheme:
TH: 05 Hours/Week	05	In-Sem : 50 Marks End- Sem: 50 Marks

Course Objectives:

- To learn the basic concept of Pattern recognition
- To study different approaches of pattern recognition
- To learn various pattern classification techniques
- To survey on recent advances and applications in pattern recognition

Course Outcomes:

On completion of the course, student will be able to-

- Analyze various type of pattern recognition techniques
- Identify and apply various pattern recognition and classification approaches to solve the problems
- Evaluate statistical and structural pattern recognition
- Percept recent advances in pattern recognition confined to various applications

Selection of Modules:

Kindly note that modules 1,2,3 and module 9 are compulsory and select any two (02) modules from remaining modules.

Course Contents

Module No.	Module Title	Credit
1	**Pattern Recognition**	01

Introduction of Pattern Recognition with its application, Pattern Recognition system, Design cycle of pattern recognition, Learning and adaption, Representation of Patterns and classes, Feature Extraction, pattern recognition models/approaches.

Module No.	Module Title	Credit
2	**Error Estimation**	01

Introduction, Error estimation methods, various distance measures (Euclidean, Manhattan, cosine, Mahalanobis) and distance based classifier, Feature selection based on statistical hypothesis testing, ROC curve.

Module No.	Module Title	Credit
3	**Decision Theory**	01

Introduction, Bayesian decision theory-continuous and discrete features, two- category classification, minimum error rate classification, discriminant functions,

Parametric Techniques:- Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics; Problems of dimensionality.

Non-Parametric Techniques:-Density estimation, Parzen Window, Metrics and Nearest-Neighbor classification; Fuzzy classification.

Module No.	Module Title	Credit
4	**Non Metric and structural pattern recognition**	01

Tree Classifiers-Decision Trees, Random Forests, **Structural Pattern recognition:** Elements of formal grammars ,String generation as pattern description ,Recognition of syntactic description ,Parsing ,Stochastic grammars and applications ,Graph based structural representation, **Stochastic method:** Boltzmann Learning.

5	**Clustering**	01

Introduction, Hierarchical Clustering, agglomerative clustering algorithm, the single linkage, complete, linkage and average, linkage algorithm. Ward's method ,Partition clustering, , K-means algorithm, clustering algorithms based on graph theory(Minimum spanning tree algorithm),Optimization methods used in clustering: clustering using simulating Annealing.

6	**Template Matching**	01

Measures based on Optimal Path Searching techniques: Bellman's optimality principle and dynamic programming, The Edit distance, Dynamic time Warping, Measures based on correlations, Deformable template models

7	**Unsupervised Learning**	01

Neural network structures for pattern recognition, Unsupervised learning in neural pattern recognition , deep learning ,Self-organizing networks

8	**Fuzzy Logic and Pattern Recognition**	01

Fuzzy logic ,Fuzzy pattern classifiers, Pattern classification using Genetic Algorithms

9	**Applications**	

Pattern recognition applications: Application of pattern recognition techniques in object recognition, biometric, facial recognition, IRIS scanner, Finger prints, 3D object recognition.

Books:

Text :

1. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", 2nd Edition, Wiley-Inter- science, John Wiley &Sons, 2001
2. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Elsevier, Academic Press, ISBN: 978-1-59749-272-0
3. B.D. Ripley, "Pattern Recognition and Neural Networks", Cambridge University Press. ISBN 0 521 46086 7

Reference :

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. David G. Stork and Elad Yom-Tov, "Computer Manual in MATLAB to accompany Pattern Classification", Wiley Inter-science, 2004, ISBN-10: 0471429775
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI, ISBN-978- 81-203-4091-6
4. eMedia at NPTEL : http://nptel.ac.in/courses/106108057/33

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610104 : Seminar II

Teaching Scheme:	Credit	Examination Scheme:
Practical: 4 Hrs/week	04	TW: 50 Marks Presentation: 50 Marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms, services.

Course Outcomes:

On completion of the course, student will be able –

- To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,.
- To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication.
- To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across

The student shall have to deliver the seminar II in semester III on a topic approved by guide and authorities.

It is appreciated if student has already selected the domain of his/her dissertation work and identified the literature confined to the domain and thorough literature study based on identified topic has been carried out. This practice will eventually lead to convergence of the efforts for the dissertation work. The meticulous analyses of the literature can be part of seminar.

The relevant literature then be explored as state-of-the-art, exotic, recent technological advancements, future trends, applications and research & innovations. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in seminar logbook approved by Board of Studies.

<table>
<tr><td colspan="3">Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610105 : Dissertation Stage I</td></tr>
<tr><td>Teaching Scheme:
Practical: 08 Hrs/week</td><td>Credit
08</td><td>Examination Scheme:
TW: 50 Marks
Presentation: 50 Marks</td></tr>
</table>

Course Objectives:

- To identify the domain of research
- To learn to communicate in a scientific language through collaboration with guide.
- To understand the various means of technical publications and terminologies associated with publications
- To categorize the research material confined to the domain of choice
- To formulate research problem with the help of the guide/mentor elaborating the research.
- To Acquire information independently and assessing its relevance for answering the research questions.

Course Outcomes:

On completion of the course the student should be able to-

- Conduct thorough literature survey confined to the domain of choice
- Develop presentation skills to deliver the technical contents
- Furnish the report of the technical research domain
- Analyze the findings and work of various authors confined to the chosen domain

Dissertation Stage – I is an integral part of the Dissertation work. In this, the student shall complete the partial work of the Dissertation which will consist of problem statement, literature review, design, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart,) and Layout & Design of the Set-up.

The student is expected to complete the dissertation at least up to the design phase. As a part of the progress report of Dissertation work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly approved and certified progress report of Dissertation Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The examiner will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journal.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, it is recommended to follow the formats and guidelines circulated / as in dissertation workbook approved by Board of Studies. Follow guidelines and formats as mentioned in Dissertation Workbook.

Semester IV

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610107 : Seminar III

Teaching Scheme:	Credit	Examination Scheme:
Practical: 20 Hrs/week	20	TW: 150 Marks Presentation: 50 Marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms, services.

Course Outcomes:

On completion of the course, student will be able–

- To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,.
- To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication.
- To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across

The student shall have to deliver the seminar III in semester IV on a topic approved by guide and authorities. Preferably the seminar III may be extension of seminar II. The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. The student shall submit the duly certified seminar report in standard format, for satisfactory completion by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, the department will follow the seminar guidelines circulated / as in logbook approved by Board of Studies.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
610108 : Dissertation Stage II

Teaching Scheme:	Credit	Examination Scheme:
Practical: 20 Hrs/week	20	TW: 150 Marks Presentation: 50 Marks

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report

Course Outcomes:

On completion of the course the student shall be able to-

- Show evidence of independent investigation
- Critically analyze the results and their interpretation ; infer findings
- Report and present the original results in an orderly way and placing the open questions in the right perspective.
- Link techniques and results from literature as well as actual research and future research lines with the research.
- Appreciate practical implications and constraints of the specialist subject

Guidelines:

In Dissertation Work Stage–II, the student shall consolidate and complete the remaining part of the dissertation which will consist of Selection of Technology, Installations, UML implementations, testing, Results, measuring performance, discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems, comparative analysis, validation of results and conclusions. The student shall prepare the duly certified final report of Dissertation in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The students are expected to validate their study undertaken by publishing it at standard platforms.

The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journal.

The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination.

The continuous assessment of the progress need to be documented unambiguously.

It is recommended to continue with guidelines and formats as mentioned in Dissertation Workbook approved by Board of Studies.

Non Credit Courses

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC1: Game Engineering

Course Contents

1. Introduction to Unity 3D Game Engines
- Introduction to game industry ,Unity Basic (Interface Intro), Intro to tools & navigation, The Main Windows, Game Objects , Scenes ,Cameras and Types, The assets store, Intro to Asset Work flow

2. Basic Photoshop
- File types, size and resolution, Cropping and Editing sprite sheet

3. C# programming in unity

4. 2D Game Development Using Unity 3D
- Intro to 2D Game system in unity, Sprite Editor in Unity, Sprite Animation in Unity
- 2D Physics in Unity

5. 3D Game Development Using Unity 3D
- UI system in Unity, Artificial Intelligence for 3D Game
- Object Oriented Design & Programming for 3D Games
- Multiplayer Game in unity, Creating 3D Game For PC

Books

1. Fabian Birzele, "The Java Game Development Tutorial
2. Sean M. Tracey, "Make Games with Python on Raspberry Pi"

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC2: Advanced Cognitive Computing

Course Contents

1. The Foundation of Cognitive Computing
Interdisciplinary Nature of Cognitive Science, Cognitive Computing Systems, Representations for Information and Knowledge, Principal Technology Enablers of Cognitive Computing, Cognitive Computing Architectures and Approaches, Cognitive Computing Resources

2. Cognitive Computing and Neural Networks: Reverse Engineering the Brain
Brain Scalability, Neocortical Brain Organization, The Concept of a Basic Circuit, Abstractions of Cortical Basic Circuits, Large-Scale Cortical Simulations, Hardware Support for Brain Simulation, Deep Learning Networks

3. The Relationship Between Big Data Analytics and Cognitive Computing
Evolution of Analytics and Core Themes, Types of Learning, Machine Learning Algorithms, Cognitive Analytics: A Coveted Goal, Cognitive Analytics Applications

4. Applications of Cognitive Computing
Applications in expert systems, Natural language programming, neural networks, robotics, virtual reality, Future applications

Books

1. **'Cognitive Computing and Big Data Analytics', by** Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Wiley publications, ISBN: 978-1-118-89662-4
2. '**Cognitive Computing: Theory and Applications**', by Vijay Raghvan, Venu Govindaraju, C.R. Rao, Elsevier publications, eBook ISBN: 9780444637512, Hardcover ISBN: 9780444637444
3. **https://www.research.ibm.com/software/IBMResearch/multimedia/Computing_Cognition_WhitePaper.pdf**

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC3: Reconfigurable Systems
Course Contents
1. Introduction to reconfigurable systems:- Reconfigurable system (RS), Reconfigurable computing (RC), Architectural components of a configurable computer, primary methods in conventional computing: Application Specific Integrated Circuit (ASIC), software-programmed microprocessors, **2. Reconfigurable computing:-**,Theories:-Tredennick's Classification, Hartenstein's Xputer, High-performance computing, Partial re-configuration, Current systems Computer emulation, COPACOBANA, Mitrionics, National Instruments, Xilinx, Intel, **3. Advanced Applications and Technologies**:- Reconfigurability mechanisms, Reconfigurable devices and fabrics, Programmable pathways, Reconfigurability enablers, **4. The Future of Reconfigurable Systems:-** Introduction, Multi-million gate FPGA Architectures, future Field Programmable System-on-a-Chip (FPSC), FPGA Architectures for Reconfigurable Computing, CAD Support for Reconfigurable Systems, Applications
Books
1. Gokhale, Maya, B., Graham, Paul S., " Reconfigurable Computing Accelerating Computation with Field-Programmable Gate Arrays", 2005, 238 p., Springer Netherland, Hardcover ISBN: 0-387-26105-2 **2.** Bobda Ch, " Introduction to Reconfigurable Computing Architectures, Algorithms, and Applications", Springer Netherlands, 2007, ISBN 978-1-4020-6088-5, 5 (Print) 978-1-4020-6100-4 359 3. Papers on the web page of the course Reconfigurable Circuits **3.** Katherine Compton and Ccott Hauck, " Reconfigurable Computing: A Survey of Systems and Software", ACM Computing Surveys, Vol. 34, No. 2, June 2002, pp. 171–210.

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC4: Convergence Technology
Course Contents
1. Introduction-Convergence continues to gain momentum Worldwide, Responding to convergence, Thinking Strategies about ICT Convergences **2.** Security Convergence Types of convergence, Security convergence collaboration, Categories of Convergence Convergence Trends: Value of technology, Convergence in design **3.** Security Planning Convergence Initiatives, Convergence and Layers of Security, Levels of Security Need of Technology roadmap **4.** Convergence in Practice The Nimble Giants: How converged business models drive successful large enterprises The New face of public sector Small Enterprises Benefits from Strategic Investment management
Books

1. Rajendra Singh and Siddhartha Raja, “Convergence in Information and Communication Technology”, World Bank, ISBN, 0821381695, 9780821381694
2. Faisal Hoque, “The power of Convergence”, AMACOM, *ISBN*-10: 0814416950,
3. Richard Baldwin, “The Great Convergence”, Harvard University Press, ISBN-13: 978-0674660489
4. Ray Bernard “Security Technology Convergence Insights”, Ray Bernard., ISBN: 9780128030011.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC5: Machine Intelligence

Course Contents

1. Introduction to Machine Intelligence, What is MI?, Background/history, Spin-offs, High-level overview, State of the art.
2. Representation of Knowledge- Knowledge Representation, Knowledge Representation using predicate logic, introduction to predicate calculus, resolution, Knowledge Representation using other logic-structured Knowledge Representation.
3. Planning and Machine Learning- Basic Plan generation systems-strips, Advanced Plan generation systems-K strips, Strategic explanations,Machine learning, Adaptive Learning
4. Expert Systems- Architecture of Expert Systems, Roles of Expert Systems, Konwledge acquisition-Meta knowledge heuristics.

Books

1. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
2. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
3. Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC6: Storage Area Networks

Course Contents

1. **Introduction to Information Storage Technology, Storage System Environment and Data protection:** Evolution, Key Challenges in Managing Information, Information Lifecycle Components, Disk Drive Components & Performance,
2. **Different Storage Technologies and Virtualization**
   Introduction to **Networked Storage**, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS) & its Components, File Sharing, I/O operations, Performance and Availability. Content Addressed Storage, Storage Virtualization
3. **Content-Addressed Storage, Business Continuity, Backup and Recovery, Local Replication, Remote Replication:**
   BC Terminology, Failure Analysis, Business Impact Analysis, Solutions, Backup Granularity, Recovery Considerations, Backup Methods, Process & Topologies, Backup in NAS Environments, Local Replication Technologies,
4. **Securing & Managing the Storage Infrastructure:**
   Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking Monitoring the Storage Infrastructure, Storage Management Activities, Storage Infrastructure Management Challenges,

Books

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne, 2001.
3. EMC Educational Services, "Information Storage and Management", Wiley India
4. Meet Gupta, "Storage Area Network Fundamentals", Pearson Education Limited

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC7: Search Engine Optimization

Course Contents

1. **Basics for SEO, SEO Research & Analysis**
   Basic Knowledge of Domain & World Wide Web, Difference between Portal and Search Engines, need of SEO, Types of SEO Techniques: Black hat techniques & White Hat techniques, Search Engine working Process, Keyword Research and Analysis, Keyword opportunity, Competitors Website Analysis, SWOT, On-page Optimization & Off-page Optimization
2. **On-page Optimization**: Meta Descriptions & Meta Keywords, Headings, Bold Text, Domain Names & Suggestions, Canonical Tag, Meta Tags, Images and Alt Text, Internal Link Building, Server and Hosting Check, Robots Meta Tag, 301 Redirects, 404 Error , Duplicate content
3. **Off-page Optimization**: Page Rank, Link Popularity, Link Building in Detail, Directory Submission, Blog Submission, Links Exchange, Reciprocal Linking, Posting to Forums, RSS Feeds Submissions, Competitor Link Analysis
4. **Analytics & SEO Tools**
   Study of Google Analytics**,** How Google Analytics can Help SEO**,** Webmaster Central & Bing/Yahoo; Website Analysis using various SEO Tools available : Keyword Density Analyzer Tools, Google Tools, Yahoo / Bing Tools, Rich Snippet Text Tools, Comparison Tools, Link Popularity Tools, search Engines Tools, Site Tools
5. **SEO Reporting**
   Google analysis, Tracking and Reporting, Reports Submission, Securing Ranks

Books

1. Jason McDonald Ph.D, "SEO Fitness Workbook: The Seven Steps to Search Engine Optimization Success"
2. Caimin Jones, "SEO Step-by-Step: The Complete Beginner's Guide to Getting Traffic"
3. Bruce Clay, " *Search Engine Optimization All-in-One for Dummies*
4. Adam Clarke, " SEO 2017: Learn search engine optimization with smart internet marketing strategies"

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC8:Virtual Reality

Course Contents

1. Introduction and Background
What VR is and why it is so different from other mediums. Its history and different forms of reality, ranging from the real world to fully immersive VR. Its various hardware and components, which composes those realities.

2. Perception
Understanding the human brain and how we perceive real and virtual worlds, real-world examples that prove reality is not always what we think it is, explanations of perceptual models and processes, the physiology of the different sensory modalities, theories of how we perceive space and time, and a discussion of how perception relates to action.

3. Designing in VR
Fundamentals of VR design including ergonomics, user testing, interface design, scale and scene setting, graphical user interfaces, and motion mechanics for mobile VR, simulator sickness, its causes.

4. VR Platforms and Applications
Understand what is happening in the VR industry, surveying current trends and technology in VR, the hardware: Mobile Performance & 360 Media, High-Immersion Unity, or High-Immersion Unreal.

Books

1. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Association for Computing Machinery and Morgan & Claypool New York, NY, USA©2016, ISBN: 978-1-97000-112-9
2. John Vince, Virtual Reality Systems, Pearson Prentice Hall, ISBN 10: 0201876876 or ISBN 13: 9780201876871
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, ISBN: 978-0-471-36089-6

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC9: Machine Translation

Course Contents

1. Introduction:
Concept and translation process. Approaches viz rule based, statistical, Example based, hybrid and neural MT.

2. Learning and inference for translation models:
Maximum likelihood, Expectation maximization, Discriminative learning, Stochastic methods, Dynamic programming, Approximate search.

3. Linguistic phenomena and their associated modeling problems:
Morphology, syntax and semantics.

4. Applications & Evaluation:
Scaling, approximation and efficient data structures

Books

1. P. Koehn, " Statistical Machine Translation", Cambridge University Press
2. Pushpak Bhatacharyya, "Machine Translation" , 2015
3. John Hutchines, " Milestone in Machine Translation"

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC10: Infrastructure Management

Course Contents

1. Introduction to Infrastructure Management

What is Infrastructure Management, Basic Framework, Policy Issues, Types of Infrastructure Management: Systems Management, Network Management, Storage Management, Objectives, Benefits of Infrastructure Management system

2. IT Infrastructure Management

Components of IT Infrastructure, Hardware resources, Data storage, Input-output Technologies used in Businesses, Types of Computer Softwares used for Infrastructure Management in Business, Principle Issues, Foundations of Business Intelligence: Databases and Information Management, Telecommunications, Wireless Technology, Security

3. Key System Applications for the Digital Age

Achieving Operational Excellence and Customer Intimacy: Enterprise Applications, E-Commerce: Digital Markets, Digital Goods, Improving Decision Making and Managing Knowledge

4. Building and Managing Systems

Building Information Systems, Ethical and Social Issues in Information Systems

Books

1. Jane P. Laudon, Azimuth, "Essentials of Business Information Systems", Pearson, ISBN-10: 0132277816,13: 9780132277815
2. Barbara Klein, Richard Alan Long, Kenneth Ray Blackman, "Introduction to IMS, An: Your Complete Guide to IBM Information Management System", IBM Press, ISBN-10: 0132886871, ISBN-13: 9780132886871
3. David Boddy, Albert Boonstra, "Managing Information Systems: Strategy and Organization", Financial Times Press,ISBN-10: 0273716816, ISBN-13: 9780273716815

JSPM's Bhivarabai Sawant Institute of Technology & Research, Wagholi, Pune (412207)

CRITERION 1 - CURRICULAR ASPECTS

1.2

Academic Flexibility

1.2.1

Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented.

DEPARTMENT OF INFORMATION TECHNOLOGY

Faculty of Science & Technology
Savitribai Phule Pune University, Pune
Maharashtra, India

Curriculum
for
Second Year of Information Technology
(2019 Course)
(With effect from AY 2020-21)

I N D E X

Home

Savitribai Phule Pune University, Pune Bachelor of Information Technology	
Program Educational Objectives	
PEO1	**Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.**
PEO2	**Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.**
PEO3	**Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science and Information Technology.**
PEO4	**Have commitment to ethical practices, societal contributions through communities and life-long learning.**
PEO5	**Possess better communication, presentation, time management and teamwork skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.**

Home

Program Outcomes

Students are expected to know and be able to–

PO1	Engineering knowledge	An ability to apply knowledge of mathematics, computing, science, engineering and technology.
PO2	Problem analysis	An ability to define a problem and provide a systematic solution with the help of conducting experiments, analyzing the problem and interpreting the data.
PO3	Design / Development of Solutions	An ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints.
PO4	Conduct Investigations of Complex Problems	An ability to identify, formulates, and provides systematic solutions to complex engineering/Technology problems.
PO5	Modern Tool Usage	An ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional.
PO6	The Engineer and Society	An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions.
PO7	Environment and Sustainability	An ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society.
PO8	Ethics	An ability to understand professional, ethical, legal, security and social issues and responsibilities.
PO9	Individual and Team Work	An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).
PO10	Communication Skills	An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities.
PO11	Project Management and Finance	An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.
PO12	Life-long Learning	An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.

Home

Program Specific Outcomes (PSO)	
A graduate of the Information Technology Program will demonstrate-	
PSO1	**An ability to apply the theoretical concepts and practical knowledge of Information Technology in analysis, design, development and management of information processing systems and applications in the interdisciplinary domain.**
PSO2	**An ability to analyze a problem, and identify and define the computing infrastructure and operations requirements appropriate to its solution. IT graduates should be able to work on large-scale computing systems.**
PSO3	**An understanding of professional, business and business processes, ethical, legal, security and social issues and responsibilities.**
PSO4	**Practice communication and decision-making skills through the use of appropriate technology and be ready for professional responsibilities.**

Home

Savitribai Phule Pune University Second Year of Information Technology Engineering(2019 Course) (With effect from Academic Year 2020-21)														
Semester-III														
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
214441	Discrete Mathematics	03	-	01	30	70	25	-	-	125	03	--	01	04
214442	Logic Design and Computer Organization	03	-	-	30	70	-	-	-	100	03	-	-	03
214443	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
214444	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
214445	Basics of Computer Network	03	-	-	30	70	-	-	-	100	03	-	-	03
214446	Logic Design Computer Organization Lab	-	02	-	-	-	25	25	-	50	-	01	-	01
214447	Data Structures and Algorithms Lab	-	04	-	-	-	25	25	-	50	-	02	-	02
214448	Object Oriented Programming Lab	-	04	-	-	-	25	25	-	50	-	02	-	02
214449	Soft Skill Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
214450	Mandatory Audit Course 3	-	-	-	-	-	-	-	-	-	Non Credit			-
Total		15	12	01	150	350	125	75	--	700	15	06	01	22

Abbreviations:

TH: Theory TW: Term Work PR: Practical

OR: Oral TUT: Tutorial

Note: Students of S.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

#Mandatory Audit Course 3:

- **214450A- Ethics and values in IT**
- **214450B - Quantitative Aptitude and Logical Reasoning**
- **214450C- Language Study- Japanese- Module**
- **214450D-Cyber Security and Law**

Savitribai Phule Pune University, Pune Second Year of Information Technology Engineering (2019 Course) (With effect from Academic Year 2020-21)														
Semester-IV														
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
207003	Engineering Mathematics- III	03	-	01	30	70	25	-	-	125	03	--	01	04
214451	Processor Architecture	03	-	-	30	70	-	-	-	100	03	-	-	03
214452	Database Management System	03	-	-	30	70	-	-	-	100	03	-	-	03
214453	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
214454	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
214455	Programming Skill Development Lab	-	02	-	-	-	25	25	-	50	-	01	-	01
214456	Database Management System Lab	-	04	-	-	-	25	25		50	-	02	-	02
214457	Computer Graphics Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
214458	Project Based Learning	-	04	-	-	-	50	-	-	50	-	02	-	02
214459	Mandatory Audit Course 4	-	-	-	-	-	-	-	-	-	Non Credit			-
Total		15	12	01	150	350	125	75	-	700	15	06	01	22

Abbreviations:

TH: Theory TW: Term Work PR: Practical

OR: Oral TUT: Tutorial

Note: Students of S.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

#Mandatory Audit Course 4:

214459A - Water Supply and Treatment

214459B - Language Study- Japanese- Module II

214459C - Waste Management and Pollution Control

214459D - Intellectual Property Rights

INSTRUCTIONS

- Practical or Tutorial must be conducted in batches and number of batches per division should be as per guidelines from regulatory bodies.
- Required minimum number of experiments/ assignments in practical/ tutorial shall be conducted as mentioned in the syllabi of respective subjects. The list of experiments/assignments is prescribed in the syllabi.
- In addition to the prescribed list, the instructor for practical/ tutorial may design one or two additional experiments/assignments relating to the subject covering some of the research/application areas of the concerned subject.
- For practical/tutorial subject, each experiment/assignment, the student must prepare a write-up consisting of assignment statement, objective(s)/outcome(s), algorithm(s), flow charts/UML diagram(s), important test cases, test case validation report etc.
- The faculty member/instructor should prepare a rubric for the assessment of practical and tutorial. Assessment of tutorial work is part of term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.
- Project based learning (PBL) requires mentoring and internal continuous assessment by faculty throughout the semester for successful completion of the tasks assigned to the students. A teaching workload of 4 hours/week/batch is associated with PBL subject should be allocated to the faculty conducting PBL mentoring and internal continuous assessment. The students in a Batch may be divided into sub-groups of 5 to 6 students for easing the process of internal continuous assessment. Assignments/activities/models/ projects etc. completed under project-based learning will be considered for internal continuous assessment, evaluation, and award of credits for PBL subjects.
- Audit course is a mandatory non-credit course. The faculty member should prepare the rubric(s) for the assessment of audit course at the start of semester. The assessment should be carried out based on the said rubric(s) only and report should be prepared and submitted to the department at the end of semester.
- Case Studies may be assigned as a self-study to students and to be excluded from theory examinations.
- All the rules, regulations and guidelines issued by regulatory authorities from time to time for effective conduction of curriculum, assessment and evaluation are to be strictly followed.

SEMESTER – III

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214441: Discrete Mathematics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 03 hrs/week Tutorial(TUT): 01 hrs/week	03 01	Mid_Semester : 30 Marks End_Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses, if any: Basic Mathematics

Companion Course, if any:

Course Objectives:

1. To gain sound knowledge to formulate and solve problems with sets and propositions.
2. To understand and solve counting problems by applying elementary counting techniques to solve problems of discrete probability.
3. To understand Graph and Tree terminologies and models to be applied in real life problems.
4. To recognize types of relation, formulate and solve problems with relations and functions.
5. To understand basics of number theory and its applications.
6. To understand the various types' algebraic structures and its applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Formulate and apply formal proof techniques and solve the problems with logical reasoning.
CO2: Analyze and evaluate the combinatorial problems by using probability theory.
CO3: Apply the concepts of graph theory to devise mathematical models.
CO4: Analyze types of relations and functions to provide solution to computational problems.
CO5: Identify techniques of number theory and its application.
CO6: Identify fundamental algebraic structures.

COURSE CONTENTS

Unit I	Sets And Propositions	(06 hrs + 2 hrs Tutorial)

Sets: Sets, Combinations of Sets, Venn Diagram, Finite and Infinite Sets, Countable Sets, Multisets, Principle of Inclusion and Exclusion, Mathematical Induction.

Propositions: Propositions, Logical Connectives, Conditional and Bi-conditional Propositions, Logical Equivalence, Validity of Arguments by using Truth Tables, Predicates and Quantifiers, Normal forms.
Applications of Sets and Propositions.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Combinatorics And Discrete Probability	(06 hrs + 2 hrs Tutorial)

Combinatorics: Rules of Sum and Product, Permutations, Combinations.

Discrete Probability: Discrete Probability, Conditional Probability, Bayes Theorem, Information and Mutual Information, Applications of Combinatorics and Discrete Probability.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Graph Theory**	**(06 hrs + 2hrs Tutorial)**
Graphs: Basic Terminologies, Multi-Graphs, Weighted Graphs, Sub Graphs, Isomorphic graphs, Complete Graphs, Regular Graphs, Bipartite Graphs, Operations on Graphs, Paths, Circuits, Hamiltonian and Eulerian graphs, Travelling Salesman Problem, Factors of Graphs, Planar Graphs, Graph Colouring. **Trees:** Tree Terminologies, Rooted Trees, Path Length in Rooted Trees, Prefix Codes, Spanning Trees, Fundamental Cut Sets and Circuits, Max flow –Min Cut Theorem (Transport Network). Applications of Graph Theory.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Relations And Functions**	**(06 hrs + 2hrs Tutorial)**
Relations: Properties of Binary Relations, Closure of Relations, Warshall'sAlgorithm, Equivalence Relations, Partitions, Partial Ordering Relations, Lattices, Chains and Anti Chains. **Functions:** Functions, Composition of Functions, Invertible Functions, Pigeonhole Principle, Discrete Numeric Functions. **Recurrence Relations:** Recurrence Relation, Linear Recurrence Relations with Constant Coefficients, Total Solutions, Applications of Relations and Functions.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Introduction To Number Theory**	**(06 hrs + 2hrs Tutorial)**
Divisibility of Integers: Properties of Divisibility, Division Algorithm, Greatest Common Divisor GCD and its Properties, Euclidean Algorithm, Extended Euclidean Algorithm, Prime Factorization Theorem, Congruence Relation, Modular Arithmetic, Euler Phi Function, Euler's Theorem, Fermat's Little Theorem, Additive and Multiplicative Inverses, Chinese Remainder Theorem.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Algebraic Structures**	**(06 hrs + 2hrs Tutorial)**
Algebraic Structures: Introduction Semigroup, Monoid, Group, Abelian Group, Permutation Groups, Cosets, Normal Subgroup, Codes and Group Codes, Ring, Integral Domain, Field. Applications of Algebraic Structures.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Text Books:		
1. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill 2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", & 7th edition, McGraw-Hill		

Reference Books:
1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, “Discrete mathematical structures”, 6th edition, Prentice Hall of India 2. Edgar G. Goodaire, Michael M. Parmenter, “Discrete Mathematics with Graph Theory”, 3rd Edition, Pearson Education 3. Tremblay J. S., “Discrete mathematical structures with application”, 3rdEdition, Tata McGraw Hill 4. Lipschutz Seymour, “Discrete mathematics”, 4th Edition, Tata McGraw-Hill 5. Johnsonbaugh Richard, “Discrete Mathematics”, 7th edition, Pearson 6. Biggs Norman L, “Discrete mathematics”, 6th edition, Oxford 7. David M. Burton, “Elementary Number Theory”, &7th Edition, McGraw-Hill

Guidelines for Tutorial and Term Work

- Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
- Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Examples on various topics of respective unit must be explained and discussed will be covered in tutorial sessions based on following:

1. **Problems for deep understanding of concepts.**
2. **Identify applications and device mathematical models for real time problems.**

Sr. No.	Name of the Tutorial	Description	Applicable CO
1	Introduction to Set Theory	Formulate problems to illustrate 1. Sets, universal sets, multisets, and operations on sets such as union, intersection, complement and set difference. 2. Introduce sets as mathematical model to classify data sets.	**CO1**
2	Propositional Logic	Formulate problems that comprises 1. Translation of English sentences into logical propositions by using logical connectives. 2. Proof for logical equivalences by using truth table analysis. 3. Propositions by using Predicates and Quantifiers. 4. Conjunctive and Disjunctive Normal Forms. 5. 5. Proof by using Mathematical Induction	**CO1**
3	Combinatorics	Design problems to illustrate counting techniques by using 1. Permutation and Combinations 2. Permutation with repetition	**CO2**

Sr. No.	Name of the Tutorial	Description	Applicable CO
		3. Properties of *nCr and nPr* 4. Addition and Multiplication Principle	
4	Discrete Probability	Formulate problems for better understanding of 1. Discrete Probability 2. Conditional Probability and Bay's theorem Identify applications of probability to Computer Science	**CO2**
5	Graph Theory	Design problems to study 1. Graph properties and operations on graphs 2. Connectedness, Hamiltonian and Eulerian graphs. 3. Introduce graph as a mathematical model to understand transport, communication, and social networks.	**CO3**
6	Tree	Problems to be formulated on 1. Prefix codes, Huffman codes 2. Fundamental cut sets and Fundamental circuits 3. Transport network by using Maximum Flow Minimum cut Theorem 4. Identify applications of tree for Searching Algorithms, Polish notation	**CO3**
7	Relations and Functions	Problems to understand 1. Types of Relations 2. Equivalence relation and Equivalence classes 3. Transitive closure by using Warshall's Algorithm. 4. Injective, Surjective and Bijective Functions. 5. Pigeonhole principle and its applications	**CO4**
8	Recurrence Relation	Problems based on 1. Formation of recurrence relation 2. Solving homogeneous recurrence relation with constant coefficients 3. Solving non-homogeneous recurrence relations to find total solution. 4. Identify applications of recurrence relation in counting.	**CO4**
9	Introduction to Number Theory	Problems to illustrate concepts such as- 1. Divisibility and its properties 2. Greatest common divisor and its properties 3. Prime numbers and prime factorization theorem to find GCD and LCM of two numbers	**CO5**
10	Modular Arithmetic	Problems to demonstrate applications of- 1. Euler's theorem and Fermat's theorem in counting remainders 2. Linear congruences 3. Chinese Remainder Theorem 4. Applications of Modular arithmetic to Cryptography and Security	**CO5**

Sr. No.	Name of the Tutorial	Description	Applicable CO
11	Algebraic Structures-I	Problems to be formulated to illustrate 1. Concept of algebraic structure 2. Examples of semigroup, monoid, group and abelian group 3. Generating group codes by using normal subgroups 4. Application of Algebraic Structure in operator overloading.	**CO6**
12	Algebraic Structures-II	Problems to illustrate 1. Definition and examples of Ring, types of Ring 2. Zero divisors and Integral domain 3. Multiplicative inverses in different rings, and Field 4. Identify Applications of Ring and Field in Coding Theory	**CO6**

* Subject Teacher can design different tasks to students as well can accept the student ideas within the above stated guidelines.

Case Study

Sr. No.	Unit	Case Study	Description	Applicable CO
1	Unit-I	Apply rules of logic to explain Barber's paradox, The Lair's paradox	i. Discuss logical paradoxes like, Jourdain's card paradox, Barber's paradox, The Lair's paradox etc. by using rules of mathematical logic. Explain how these paradoxes are resolved ii. Describe the limitations of classical logic and how fuzzy logic is applied to practical applications	**CO1**
2	Unit-II	Demonstrate counting techniques to form telephone numbering plan.	**i.** Discuss ways in which telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers, for each numbering plan find how different telephone numbers can be formed.	**CO2**
3	Unit-III	Model a social network group as a connected graph and study simple properties of graphs	**i.** Investigate the properties of web graph, analyze web graphs by correlating the graph theoretic concepts with properties of web graph **ii.** Construct a social network graph, for example graph for Whats-App group	**CO3**

Sr. No.	Unit	Case Study	Description	Applicable CO
			of your friends. Study the properties of social network graph **iii.** Define and analyze AVL-tree, Quad-tree. Describe heaps, how heap can be built by using tree. Identify practical applications of these special trees	
4	Unit-IV	Demonstrate the correlation of the concept of relations with the relational database	**i.**Describe basic principles of relational databases. Find the correlation between relational databases and relations that you have studied. **ii.**Describe the importance of fuzzy relations in smart applications **iii.**Built input-output models by using function for simple machines.	**CO4**
5	Unit-V	Generate a public key cryptosystem with small primes*p, q* for a set of alphabets.	**i.**Apply the number theoretic concepts to generate public keys and private keys for public key cryptography **ii.** Find the day of the week for any given date by using congruence relation.	**CO5**
6	Unit-VI	Demonstrate the application of group properties in generating group codes.	**i.**Correlate the properties of binary operation with operator overloading. **ii.**Identify applications of encoding-decoding functions in satellite communication.	**CO6**

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Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214442:Logic Design & Computer Organization		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory(TH) :03hrs/week	**3**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any: Basics of electronics engineering

Companion Course, if any:

Course Objectives:

1. To make undergraduates, aware of different levels of abstraction of computer systems from hardware perspective.
2. To make undergraduates, understand the functions, characteristics of various components of Computer& in particular processor & memory.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Perform basic binary arithmetic & simplify logic expressions.

CO2: Grasp the operations of logic ICs and Implement combinational logic functions using ICs.

CO3: Comprehend the operations of basic memory cell types and Implement sequential logic functions using ICs.

CO4: Elucidate the functions & organization of various blocks of CPU.

CO5: Understand CPU instruction characteristics, enhancement features of CPU.

CO6: Describe an assortment of memory types (with their characteristics) used in computer systems and basic principle of interfacing input, output devices.

COURSE CONTENTS

Mapping of Course Outcomes for Unit I	**CO1**	
Unit 1	**Introduction To Digital Electronics**	**06 hrs**

Digital Logic families: Digital IC Characteristics; **TTL:** Standard TTL characteristics, Operation of TTL NAND gate; **CMOS:** Standard CMOS characteristics, operation of CMOS NAND gate; Comparison of TTL & CMOS.

Signed Binary number representation and Arithmetic: Sign Magnitude, 1's complement & 2's complement representation, unsigned Binary arithmetic (addition, subtraction, multiplication, and division), subtraction using 2's complement; IEEE Standard 754 Floating point number representations.

Codes: Binary , BCD, octal , hexadecimal , Excess-3 , Gray code & their conversions

Logic minimization: Representation of logic functions: logic statement, truth table, SOP form, POS form; Simplification of logical functions using K-Maps up to 4 variables.

Case Study:1) CMOS 4000 series ICs 2) practical applications of various codes in computers 3) four basic arithmetic operations using floating point numbers in a calculator.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit 2	**Combinational Logic Design**	**06 hrs**
Design using SSI chips: Code converters, Half- Adder, Full Adder, Half Subtractor, Full Subtractor, n bit Binary adder. **Introduction to MSI chips:** Multiplexer (IC 74153), Demultiplexer (IC 74138), Decoder (74238) Encoder (IC 74147), Binary adder (IC 7483) **Design using MSI chips:** BCD adder & subtractor using IC 7483, Implementation of logic functions using IC 74153 & 74138.		
Case Study : Use of combinational logic design in 7 segment display interface		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit 3	**Sequential Logic Design**	**06 hrs**
Introduction to sequential circuits: Difference between combinational circuits and sequential circuits; Memory element-latch & Flip-Flop**.** **Flip- Flops:** Logic diagram, truth table & excitation table of SR, JK, D, T flip flops; Conversion from one FF to another , Study of flip flops with regard to asynchronous and synchronous, Preset & Clear, Master Slave configuration ; Study of 7474, 7476 flip flop ICs. **Application of flip-flops**: Counters- asynchronous, synchronous and modulo n counters, study of 7490 modulus n counter ICs & their applications to implement mod counters; Registers- shift register types (SISO, SIPO, PISO &PIPO)& applications.		
Case Study : Use of sequential logic design in a simple traffic light controller		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit 4	**Computer Organization &Processor**	**06 hrs**
Computer organization & computer architecture, organization, functions & types of computer units- CPU(typical organization ,Functions , Types), Memory (Types & their uses in computer), IO(types & functions) & system bus(Address, data & control , Typical control lines, Multiple-Bus Hierarchies); Von Neumann & Harvard architecture; Instruction cycle **Processor:** Single bus organization of CPU; ALU(ALU signals, functions & types); Register (types & functions of user visible, control & status registers such as general purpose, address registers, data registers, flags, PC, MAR, MBR, IR)& control unit (control signals & typical organization of hard wired & microprogrammed CU). Micro Operations (fetch, indirect, execute, interrupt) and control signals for these micro operations.		
Case Study : 8086 processor , PCI bus		

<table>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
<tr><td>Unit 5</td><td>Processor Instructions &Processor Enhancements</td><td>06 hrs</td></tr>
<tr><td colspan="3">Instruction : elements of machine instruction ; instruction representation (Opcode& mnemonics, Assembly language elements) ; Instruction Format & 0-1-2-3 address formats, Types of operands
Addressing modes; Instruction types based on operations (functions & examples of each); key characteristics of RISC& CISC; Interrupt: its purpose, types , classes & interrupt handling (ISR , multiple interrupts), exceptions; instruction pipelining(operation & speed up)
Multiprocessor systems: Taxonomy of Parallel Processor Architectures, two types of MIMD clusters & SMP (organization & benefits) & multicore processor (various Alternatives & advantages 0f multicores), typical features of multicore intel core i7.</td></tr>
<tr><td colspan="3">Case Study : 8086 Assembly language programming</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO5</td></tr>
<tr><td>Unit 6</td><td>Memory &Input / Output Systems</td><td>06 hrs</td></tr>
<tr><td colspan="3">Memory Systems: Characteristics of Memory Systems, Memory Hierarchy, signals to connect memory to processor, memory read & write cycle, characteristics of semiconductor memory: SRAM, DRAM &ROM, Cache Memory – Principle of Locality, Organization, Mapping functions, write policies, Replacement policies, Multilevel Caches, Cache Coherence,
Input / Output Systems: I/O Module, Programmed I/O, Interrupt Driven I/O, Direct Memory Access (DMA).</td></tr>
<tr><td colspan="3">Case Study : USB flash drive</td></tr>
<tr><td>Mapping of Course Outcomes for Unit VI</td><td colspan="2">CO6</td></tr>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td colspan="3">1. “Modern Digital Electronics”, R.P. Jain, Tata McGraw-Hill, Third Edition
2. “Computer organization and architecture, designing for performance” by William Stallings , Prentice Hall ,Eighth edition</td></tr>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td colspan="3">1. “Digital Design”, M Morris Mano, Prentice Hall, Third Edition
2. “Computer organization” , Hamacher and Zaky, Fifth Edition
3. “Computer Organization and Design: The Hardware Software Interface” D. Patterson, J. Hennessy, Fourth Edition, Morgan Kaufmann
4. “ Microprocessors and interfacing-programming and hardware” Douglas V. Hall and SSSP Rao, McGraw-Hill ,Third Edition</td></tr>
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Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214443:Data Structure & Algorithms		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory(TH):03hrs/week	**03**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any: Fundamental knowledge of programming language and basics of algorithms

Companion Course, if any: Discrete Structures/Discrete Mathematics

Course Objectives:

1. To study data structures and their implementations and applications.
2. To learn different searching and sorting techniques.
3. To study some advanced data structures such as trees, graphs and tables.
4. To learn different file organizations.
5. To learn algorithm development and analysis of algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Perform basic analysis of algorithms with respect to time and space complexity.
CO2: Select appropriate searching and/or sorting techniques in the application development.
CO3: Implement abstract data type (ADT) and data structures for given application.
CO4: Design algorithms based on techniques like brute -force, divide and conquer, greedy, etc.
CO5: Apply implement learned algorithm design techniques and data structures to solve problems.
CO6: Design different hashing functions and use files organizations.

COURSE CONTENTS

Unit- I	**Introduction**	**07hrs**

Introduction to Data Structures: Concept of data, Data object, Data structure, Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures, Definition of ADT

Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm Big 'O', 'Ω' and 'Θ' notations,

Sequential Organization: Single and multidimensional array and address calculation.

Linked Organization: Concept of linked organization, Singly Linked List, Doubly Linked List, Circular Linked List (Operations: Create, Display, Search, Insert, Delete).

Case Study	**Set Operation, String Operation**
Mapping of Course Outcomes for Unit I	**CO1, CO3, CO5**

Unit- II	**Searching and Sorting**	**06 hrs**

Searching and sorting: Need of searching and sorting, Concept of internal and external sorting, sort stability, Searching methods: Linear and binary search algorithms, Fibonacci Series.

Sorting methods: Bubble, insertion, Quick, Merge, shell and comparison of all sorting methods.

Analyze Insertion sort, Quick Sort, binary search, hashing for Best, Worst and Average case.

<table>
<tr><td>Case Study</td><td colspan="2">Study and Analyze Selection sort, bucket sort,radix sort.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO1, CO2, CO4, CO5</td></tr>
<tr><td>Unit- III</td><td>Stack &Queue</td><td>06 hrs</td></tr>
<tr><td colspan="3">Stack: Concept of stack, Concept of implicit and explicit stack, stack as an ADT using sequential and linked organization, Applications of stack: recursion, converting expressions from infix to postfix or prefix form, evaluating postfix or prefix form.
Queue: Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, double ended queue, Applications of queue: priority queue.</td></tr>
<tr><td>Case Study</td><td colspan="2">Reversing a string, balanced parentheses in algebraic expressions, Towers of Hanoi problem, double ended queue as Stack and Queue.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO1, CO3, CO4,CO5</td></tr>
<tr><td>Unit- IV</td><td>Trees</td><td>06 hrs</td></tr>
<tr><td colspan="3">Tree : Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, , Binary search tree, Recursive and Non recursive algorithms for binary tree traversals ,Binary search tree as ADT(Insert Search Delete, level wise Display)
Threaded binary tree: Concept of threaded binary tree (inorder, preorder and postorder). Preorder and In-order traversals of in-order threaded binary tree, Applications of trees.</td></tr>
<tr><td>Case Study</td><td colspan="2">Construction of BST from pre and postorder traversal, Expression Tree construction</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO1, CO2, CO3, CO5</td></tr>
<tr><td>Unit- V</td><td>Graph and Symbol Table</td><td>07hrs</td></tr>
<tr><td colspan="3">Graph -Concept and terminologies, Graph as an ADT, Representation of graphs using adjacency matrix and adjacency list, Breadth First Search traversal, Depth First Search traversal, Prim’s and Kruskal’s algorithms for minimum spanning tree, Shortest path using Dijkstra's algorithm, topological sorting.
Symbol Table -Notion of Symbol Table, OBST, AVL Trees
Heap: Heap data structure, Min and Max Heap, Heap sort, applications of heap</td></tr>
<tr><td>Case Study</td><td colspan="2">Consider a network of computers connected to each other. The connection has various parameters associated with it as distance, propagation delay, bandwidth (capacity of carrying data), etc. Based on these parameters, decide which path should be chosen to send data from one computer to every other on the network.
In a system, jobs are submitted for execution at different times. If the system is idle, the job is taken for executed immediately. If there is a job in execution, the newly submitted job is added to a queue. The jobs are assigned a number, which indicates tells the priority of the jobs. The system must execute the high priority jobs first for execution. Implement the above said system using heap data structure.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO1, CO2, CO3, CO4, CO5</td></tr>
</table>

Unit- VI	Hashing and File Organization	06 hrs
Hashing: Hash tables and scattered tables: Basic concepts, hash function, characteristics of good hash function, Different key-to-address transformations techniques, synonyms or collisions, collision resolution techniques- linear probing, quadratic probing, rehashing, chaining with and without replacement. **File:**Concept of File, File types and file organization (sequential, index sequential and Direct Access), Comparison of different file organizations.		
Case Study	**What are the advantages of binary tree and binary search in file handling?** **Study Hashing techniques for expandable Files(Extendible, Dynamic and Linear Hashing)**	
Mapping of Course Outcomes for Unit VI	**CO1, CO3,CO5,CO6**	

Text Books:

1. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928
2. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.

Reference Books:

1. G. A.V, PAI , “Data Structures and Algorithms “, McGraw Hill, ISBN -13: 978-0-07-066726-6
2. A. Tharp ,"File Organization and Processing", 2008 ,Willey India edition, 9788126518685
3. M. Folk, B. Zoellick, G. Riccardi, "File Structure An Object Oriented Approach with C++", Pearson Education, 2002, ISBN 81 - 7808 - 131 - 8.
4. M. Welss, “Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0

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Savitribai Phule Pune University

Second Year Information Technology (2019 Course)

214444: Object-Oriented Programming

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 03hrs/Week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisites: Principles of Programming Languages

Course Objectives:

1. Apply concepts of object-oriented paradigm.
2. Design and implement models for real life problems by using object-oriented programming.
3. Develop object-oriented programming skills.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate various programming paradigms.

CO2: Identify classes, objects, methods, and handle object creation, initialization, and Destruction to model real-world problems.

CO3: Identify relationship among objects using inheritance and polymorphism principles.

CO4: Handle different types of exceptions and perform generic programming.

CO5: Use of files for persistent data storage for real world application.

CO6: Apply appropriate design patterns to provide object-oriented solutions.

COURSE CONTENTS

Unit I	**Foundations of Object Oriented Programming**	**06 hrs**
Introduction OOP : Software Evolution, Introduction to Procedural, Modular, Object-Oriented and Generic Programming Techniques, Limitations of Procedural Programming, Need of Object-Oriented Programming, Fundamentals of Object-Oriented Programming: Objects, Classes, Data Members, Methods, Messages, Data Encapsulation, Data Abstraction and Information Hiding, Inheritance, Polymorphism, Static and Dynamic Binding, Message Passing.		
Case Study	**Model a real world scenario (vehicle class, fruit class, student management in university etc.) using Object Oriented Paradigm**	
Mapping Course Outcomes for Unit 1	**CO1**	
Unit II	**Classes, Objects and Methods**	**06 hrs**
Class: Creating a Class, Visibility/Access Modifiers, Encapsulation, Methods: Adding a Method to Class, Returning a Value, Adding a Method That Takes Parameters, The 'this' Keyword, Method Overloading, Object Creation, Using Object as a Parameters, Returning Object, Array of Objects, Memory Allocation: 'new', Memory Recovery: 'delete', Static Data Members, Static Methods, Forward Declaration, Class as Abstract Data Types (ADTs), Classes as Objects.		
Case Study	**Represent a vector using class and include appropriate methods to perform various tasks.**	

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Constructors and Destructors**	**06 hrs**
Constructors: Introduction, Use of Constructor, Characteristics of Constructors, Types of Constructor, Constructor Overloading, Dynamic Initialization of an Object, Constructor with Default Arguments, Symbolic Constants, Garbage Collection: Destructors and Finalizes.		
Case Study	**A book shop inventory**	
Mapping of Course Outcomes for Unit III	**CO2**	
Unit IV	**Inheritance and Polymorphism**	**06 hrs**
Inheritance: Introduction, Need of Inheritance, Types of Inheritance, Benefits of Inheritance, Cost of Inheritance, Constructors in derived Classes, Method Overriding, Abstract Classes and Interfaces. Polymorphism and Software Reuse: Introduction, Types of Polymorphism (Compile Time and Run Time Polymorphism), Mechanisms for Software Reuse, Efficiency and Polymorphism		
Case Study	**A bank account system**	
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Exception Handling and Generic Programming**	**06 hrs**
Exception: Errors, Types of Errors, Exception and its Types, Exception-Handling Fundamentals, Uncaught Exception, Using try and Catch, Multiple Catch Clauses, Nested Try Statements, User Define Exception using Throw. **Generics:** What are Generics? Introduction to Language Specific Collection Interface: List Interface and Set Interface, Collection Classes: ArrayList Class and LinkedList Class.		
Case Study	**Exception handling and generic programming using array list (ArrayList class)**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit VI	**File Handling and Design Patterns**	**06 hrs**
File Handling: Introduction, Concepts of Stream, Stream Classes, Byte Stream Classes, Character Stream, Classes, Using Stream, and Other Useful I/O Classes, Using the File Class, Input/output Exceptions, Creation of Files, Reading/Writing Character, Reading/Writing Bytes, Handling Primitive Data Types, Concatenating and Buffering Files, Random Access Files. **Design Patterns:** Introduction, Types of Design Patterns, Adapter, Singleton, Iterator		
Case Study	**Student Management System**	
Mapping of Course Outcomes for Unit VI	**CO5 and CO6**	
Text Book:		
1. An Introduction to Object Oriented Programming (3rd Ed), by Timothy A. Budd, published by Addison-Wesley,2002		

2. E. Balaguruswamy, “Object Oriented Programming Using C++ and Java”, Tata McGraw Hill
Reference Books:
1. Object-Oriented Programming and Java by Danny Poo (Author), Derek Kiong (Author), Swarnalatha Ashok (Author)Springer; 2nd ed. 2008 edition (12 October 2007), ISBN-10: 1846289629, ISBN-13: 978-1846289620,2007 2. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd. 3. Object-Oriented Design Using Java, Dale Skrien, McGraw-Hill Publishing, 2008, ISBN - 0077423097, 9780077423094. 4. UML for Java Programmers by Robert C. Martin, Prentice Hall, ISBN 0131428489,2003.

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Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214445: Basics of Computer Network

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH):03hrs/week	03	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Basics of communication

Course Objectives:

1. To understand the fundamentals of communication system.
2. To understand the basics of internetworking.
3. To understand services and protocols used at Physical, Data Link, Network, Transport Layer.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Understand and explain the concepts of communication theory and compare functions of OSI and TCP/IP model.

CO2: Analyze data link layer services, error detection and correction, linear block codes, cyclic Codes, framing and flow control protocols.

CO3: Compare different access techniques, channelization and IEEE standards.

CO4: Apply the skills of subnetting, supernetting and routing mechanisms.

CO5: Differentiate IPv4 and IPv6.

CO6: Illustrate services and protocols used at transport layer.

COURSE CONTENTS

Unit I	Data Communication and Network Models	06 hrs

Introduction to communication Theory - Basics of data communication, Types of Signals, A/D, D/A, A/A, D/D Signal Conversion Methods, Bandwidth Utilization and Data Rate Limits, Multiplexing Techniques, Data rate limits, Topologies, Noise, types of noise, Shannon Hartley Theorem, Channel capacity, Nyquist and Shannon Theorem, Bandwidth S/N trade off.

Network Models And addressing - OSI Model TCP/IP Model (Data Format, Addressing Mechanisms, Devices)

Case Study	**Study of Physical layer components such as Cable, NIC, hub, etc. available in the computers /laboratories of your department**
Mapping of Course Outcomes for Unit I	CO1

Unit II	Error Detection, Correction and Data Link Control	06 hrs

Data Link Layer: Data Link Layer Services, Error Detection and Correction: Introduction, Error Detection and Error Correction. Linear Block Codes: hamming code, Hamming Distance, parity check code. Cyclic Codes: CRC (Polynomials), Advantages of Cyclic Codes, Other Cyclic Codes (Examples: CHECKSUM: One's Complement, Internet Checksum). Framing: fixed-size framing, variable size framing. Flow control: flow control protocols. Noiseless channels: simplest protocol, stop-and-wait protocol.

Noisy channels: stop-and-wait Automatic Repeat Request (ARQ), go-back-n ARQ, Selective repeat ARQ, piggybacking.

Case Study	**Draw PPPoE connection diagram with multiple devices, FFTH connection diagram**	
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Multi-Access Mechanism and Ethernet Standards**	**06 hrs**

Random Access Techniques: CSMA, CSMA/CD, CSMA/CA, Controlled Access Techniques: Reservation, Polling, Token Passing, Channelization: FDMA, TDMA, CDMA, Ethernet: IEEE Standards- 802.3, 802.4, 802.5, 802.6 Comparison of Ethernet Standards: Standard Ethernet, Fast Ethernet, Gigabit Ethernet with reference to MAC layer and Physical Layer (Wired Network Only)

Case Study	**Campus network design case study**	
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Network Layer: Services and Addressing**	**06 hrs**

Network Layer : Network Layer Services, IPv4 Addresses: Static and Dynamic Configuration Classful and Classless Addressing, Special Addresses, NAT, Subnetting, Supernetting, Delivery and Forwarding of IP Packet, Structure of Router, IPv4: Datagrams, Fragmentation, Options, Checksum, IPv6Addressing: Notations, Address Space, Packet Format, Transition from Ipv4 to IPv6

Case Study	**Visit server room of campus and understand how IP addressing is done for your respective Campus →Institute→Department**	
Mapping of Course Outcomes for Unit IV	**CO4, CO5**	
Unit V	**Network Layer : Routing Protocols**	**06 hrs**

Routing: Metric, Static vs Dynamic Routing Tables, Routing Protocol, Unicast Routing Protocols - Optimality Principle, Intra and Inter Domain Routing, Shortest Path Routing, Flooding, Distant Vector Routing, Link State Routing, Path Vector Routing Interior Gateway Routing Protocol- OSPF, EIGRP, RIP, Exterior Gateway Routing Protocol– BGP

Case Study	**Case study on network simulation tools such as Packet tracer**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit VI	**TRANSPORT LAYER - SERVICES AND PROTOCOLS**	**06 hrs**

Transport layer : Transport layer services(Duties), TCP: COTS, TCP header, Services, Segments, Connection Establishment, Flow control, Congestion Control, Congestion Control Algorithms, Leaky Bucket, Token Bucket and QoS, Timers, UDP: CLTS, UDP header, Datagram, Services, Applications, Socket: Primitives, TCP & UDP Sockets.

Case Study	**Case study on Client server model using simple socket programming,** **Case Study on Transport Layer Security - Firewall (Stateless Packet**

	Filtering), Stateful, Application
Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, McGraw Hill Education, ISBN: 978-0-07-070652-1, 4th Edition
2. Andrew S. Tanenbaum, David J. Wethrall, Computer Network, Pearson Education, ISBN: 978-0-13-212695-3

Reference Books:

1. Kurose Ross, Computer Networking: A Top Down Approach Featuring the Internet, Pearson Education, ISBN: 978-81-7758-878-1
2. Behrouz A. Forouzan, Data Communication and Networking, McGraw Hill Education, ISBN: 978-1-25-906475-3, 5th Edition
3. Mayank Dave, Computer Network, Cengage Learning, ISBN: 978-81-315-0986-9

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214446: Logic Design &Computer Organization Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 02hrs/week	01	PR : 25Marks TW : 25Marks

Prerequisites: Basic Electronics Engineering

Course Objectives :

1. To design & implement combinational and sequential circuits.
2. To learn simulation of digital systems.

Course Outcomes :

On completion of the course, students will be able to–

CO1: Use logic function representation for simplification with K-Maps and design Combinational logic circuits using SSI & MSI chips.

CO2: Design Sequential Logic circuits: MOD counters using synchronous counters.

CO3: Understand the basics of simulator tool & to simulate basic blocks such as ALU & memory.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/assistant. The instructor's manual should include prologue, university syllabus, conduction& Assessment guidelines, topics under consideration concept, objectives, outcomes, algorithms, sample test cases, data sheets of various elements of computer system, ICs, tools and references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by student in the form of journal. The Journal consists of Certificate, table of contents, and handwritten write-up of each assignment.(Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept, circuit diagram, pin configuration, conclusion/analysis, printouts of the output using coding standards, sample test cases etc.)
2. Practical Examination will be based on the term work.
3. The practical examination should be conducted if the teamwork is completed, submitted by the student and is duly assessed, certified by concerned faculty and head of the department.
4. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students; methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of necessary tools software and hardware such as ICs, digital

trainer kits, IC tester& simulation software, should be checked by the faculty member.

Guidelines for Laboratory Conduction

The instructor is expected to understand the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student‘s understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

Group A

Combinational Logic Design– CO1

1. Design and implement 4-bit BCD to Excess-3 code
2. Design and implement 1 digit BCD adder usingIC7483
3. Design and implement following using multiplexer IC 74153 1) full adder 2) Any three variable function (cascade method)
4. Design and implement full subtractor using decoder IC 74138

Group B

Sequential Logic Design– CO 2

1. Design and implement 3 bit Up and 3 bit Down Asynchronous Counters using master slave JK flip-flop IC 7476
2. Design and implement 3 bit Up and 3 bit Down Synchronous Counters using master slave JK flip-flop IC 7476
3. Design and implement Modulo ‘N’ counter using IC7490. (N= 100 max)

Group C

Computer organization– CO 3

Any **two** of following , using virtual lab simulator

1. Design& simulate single bit RAM cell **OR** 4 address*2bit memory using 8 single bit RAM cells.
2. Design& simulate single bit ALU with four functions(AND, OR, XOR, ADD).
3. Design& simulation of single instruction CPU.

Student should submit term work in the form of a journal based on the above assignments.

Note - Instructor should take care that datasheets of all the required ICs are available in the laboratory& students will be able to verify the functionality of ICs being used.
Reference Books:
1. R.P. Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, ISBN:0-07-049492-4. 2. Virtual Lab simulator Link **http://vlabs.iitkgp.ac.in/coa/**

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214447: Data Structure & Algorithms Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	02	PR : 25 Marks TW: 25 Marks

Prerequisite Courses, if any: Fundamental knowledge of programming language and basics of algorithms

Course Objectives:

1. To study data structures and their implementations and applications.
2. To learn different searching and sorting techniques.
3. To study some advanced data structures such as trees, graphs and tables.
4. To learn different file organizations.
5. To learn algorithm development and analysis of algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Analyze algorithms and to determine algorithm correctness and time efficiency class.

CO2: Implement abstract data type (ADT) and data structures for given application.

CO3: Design algorithms based on techniques like brute -force, divide and conquer, greedy, etc.).

CO4: Solve problems using algorithmic design techniques and data structures.

CO5: Analyze of algorithms with respect to time and space complexity.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references. Experiments to be conducted in C++.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by students in the form of journals. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.)
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.

5. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware such as compiler, debugger, coding standards, algorithm to be implemented etc. should be checked by the concerned faculty member(s).

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

All the assignments should be conducted on multicore hardware and 64-bit open-source software.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Assignments

Virtual Laboratory

- https://ds1-iiith.vlabs.ac.in/data-structures-1/
- https://ds2-iiith.vlabs.ac.in/data-structures-2/
- http://cse01-iiith.vlabs.ac.in/

1. Searching and Sorting -- CO1, CO2, CO3, CO5

Consider a student database of SEIT class (at least 15 records). Database contains different fields of every student like Roll No, Name and SGPA.(array of structure)

a) Design a roll call list, arrange list of students according to roll numbers in ascending order (Use Bubble Sort)
b) Arrange list of students alphabetically. (Use Insertion sort)
c) Arrange list of students to find out first ten toppers from a class. (Use Quick sort)
d) Search students according to SGPA. If more than one student having same SGPA, then print list of all students having same SGPA.
e) Search a particular student according to name using binary search without recursion. (all the

student records having the presence of search key should be displayed)

(Note: Implement either Bubble sort or Insertion Sort.)

2. Stack -- CO1, CO2, CO3, CO5

Implement stack as an abstract data type using singly linked list and use this ADT for conversion of infix expression to postfix, prefix and evaluation of postfix and prefix expression.

3. Circular Queue -- CO1, CO2, CO3, CO5

Implement Circular Queue using Array. Perform following operations on it.

a) Insertion (Enqueue)
b) Deletion (Dequeue)
c) Display

(Note: Handle queue full condition by considering a fixed size of a queue.)

4. Expression Tree -- CO1, CO2, CO3, CO5

Construct an Expression Tree from postfix and prefix expression. Perform recursive and non-recursive In-order, pre-order and post-order traversals.

5. Binary Search Tree -- CO1, CO2, CO3, CO5

Implement binary search tree and perform following operations:

a) Insert (Handle insertion of duplicate entry)
b) Delete
c) Search
d) Display tree (Traversal)
e) Display - Depth of tree
f) Display - Mirror image
g) Create a copy
h) Display all parent nodes with their child nodes
i) Display leaf nodes
j) Display tree level wise

(Note: Insertion, Deletion, Search and Traversal are compulsory, from rest of operations, perform Any three)

6. Threaded Binary Tree -- CO1, CO2, CO3, CO5

Implement In-order Threaded Binary Tree and traverse it in In-order and Pre-order.

7. Graph: Minimum Spanning Tree -- CO1, CO2, CO3, CO5

Represent a graph of your college campus using adjacency list /adjacency matrix. Nodes should represent the various departments/institutes and links should represent the distance between them. Find minimum spanning tree

a) Using Kruskal's algorithm.
b) Using Prim's algorithm.

8. Graph: Shortest Path Algorithm -- CO1, CO2, CO3, CO5

Represent a graph of city using adjacency matrix /adjacency list. Nodes should represent the various

landmarks and links should represent the distance between them. Find the shortest path using Dijkstra's algorithm from single source to all destination.
9. Heap Sort -- CO1, CO2, CO4
Implement Heap sort to sort given set of values using max or min heap.
10. FILE Handling -- CO1, CO3, CO5
Department maintains student's database. The file contains roll number, name, division and address. Write a program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular student. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.

Text Books :

1. Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach using C++", Cengage Learning, 5th Edition, ISBN 978-8131504925
2. Mark Allen Weiss, "Data structures and Algorithm Analysis in C++ ", Pearson Education India, 3 edition (2007), ISBN 978-8131714744
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++", University Press (2008), ISBN 978-8173716065

Reference Books

1. Hemant Jain, "Problem Solving in Data Structures & Algorithms using C++", CreateSpace Independent Publishing Platform (2017), ISBN 978-1542396479
2. G A V PAI, "DATA STRUCTURES and Algorithms Concepts, Techniques and Applications", McGraw Hill (2017), ISBN 978-0070667266
3. Michael T. Goodrich, Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++ ", Wiley (2007), ISBN 978-8126512607
4. E Balagurusamy, "Object-Oriented Programming with C++", McGraw Hill Education; Seventh edition (2017), ISBN 978-9352607990

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214448: Object Oriented Programming Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	02	PR: 25 Marks TW: 25 Marks

Prerequisites: Student should have knowledge of programming language.

Course Objectives:

1. Apply concepts of object-oriented paradigm.
2. Design and implement models for real life problems by using object-oriented programming.
3. Develop object-oriented programming skills.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate various programming paradigms.
CO2: Identify classes, objects, methods, and handle object creation, initialization, and destruction to model real-world problems.
CO3: Identify relationship among objects using inheritance and polymorphism.
CO4: Handle different types of exceptions and perform generic programming.
CO5: Use file handling for real world application.
CO6: Apply appropriate design patterns to provide object-oriented solutions.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc.), University syllabus, conduction & Assessment guidelines, topics under consideration concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by student in the form of journal.
2. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- OOP feature/Concept in brief, algorithm, flowchart, test cases, conclusion/analysis.
3. Program codes with sample output of all performed assignments are to be submitted as hardcopy.
4. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.
5. Use of DVD containing students programs maintained by lab In-charge is highly encouraged.
6. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

1. Continuous assessment of laboratory work is done based on overall performance and lab

assignments performance of student.
2. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments without changing its complexity level and distribute among batches of students. Encourage students for the use of industry coding standards such as appropriate use of Hungarian notation, Indentation and comments. Use of open source software is encouraged. Set of suggested assignment list is provided, instructors may take different case studies with similar complexity level. Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - JAVA IDE

List of Assignments

1.Classes and object -- CO1 and CO2

Design a class 'Complex 'with data members for real and imaginary part. Provide default and Parameterized constructors. Write a program to perform arithmetic operations of two complex numbers.

2. Polymorphism -- CO3

Identify commonalities and differences between Publication, Book and Magazine classes. Title, Price, Copies are common instance variables and saleCopy is common method. The differences are, Bookclass has author and orderCopies(). Magazine Class has methods orderQty, Current issue, receiveissue().Write a program to find how many copies of the given books are ordered and display total sale of publication.

3.Inheritance -- CO3

Design and develop inheritance for a given case study, identify objects and relationships and implement inheritance wherever applicable. Employee class hasEmp_name, Emp_id, Address, Mail_id, and Mobile_noas members. Inherit the classes: Programmer, Team Lead, Assistant Project Manager and Project Manager from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.

4.Dynamic Binding -- CO3

Design a base class shape with two double type values and member functions to input the data and compute_area() for calculating area of shape. Derive two classes: triangle and rectangle. Make compute_area() as abstract function and redefine this function in the derived class to suit their requirements. Write a program that accepts dimensions of triangle/rectangle and display calculated area. Implement dynamic binding for given case study.

5.Interface -- CO1, CO3

Design and develop a context for given case study and implement an interface for Vehicles Consider the example of vehicles like bicycle, car and bike. All Vehicles have common functionalities such as Gear Change, Speed up and apply breaks. Make an interface and put all these common functionalities. Bicycle, Bike, Car classes should be implemented for all these functionalities in their own class in their own way.

6.Exception handling -- CO4

Implement a program to handle Arithmetic exception, Array Index Out of Bounds. The user enters two numbers Num1 and Num2. The division of Num1 and Num2 is displayed. If Num1 and Num2 are not integers, the program would throw a Number Format Exception. If Num2 were zero, the program would throw an Arithmetic Exception. Display the exception.

7.Template -- CO4

Implement a generic program using any collection class to count the number of elements in a collection that have a specific property such as even numbers, odd number, prime number and palindromes.

8.File Handling -- CO5

Implement a program for maintaining a database of student records using Files.
Student has Student_id,name, Roll_no, Class, marks and address. Display the data for few students.

1. Create Database
2. Display Database
3. Delete Records
4. Update Record
5. Search Record

9.Case Study -- CO2, CO5

Using concepts of Object-Oriented programming develop solution for any one application
1) Banking system having following operations :

1. Create an account 2. Deposit money 3. Withdraw money 4. Honor daily withdrawal limit
5. Check the balance 6. Display Account information.

2) Inventory management system having following operations :
1. List of all products 2. Display individual product information 3. Purchase 4. Shipping
5. Balance stock6. Loss and Profit calculation.

10. Factory Design Pattern -- CO6

Implement Factory design pattern for the given context. Consider Car building process, which requires many steps from allocating accessories to final makeup. These steps should be written as methods and should be called while creating an instance of a specific car type. Hatchback, Sedan, SUV could be the subclasses of Car class. Car class and its subclasses, CarFactory and Test Factory Pattern should be implemented.

11. Strategy Design Pattern -- CO6

Implement and apply Strategy Design pattern for simple Shopping Cart where three payment strategies are used such as Credit Card, PayPal, Bit Coin. Create an interface for strategy pattern and give concrete implementation for payment.

Text Books:

1. E. Balagurusamy, “Programming with Java – A Primer”, Tata – McGraw-Hill Publication, 4th Edition, 2019
2. Kathy Sierra, “OCA /OCP Java SE 7 Programmer I & II Study Guide”(Exams 1Z0-803 & IZ-804) Oracle Press (2017)
3. Steven Holzner et al. “Java 2 Programming”, Black Book, Dreamtech Press, 2009

Reference Books:

1. H.M. Deitel, P.J. Deitel, “Java - How to Program”, PHI Publication, 6th Edition, 2005
2. Bruce Eckel, “Thinking in Java”, PHI Publication
3. Poo, Danny, Kiong, Derek, Ashok, Swarnalatha,“ Object-Oriented Programming and Java”, ISBN 978-1-84628-963-7
4. Erich Gamma,Richard Helm ,Ralph Johnson,JohnVlissides, “Design Patterns ,Elements of Reusable Object- Oriented Software” ISBN-13: 978-0201633610
5. RohitJoshi, “Java Design patterns, Reusable solutions to common problems” Java Code Geeks

Home

Savitribai Phule Pune University Second Year Information Technology (2019 Course) 214449: Soft Skill Lab		
Teaching Scheme:	**Credit Scheme :**	**Examination Scheme:**
Practical (PR) : 02 hrs/Week	**01**	**TW : 25 Marks**

Prerequisites , If any: ------

Course Objectives:

1. To facilitate a holistic development of students while focusing on enhancing soft skills.
2. To highlight the need to improve soft skills among engineering students so as to become good professionals.
3. To develop and nurture the soft skills of the students through individual and group activities.
4. To expose students to right attitudinal and behavioural aspects and assist in building the same through activities.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Introspect about individual's goals, aspirations by evaluating one's SWOC and think creatively.

CO2: Develop effective communication skills including Listening, Reading, Writing and Speaking.

CO3: Constructively participate in group discussion, meetings and prepare and deliver Presentations.

CO4: Write precise briefs or reports and technical documents.

CO5: Practice professional etiquette, present oneself confidently and successfully handle personal interviews .

CO6: Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

COURSE CONTENTS

Unit I	**Introspective & Self Development**	**04 hrs**
Introduction to soft skills, SWOC analysis, planning career, setting short-term & long-term goals, identifying difference between jobs & career, aligning aspirations with individual skills, understanding self-esteem, developing discipline and critically evaluating oneself		
Mapping of Course Outcomes for Unit I	**CO1, CO6**	
Unit II	**Communication Skills**	**04 hrs**
Essentiality of good communication skills, importance of feedback, different types of communication, barriers in communication and how to overcome these barriers, significance of non-verbal messages as augmentation to verbal communication, group discussion, listening vs hearing, reading to comprehend, learning to skim and scan to extract relevant information, effective digital communication		
Mapping of Course Outcomes for Unit II	**CO2, CO3, CO5**	

Unit III	**Language and Writing Skills**	**04 hrs**
Fundamentals of english grammar, improve lexical resource, essential steps to improve spoken and written english, business vocabulary, writing – email, resume, formal letter, official communication, essay, presentation – planning, organizing, preparing and delivering professional presentation		
Mapping of Course Outcomes for Unit III	**CO2, CO4**	
Unit IV	**Leadership Skills and Group Dynamics**	**04 hrs**
Understanding corporate culture and leadership skills, difference between a leader and a manager, importance of resilience in a professional surrounding, developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, creative and solution-centric thinking, resolving conflicts, working cohesively as a team to achieve success, five qualities of an effective team – positivity, respect for others, trust, goal-focused, supportiveness		
Mapping of Course Outcomes for Unit IV	**CO1, CO5, CO6**	
Unit V	**Ethics, Professional Etiquette**	**04 hrs**
Understanding ethics and morals, importance of professional ethics, hindrances due to absence of work ethics, professional etiquette – introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing		
Mapping of Course Outcomes for Unit V	**CO5, CO6**	
Unit VI	**Stress And Time Management**	**04 hrs**
Stress as integral part of life, identifying signs and sources of stress, steps to cope with stress – open communication, positive thinking, belief in oneself, ability to handle failure, retrospective thinking for future learning, organizing skills to enhance time management, focusing on goals, smart work vs hard work, prioritizing activities, perils of procrastination, daily evaluation of "to-do" list.		
Mapping of Course Outcomes for Unit VI	**CO1, CO3, CO6**	
Text Book :		
1. Gajendra Singh Chauhan, Sangeeta Sharma,"Soft Skills – An Integrated Approach to Maximize Personality", WILEY INDIA, ISBN:13:9788126556397		
Reference Books :		
1. Indrajit Bhattacharya, "An Approach to Communication Skills", Delhi, DhanpatRai, 2008 2. Simon Sweeney, "English for Business Communication", Cambridge University Press, ISBN 13:978-0521754507 3. Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press, ISBN 10:9780199457069 4. Atkinson and Hilgard, "Introduction to Psychology", 14th Edition, Geoffrey Loftus, ISBN-10:0155050699, 2003 5. Kenneth G. Mcgee, "Heads Up: How to Anticipate Business Surprises & Seize Opportunities		

First", Harvard Business School Press, Boston, Massachusetts, 2004, ISBN 10:1591392993
6. Krishnaswami, N. and Sriraman T., "Creative English for Communication" , Macmillan

Guidelines for Student's Lab Journal and TW Assessment

Each student should have a Lab Workbook (sample workbook attached) which outlines each lab activity conducted. The student must respond by writing out their learning outcomes and elaborating the activities performed in the lab. Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student. Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments.

Guidelines for Conduction of Soft Skills Lab

The teacher may design specific assignments that can highlight the learning outcomes of each unit. Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students. Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment. Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills. Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For e.g. – Team Building Activity can highlight 'open communication', 'group discussion', 'respecting perspectives', 'leadership skills', 'focus on goals' which can help students improve their inherent interpersonal skills.
At least one session should be dedicated to an interactive session that will be delivered by an expert from the industry; giving the students an exposure to professional expectations.

Virtual Laboratory

- https://ve-iitg.vlabs.ac.in/

Recommended List of Lab Sessions

1. Introduction of Self / SWOC Analysis -- CO1, CO4

a. Explain how to introduce oneself in a professional manner and presenting oneself positively Name, Academic Profile, Achievements, Career Aspirations, Personal Information (hobbies, family, social).
b. Focus on introspection and become aware of one's Strengths, Weakness, Opportunities and Challenges.

Students can write down their SWOC in a matrix and the teacher can discuss the gist personally.

2. Career Goals and Planning -- CO1, CO4

a. Make students understand the difference between a job and a career. Elaborate steps on how to plan a career.
Students can choose a career and they should write down what skills, knowledge, steps are need

to be successful in that particular career and how they can get the right opportunity.

b. Explain to students how to plan short term and long term goals.
Think and write down their short-term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written.

3. Public Speaking -- (Choose any 2) -- CO3, CO2

a. Prepared Speech
Topics will be shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&A from audience. Teacher will evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.

b. Extempore Speech
Various topics will be laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&A from audience. Teacher will evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively.

c. Reviewing an Editorial article
Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is.

d. Book Review
Each student will orally present to the audience his/her review of a book that he/she has recently read.

4. Group Discussion -- CO3, CO2

a. The class will be divided into groups of 8 – 10 students in for a discussion lasting 10 minutes.

b. Topics should be topical and non-controversial. After each group finishes its discussion, the teacher will give critical feedback including areas of improvement. The teacher should act as a moderator / observer only

5. Listening and Reading Skills -- CO2

a. Listening Worksheets to be distributed among students
Each student will be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students have to listen to the audio (only once) and complete the worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines)

b. Reading Comprehension Worksheets to be distributed/displayed to students
Teacher will choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance student's reading skills by learning how to skim and scan for information.

6. Writing Skills (Choose any 2) -- CO2

a. Letter / Email Writing
After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter,

i. Requesting opportunity to present his/her product.
ii. Complaining about a faulty product / service.

iii. Apologizing on behalf of one's team for the error that occurred. **iv.** Providing explanation for a false accusation by a client. **b.** Report Writing After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital/ paper-based) on any of the following topics, **i.** Industrial visit. **ii.** Project participated in. **iii.** Business / Research Proposal. **c.** Resume Writing The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes **i.** Share various professional formats. **ii.** Focus on highlighting individual strengths. **iii.** Develop personalized professional goals / statement at the beginning of the resume.
7. Team Building Activities -- CO3, CO4
The class will be divided into groups of 4-5 students in each group and an activity will be given to each group. The activities chosen for each team should be competitive and should involve every student in the team. The activities may be conducted indoors or outdoors depending on infrastructure. While selecting the team, ensure that each team has a mix of students who have varied skills. The teacher should give critical feedback including areas of improvement at the end of the activity.
8. Expert Lecture -- CO4
Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR may be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures.
9. Lateral and Creative Thinking -- CO1, CO4
Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities, **i.** Each group (3-4 students) can be given random unrelated items and they will be given sufficient time to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one. **ii.** Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end. **iii.** Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas.
10. Mock Interviews -- CO2, CO3
Student has to undergo interview session and the teacher should seek the assistance of another faculty member / TPO Officer/ Alumni to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Interviewer can choose to give problems to solve using technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills.

11. Presentation Skills -- CO2, CO3
Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be instructed about it.
12. Corporate and Business Etiquette -- CO4, CO1
The teacher can design an interactive session that allows students to be involved in understanding the requirements of a corporate environment. This can be done using innovative quiz competition in the classroom and the teacher explaining the concept / relevance of that particular aspect in the professional context. Alternatively, the teacher can invite professionals to have an interactive session with students about various aspects of professional etiquette.

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214450 (A): Mandatory Audit Course 3: Ethics and Values in Information Technology		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses, if any:--

Course Objectives:

1. To understand and implement the values and principles in the field of Information Technology.
2. To nurture honest and responsible professionals in Information Technology.
3. To develop student's understanding about social/ professional ethical issues related to Information Technology.
4. To inculcate professional ethics in the field of IT.

Course Outcomes:

On completion of this course students will be able to-

CO1: Adapt the global ethical principles and modern ethical issues.
CO2: Apprehend ethics in the business relationships and practices of IT.
CO3: Implement trustworthy computing to manage risk and security vulnerabilities.
CO4: Analyse concerns of privacy, privacy rights in information-gathering practices in IT.

COURSE CONTENTS

Unit -I	An Overview of Ethics	03hrs

An overview of Ethics: Brief about ethics, Ethics in the Business World, Ethics in IT.

Ethics for IT professionals and IT users: **IT professionals:** Changing Professional Services, Professional Relationships, Codes of Ethics, awareness of IT malpractices, **IT Users:** Common Ethical Issues for IT Users, Supporting the Ethical Practices of IT Users.

Mapping of Course Outcomes for Unit I	CO1 , CO2

Unit- II	Computer And Internet Crime	03hrs

Introduction: IT security incidents, Types of Exploits, Types of Perpetrators, Laws for Prosecuting Computer Attacks, Implementing Trustworthy Computing, Risk and Vulnerability Assessment, Educating Employees, Contractors, and Part-Time Workers, Establishing a Security Policy

Privacy: The right of Privacy, Privacy Protection and the Law, Key Privacy and Anonymity Issues Identity Theft, Consumer Profiling, Treating Consumer Data Responsibility, Workplace Monitoring

Freedom of Expression: Defamation and Hate Speech, Key issues, Controlling Access to Information on the Internet, Anonymity on the Internet, Corporate Blogging, Pornography

Mapping of Course Outcomes for Unit II	CO3, CO4

Unit- III	Social Networking &Ethics of IT Organization	03 hrs

Social Networking: Brief about Social Networking, **Social Networking Ethical Issues***:* Cyber bullying, Cyber stalking, Encounters with Sexual Predators, Uploading of Inappropriate Material,

Online Virtual Worlds: Crime in Virtual Worlds, Educational and Business Uses of Virtual Worlds.

Ethics of IT Organization: Key Ethical Issues for Organizations, of Workers, Outsourcing, Whistle-blowing, Code of Ethics and Professional Conduct.

Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**

Unit - IV	Case Study	03hrs

Malware, Medical Implants, Abusive Workplace Behaviour, Automated Active Response Weaponry, Malicious Inputs to Content Filters.

Mapping of Course Outcomes for Unit IV	**CO1, CO2, CO3, CO4**

Text Books:

1. George Reynolds,"Ethics in Information Technology", Cengage learning, 5th Edition
2. R. Subramanian, "Professional Ethics", OXFORD University Press, Second Edition

Reference Books:

1. William Lillie,"An Introduction to Ethics", Allied Publishers
2. Charles b. Fleddermann, "Engineering Ethics", Prentice Hall
3. M.Govindarajan,S.Natarajan&V.S.Senthilkumar, "Engineering Ethics &Human Values", PHI Learning
4. "ACM Code of Ethics and Professional Conduct Case Studies" **https://www.acm.org/code-of-ethics/case-studies**
5. "Case Studies of Ethics", **https://flylib.com/books/en/4.269.1.115/1/**
6. "UNODC Case Studies" **https://www.unodc.org/e4j/en/integrity-ethics/module-12/exercises/case-studies.html**

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214450 (B) : Mandatory Audit Course3:
Quantitative Aptitude & Logical Reasoning

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any:--

Course Objectives:

1. To develop the quantitative, logical and verbal abilities.
2. To enable learners to interpret the data accurately.
3. To build logical thinking ability among the learners.
4. To enable students to comprehend the English text.

Course Outcomes:

On completion of the course, learner will be able to ---

CO1: Apply basic concepts of quantitative abilities

CO2: Use logical reasoning for solving real world problems

CO3: Compete in examinations like internships, industry placements, postgraduate admissions, civil services etc.

COURSE CONTENTS

Unit I	Fundamental Quantitative Abilities	03 hrs
Concepts and Problems on Number System, HCF and LCM, Average, Ratio and Proportion, Percentage, Year month days counting, SI units and measurements		
Mapping of Course Outcomes for Unit I	**CO1, CO2, CO3**	
Unit II	**Arithmetic Quantitative Abilities**	**02 hrs**
Concepts and Problems on Ages, Profit and loss, Simple and Compound interest, Time value of money, Time and distance, Time and Work, Geometry and Coordinate Geometry, logarithms		
Mapping of Course Outcomes for Unit II	**CO1, CO2, CO3**	
Unit III	**Logical Reasoning Ability**	**02 hrs**
Number Series, Pattern recognition, Alpha Numerical, Letter & Symbol Series , Numerical and Alphabet Puzzles, Seating Arrangement		
Mapping of Course Outcomes for Unit III	**CO2,CO3**	
Unit IV	**Thinking and Reasoning**	**02 hrs**
Objective Reasoning, Graph and Plots, Data sufficiency, Blood Relation, Coding deductive logic, Logical word sequence		

Mapping of Course Outcomes for Unit IV	**CO2, CO3**	
Unit V	**Verbal Ability**	**03 hrs**
Synonyms, Antonyms, Contextual Vocabulary, Error Identification, Sentence Correction, Sentence Improvement, Subject-Verb agreement, Tenses and Articles, Reading Comprehension, Preposition & Conjunction		
Mapping of Course Outcomes for Unit V	**CO1, CO2, CO3**	

Text Books:

1. Quantitative abilities by Arun Sharma, Motilal Uk Books Of India, 2012
2. Quantitative Aptitude for Competitive Examinations by R S Agrawal
3. Verbal and Non-Verbal reasoning by R S Agrawal

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214450 (C) : Mandatory Audit Course 3:

Language Study Japanese -Module I

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: Audit Course 4: Language Study Japanese: Module-II

Course Objectives:

1. To teach pronunciation and intonation of Japanese sounds.
2. To enable students to comprehend and speak simple sentences in Japanese.
3. To introduce Japanese language at the basic level, to enable students to read and write the phonetic scripts, *Hiragana* and *Katakana,* and approx.100 *Kanji.,*
4. To teach some aspects of Japanese society and culture.

Course Outcomes:

On completion of the course, learner will be able to --

CO1: Converse with simple sentences in Japanese.
CO2: Recognize and read simple sentences in Japanese.
CO3: Write simple sentences in Japanese.
CO4: Be aware about Japanese society and people.

COURSE CONTENTS

Unit I	Japanese Oral Expression	(02 hrs + 04 hrs Self Study)

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self-introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes

Mapping of Course Outcomes for Unit I	CO1

Unit II	Japanese Kana and Kanji	(02 hrs + 04 hrs Self Study)

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji* (100-120), word-building, writing foreign names and loan words in Katakana

Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	Japanese Greetings	(02 hrs + 04 hrs Self Study)

Basic sentence patterns to be applied in self-introduction, identifying things; time of the day; calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities; kinship terms used for address and reference; seasons; giving and receiving; shopping; making requests; talking of one's likes and dislikes

Mapping of Course Outcomes for Unit III	**CO1**	
Unit IV	**Japanese Comprehension**	**(02 hrs+ 04 hrs Self Study)**
Extensive practice of basic patterns at the elementary level through drills and exercises		
Mapping of Course Outcomes for Unit IV	**CO1, CO2**	
Unit V	**Speaking Japanese**	**(02 hrs + 4 hrs Self Study)**
Simple conversation in situations such as describing things, making comparisons, talking of daily activities, giving and receiving of gifts, talking of illnesses and visit to a doctor, shopping, making requests, talking of one's likes and dislikes, talking on telephone etc.		
Mapping of Course Outcomes for Unit V	**CO1**	
Unit VI	**Social Environment of Japan**	**(02 hrs + 4 hrs Self Study)**
An introduction to some aspects of Japanese culture such as festivals, Japanese seasons, Japanese people and their love for nature; Japanese food, sports; society; geography; education system; Japan and the world etc. The objective is to create general awareness in students about life in Japan.		
Mapping of Course Outcomes for Unit VI	**CO4**	

E-Resources for Learning Support:

a. **https://www.duolingo.com/course/ja/en/Learn-Japanese**
b. **https://www.freejapaneselessons.com/**
c. **https://minato-jf.jp/ (Japan Foundation)**

Text Books:

1. Taeko Kamiya, Japanese For Fun Phrasebook & Dictionary: The Easy Way to Learn Japanese Quickly, Rev Edition 2017 Tuttle Publishing, (ISBN 10- 4805313986, ISBN 13 -9784805313985)
2. Eri Banno, Genki I: An Integrated Course in Elementary Japanese , 3rd Edition 2020, The Japan Times, (ISBN13: 9784789017305)
3. Sushama Jain, Japan : The Living Culture, Har-anand Publications, 2009, (ISBN 10: 8124114870 / ISBN 13: 9788124114872)

Reference Books:

1. Kanji Power Handbook for the Japanese Language Proficiency Test, 1994, ARC Press (ISBN: 9784872343144)
2. Yukiko Ogata, Kana Sumitani, Yasuko Hidari, Yukiko Watanabe, Nihongo fun and Easy -I Survival Japanese Conversation for Beginners,
3. Eriko Sato, Japanese Demystified: A Self-Teaching Guide, 2008, McGraw-Hill Companies, McGraw-Hill Demystified Series (ISBN 10-0071477268, ISBN 13-9780071477260)

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) 214450 (D) : Mandatory Audit Course 3: Cyber Security and Law		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses, if any: Basics of Computer

Course Objectives:

1. Understand basics of computer and cyber security.
2. To study the information technology law.
3. To understand reasons for cybercrime.
4. To learn investigation techniques.

Course Outcomes:

On completion of the course, learner will be able to --

CO1: Understand the basic concepts of cyber security and its abilities

CO2: Analyse and evaluate the cyber security needs of an organization.

CO3: Understand the importance of cyber laws and its practices.

CO4: Determine and analyse software vulnerabilities and security solutions to reduce the risk of exploitation

COURSE CONTENTS

Unit I	Basics of Cyber Security	04 hrs

Information Security Definition and Concepts, Overview of Security Threats , Goals of Security, , Limitations and Challenges in cyber security , Types of Security attacks, Network Security, Malicious Codes, Intrusion detection systems, Hacking Techniques, Password cracking , Insecure Network Connections ,Concept of Firewall and Security.

Mapping of Course Outcomes for Unit I	**CO1, CO2**

Unit II	Cyber Laws	04 hrs

Introduction, Definition and origin, Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective- IT Act 2000, Global perspective, Categories of Cybercrime, Reasonable Security Practices

Mapping of Course Outcomes for Unit II	**CO2, CO3, CO4**

Unit III	Cyber Crime	04 hrs

Definition of Cyber Crime & Computer related Crimes, Classification &Differentiation between traditional crime and cybercrimes, Data Theft, Hacking, Spreading Virus &Worms, Phishing, Cyber Stalking/ Bullying, Identity Theft &Impersonation, Credit card & Online Banking Frauds , Denial of Service Attacks , Cyber terrorism etc.. , Search and Seizure Procedures of Digital Evidence- Data

Acquisition ,Data Analysis, Reporting, Cybercrime Scenario in India	
Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**

Text Books:

1. William Stallings, "Computer Security: Principles and Practices", Pearson 6th Ed, ISBN: 978-0-13-335469-0
2. Nina Godbole, Sunit Belapure, "Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, ISBN- 978-81-265-2179-1
3. Nina Godbole , "Information Systems Security" , Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6
4. Mark Merkow, "Information Security-Principles and Practices", Pearson Ed., ISBN- 978-81-317-1288-7
5. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, ISBN-978-81-315-1349-1
6. "The Information Technology Act, 2000; Bare Act" – Professional Book Publishers

Evaluation :

Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

SEMESTER – IV

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

207003: Engineering Mathematics III

Teaching Scheme:	Credit Scheme:	Examination Scheme:	
Theory (TH) : 03 hrs/week Tutorial (TUT) :01 hrs/ week	03 01	Mid_Semester: End_Semester: TW :	30 Marks 70 Marks 25 Marks

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification and Representation of data.

Course Objectives:

1. To make the students familiarize with concepts and techniques in Linear differential equations, Fourier transform& Z-transform, Statistical methods, Probability theory and Numerical methods.2. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes:

On completion of this course student will be able to –

CO1: Solve Linear differential equations, essential in modelling and design of computer-based systems.

CO2: Apply concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.

CO3: Apply Statistical methods like correlation& regression analysis and probability theory for data analysis and predictions in machine learning.

CO4: Solve Algebraic &Transcendental equations and System of linear equations using numerical techniques.

CO5: Obtain Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

COURSE CONTENTS

Unit I	Linear Differential Equations	06 hrs

LDE of n^{th} order with constant coefficients, Complementary function, Particular integral, General method, Short methods, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE.

Unit II	Transforms	06 hrs

Fourier Transform (FT)**:** Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses, Discrete Fourier Transform.

Z –Transform(ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	06 hrs

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves,

Correlation and Regression, Reliability of Regression Estimates.		
Unit IV	**Probability and Probability Distributions**	**06 hrs**
Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hyper geometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.		
Unit V	**Numerical Methods**	**06 hrs**
Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability. Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.		
Unit VI	**Numerical Methods**	**06hrs**
Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods		
Text Books:		
1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi		
Reference Books:		
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10ed, Wiley India 2. M. D. Greenberg, "Advanced Engineering Mathematics", 2edPearson Education 3. Peter V. O'Neil , "Advanced Engineering Mathematics", 7ed,Cengage Learning 4. S. L. Ross , "Differential Equations", 3e, Wiley India 5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press 6. M. K. Jain, S. R. K. Iyengar And R. K. Jain1, "Numerical Methods for Scientific and Engineering Computation", 5e,New Age International Publication		
Guidelines for Tutorial and Term Work:		
i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division. ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.		

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<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214451: Processor Architecture</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH): 03hrs/week</td><td>03</td><td>Mid_Semester: 30 Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="3">Prerequisites: Logic Design & Computer Organization</td></tr>
<tr><td colspan="3">Course Objectives :
1. To study architectural details of PIC 18 microcontroller.
2. To study applications of PIC through various interfacing devices.</td></tr>
<tr><td colspan="3">Course Outcomes :
On completion of this course student will be able to –
CO1: Apprehend architecture and memory organization of PIC 18 microcontroller.
CO2: Implement embedded C programming for PIC 18.
CO3: Use concepts of timers and interrupts of PIC 18.
CO4: Demonstrate real life applications using PIC 18.
CO5: Analyze architectural details of ARM processor.</td></tr>
<tr><td colspan="3" align="center">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>PIC Microcontroller Architecture</td><td>06 hrs</td></tr>
<tr><td colspan="3">Introduction: introduction to microcontroller, Brief history of microcontrollers, Difference between microprocessor and microcontroller, Criteria for selection of microcontroller,
PIC18FXXX: Features and architecture, comparison of PIC 18 series microcontrollers; PIC18F458/452 Pin out connection, Registers of PIC18F,
Program and data memory organization: The Program Counter and Programmable ROM space in the PIC, File register and Access bank, Bank switching in PIC18;
Addressing modes: Addressing modes with instruction example, Oscillator configurations, Reset operations, Brownout reset, Watchdog timer, Power down modes & Configuration registers.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1,CO2</td></tr>
<tr><td>Unit II</td><td>PIC I/O Ports and Timer</td><td>06 hrs</td></tr>
<tr><td colspan="3">I/O Port: I/O Port structure with programming: I/O Port structure, I/O Port programming, I/O Bit manipulation Programming.
Timer/Counter: Registers used for Timer/Counter operation, Delay calculations, Programming of Timers using Embedded C.</td></tr>
<tr><td>Case Study</td><td colspan="2">Traffic light signal controller using Timer/Counter</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2, CO3</td></tr>
<tr><td>Unit III</td><td>PIC Interrupts & Interfacing-I</td><td>06 hrs</td></tr>
</table>

PIC Interrupts: Interrupt Vs Polling, IVT, Steps in executing interrupt, Sources of interrupts; Enabling and disabling interrupts, Interrupt registers, Priority of interrupts, Programming of: Timer using interrupts, External hardware interrupts, Serial communication interrupt; Interfacing of LED, Interfacing 16X2 LCD (8 bits) and Key board (4 x 4 Matrix), Interfacing Relay & Buzzer.		
Mapping of Course Outcomes for Unit III	**CO2, CO3, CO4**	
Unit IV	**PIC Interfacing-II**	**06 hrs**
CCP modes: Capture, Compare and PWM generation; DC Motor speed control with CCP, Stepper motor interfacing with PIC, **Basics of Serial communication protocols:** Study of RS232, I2C, SPI, UART, Serial communication programming using Embedded C.		
Mapping of Course Outcomes for Unit IV	**CO2, CO4**	
Unit V	**PIC Interfacing-III**	**06 hrs**
Interfacing : Interfacing of ADC and DAC 0808 with PIC, Temperature sensor interfacing using ADC and I2C with PIC, Interfacing of RTC (DS1306) using I2C with PIC, Interfacing of EEPROM using SPI with PIC,		
Case Study	**Home protection system, All programs in Embedded C**	
Mapping of Course Outcomes for Unit V	**CO2, CO4**	
Unit VI	**Current Trends in Processor Architecture**	**06 hrs**
ARM & RISC :ARM and RISC design philosophy, Introduction to ARM processor & its versions ARM 7, ARM 9, ARM 11, Features& advantages of ARM processor, Suitability of ARM processor in embedded applications, ARM 7 dataflow model, Programmers model. CPSR & SPSR registers, Modes of operation, Difference between PIC and ARM.		
Mapping of for Unit VI	**CO5**	
Text Books:		
1. Muhammad Ali Mazidi , Danny Causey, RolinMcKinlay, “PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18”, 4th Edition by,Pearson international edition 2. Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan, “ARM System Developer’s Guide Designing and Optimizing System Software”, Kaufmann Publishers		
Reference Books:		
1. Peatman, John B, “Design with PIC Microcontroller”, Pearson Education PTE 2. Ramesh Gaonkar, “Fundamentals of Microcontrollers and Applications In Embedded Systems(with the PIC18 Microcontroller Family)”Thomson/Delmar Learning; 1 edition (January 8, 2007), ISBN:978-1401879143 3. Microchip’s PIC18FXXX Data Sheet 4. Muhammad Ali Mazidi, SarmadNaimi,“ARM Assembly Language Programming & Architecture”		

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<table>
<tr><td colspan="4">Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214452: Database Management System</td></tr>
<tr><td>Teaching Scheme:</td><td colspan="2">Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH):03hrs/week</td><td colspan="2">03</td><td>Mid_Semester: 30 Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="4">Prerequisite Courses, if any: Discrete Mathematics</td></tr>
<tr><td colspan="4">Course Objectives:
1. The objective of the course is to present an introduction to database management system as a subject in its own right.
2. To understand the fundamental concepts of Relational Database management system.
3. To present SQL and procedural interfaces to SQL comprehensively.
4. To provide a strong formal foundation in Relational Database Concepts, database concepts, technology and practice &to introduce the concepts of Query Processing.
5. To introduce the concepts of Transaction Processing and to present the issues and techniques relating to concurrency and recovery in multi-user database environments.
6. To introduce the recent trends in database technology.</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of this course student will be able to --
CO1: Apply fundamental elements of database management systems.
CO2: Design ER-models to represent simple database application scenarios.
CO3: Formulate SQL queries on data for relational databases.
CO4: Improve the database design by normalization & to incorporate query processing.
CO5: Apply ACID properties for transaction management and concurrency control.
CO6: Analyze various database architectures and technologies.</td></tr>
<tr><td colspan="4">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td colspan="2">Introduction to DBMS</td><td>06 hrs</td></tr>
<tr><td colspan="4">Introduction : Basic concepts, Advantages of DBMS over file processing systems, Data abstraction, Database languages, Data models, Data independence, Components of a DBMS, Overall structure of DBMS, Multi-user DBMS architecture, System catalogs, Data Modeling: Basic concepts, Entity, attributes, relationships, constraints, keys.</td></tr>
<tr><td>Case Study</td><td colspan="3">MySQL Database</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="3">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">Relational Model</td><td>06 hrs</td></tr>
<tr><td colspan="4">ER and EER diagrams: Components of ER model, Conventions, Converting ER diagrams into tables Relational Model: Basic concepts, Attributes and Domains, Codd's rules.</td></tr>
</table>

Relational Integrity: Nulls, Entity, Referential integrities, Enterprise constraints, Views, Schema diagram		
Case Study	**Student / Timetable / Reservation / any data Management System**	
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Introduction to SQL - PL/SQL**	**06 hrs**
Introduction to SQL: Characteristics and advantages SQL Data Types, Literals, DDL, DML, SQL Operators Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updation using Views, Indexes, Nulls. **SQL DML Queries**: SELECT query and clauses, Set operations, Tuple Variables, Set comparison, Ordering of Tuples , Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update, Delete Queries, Stored Procedure, Triggers, Programmatic **SQL** : Embedded SQL, Dynamic SQL, ODBC		
Case Study	**Employee database system**	
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Database Design & Query Processing**	**06 hrs**
Relational Databases Design: Purpose of Normalization, Data Redundancy and Update Anomalies, Functional Dependencies. The process of Normalization: 1NF, 2NF, 3NF, BCNF. Introduction to **Query Processing:** Overview, Measures of Query cost, Selection and Join operations, Evaluation of Expressions **Introduction to Query optimization:** Estimation, Transformation of Relational Expression		
Case Study	**Employee Database design**	
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Transaction & Concurrency Control**	**06 hrs**
Transaction Management: Basic concept of a Transaction, Properties of Transactions, Database Architecture, Concept of Schedule, Serial Schedule. **Serializability:** Conflict and View, Cascaded aborts Recoverable and Non-recoverable Schedules. **Concurrency Control:** Need Locking methods Dead locks, Time stamping Methods. Optimistic Techniques, Multi-version Concurrency Control. **Different crash recovery methods:** Shadow-Paging, Log-based Recovery: Deferred and Immediate, Check Points		
Case Study	**Banking Transaction**	
Mapping of Course Outcomes for Unit V	**CO5**	

Unit VI	Advanced Databases	06 hrs
Database Architectures: Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Introduction to Parallel Databases, Key elements of Parallel Database Processing, Architecture of Parallel Databases, Introduction to Distributed Databases, Architecture of Distributed Databases, Distributed Database Design. **Emerging Database Technologies:** Introduction, No SQL Databases- Internet Databases, Cloud databases, Mobile Databases, SQLite database, XML databases		
Case Study	**RealmDB, ORMLite, Couchbase Lite**	
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Silberschatz A., Korth H., Sudarshan S. "Database System Concepts", 6th edition, Tata McGraw Hill Publishers
2. G. K. Gupta "Database Management Systems" , Tata McGraw Hill

Reference Books:

1. Rab P., Coronel C. "Database Systems Design, Implementation and Management", 5th edition, Thomson Course Technology, 2002
2. Elmasri R., Navathe S. " Fundamentals of Database Systems", 4th edition, Pearson Education, 2003
3. Date C. " An Introduction to Database Systems", 7th edition, Pearson Education, 2002
4. Ramkrishna R., Gehrke J. " Database Management Systems", 3rd edition, McGraw Hill

Web Resources:

https://nptel.ac.in/courses/106/105/106105175/

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019 Course) **214453: Computer Graphics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 03 hrs/week	**03**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any: Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms

Course Objectives:

1. Understand the foundations of computer graphics: hardware systems, math basis, light and color.
2. Understand the complexities of modeling realistic objects through modeling complex scenes using a high-level scene description language.
3. Become acquainted with some advanced topics in computer graphics. The student should gain an expanded vocabulary for discussing issues relevant to computer graphics (including both the underlying mathematics and the actual programming).
4. The student should gain an appreciation and understanding of the hardware and software utilized in constructing computer graphics applications.
5. The student should gain a comprehension of windows, clipping and view-ports in relation to images displayed on screen.
6. The student should gain an understanding of geometric, mathematical and algorithmic concepts necessary for programming computer graphics.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Apply mathematical and logical aspects for developing elementary graphics operations like scan conversion of points, lines, circle, and apply it for problem solving.

CO2: Employ techniques of geometrical transforms to produce, position and manipulate Objects in 2 dimensional and 3-dimensional space respectively.

CO3: Describe mapping from a world coordinates to device coordinates, clipping, and projections in order to produce 3D images on 2D output device.

CO4: Apply concepts of rendering, shading, animation, curves and fractals using computer graphics tools in design, development and testing of 2D, 3D modeling applications.

CO5: Perceive the concepts of virtual reality.

COURSE CONTENTS

Unit – I	Computer Graphics Basic, OpenGL and Line, Circle Drawing	06 hrs

Introduction CG :Introduction to computer graphics, basics of graphics systems, raster and random scan, basic display processor

OpenGL – Introduction – Graphics function, OpenGL Interface, primitives and attributes, Control functions, programming events.

Line Drawing: DDA Line drawing algorithm, Bresenham Line drawing algorithm **Circle Drawing:** Bresenham circle drawing algorithm. **Character Generation:** Stroke principle, starburst principle, bitmap method. Introduction to aliasing and anti-aliasing.		
Case Study	**Computer-generated imagery (CGI)**	
Mapping of Course Outcomes for Unit I	**CO1**	
Unit – II	**Polygons, 2D Transformations**	**06 hrs**
Polygons: Polygons and its types, inside test, Polygon filling methods: Seed Fill – Flood fill and Boundary Fill, Scan-line Fill algorithms, **2D Transformations:** Translation, Scaling, Rotation, Reflection and Shearing, Matrix representation and homogeneous coordinate system, composite transformations.		
Case Study	**Transformation of an Object in Computer Graphics: Mathematical Matrix Theory**	
Mapping of Course Outcomes for Unit II	**CO2**	
Unit – III	**Windowing, Clipping,3D Transformation, Projections**	**06 hrs**
Windowing: Concept of window and viewport, viewing transformations **Line Clipping:** Cohen Sutherland method of line clipping **Polygon Clipping:** Sutherland Hodgeman method for convex and concave polygon clipping. **3D Transformation:** Translation, scaling, rotation about X, Y, Z & arbitrary axis, and reflection about XY, YZ, XZ & arbitrary plane. **Projections:** Types of projections- Parallel, Perspective **Parallel:** oblique – Cavalier, Cabinet, Orthographic – isometric, diametric, trimetric **Perspective:** vanishing points as 1 point, 2 point and 3 point.		
Case Study	**3D Rendering and Modeling**	
Mapping of Course Outcomes for Unit III	**CO2 & CO3**	
Unit – IV	**Segments, Illumination models, colour models and shading**	**06 hrs**
Segments: Introduction, Segment table, segment creation, closing, deleting, renaming, and visibility. **Illumination models**: Light sources, ambient light, diffuse light, specular reflection, the Phong model, combined diffuse and specular reflections with multiple light sources. **Color Models:** CIE Chromaticity Diagram, Color Gamut, RGB, CMY, YCbCr,HSVcolor models. **Shading Algorithms:** Constant intensity shading, Halftone, Gourand and Phong Shading.		
Case Study	**Best practices in Day lighting& Passive Systems for Smaller Commercial Buildings**	
Mapping of Course Outcomes for Unit IV	**CO4**	

Unit – V	Curves, fractals and Animation	06 hrs
Curves: Introduction, interpolation and approximation, Spline Interpolation Methods – hermite interpolation, Bezier curves, B-Splines. **Fractals:** Introduction, Classification, fractal Dimension, Fractal dimension and surfaces, Hilbert curve, Koch Curve. **Animation:** Basics of animation, types of animation, principles of animation, design of animation sequences, animation languages, key frame, morphing, motion specification. Methods of controlling animation, frame-by-frame animation techniques, real-time animation techniques.		
Case Study	**3D Animation services for character expressions.**	
Mapping of Course Outcomes for Unit V	**CO4**	
Unit – VI	**Virtual Reality**	**06 hrs**
Introduction of Virtual Reality: Fundamental Concept, Three I's of virtual reality and Classic Components of VR systems, Applications of VR systems. **Multiple Modals of Input and Output Interface in Virtual Reality:** Input – 3D position Trackers and its types, Navigation and Manipulation Interfaces, Gesture Interfaces, Graphics Displays – HMD and CAVE, Sound Displays, Haptic Feedback **Rendering Pipeline:** Graphics rendering Pipeline, Haptics Rendering Pipeline Modeling in Virtual Reality: Concepts of Geometric Modeling, Kinematic Modeling, Physical modeling and Behavior modeling.		
Case Study	**Virtual reality in aviation and Space travel Training**	
Mapping of Course Outcomes for Unit VI	**CO5**	

Test Books

1. D. Hearn, M. Baker, "Computer Graphics – C Version", 2nd Edition, Pearson Education, 2002, ISBN81 – 7808 – 794 – 4
2. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 –100472 – 6
3. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", second edition, Wiley India Edition, ISBN 81-265-0789-6

Reference books

1. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-HillPublication, 2001, ISBN 0 – 07 – 047371 – 4.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
3. Foley, "Computer Graphics: Principles & Practice in C", 2e, ISBN 9788131705056, Pearson Edu.
4. F.S. Hill JR, "Computer Graphics Using Open GL", Pearson Education

Home

<table>
<tr><td colspan="4" align="center">Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214454: Software Engineering</td></tr>
<tr><td>Teaching Scheme:</td><td colspan="2" align="center">Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH) : 03 hrs/week</td><td colspan="2" align="center">03</td><td>Mid_Semester: 30 Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="4">Prerequisite Courses, if any: Fundamentals of Programming Languages</td></tr>
<tr><td colspan="4">Course Objectives:
1. To learn the principles of Software Engineering.
2. To learn and understand methods of capturing, specifying, visualizing and analyzing software requirements.
3. To know design principles to software project development.
4. To learn basics of IT project management.
5. To understand software quality attributes and testing principles.
6. To introduce formal methods and recent trends in Software Engineering.</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of the course, students will be able to --
CO1: Classify various software application domains.
CO2: Analyze software requirements by using various modeling techniques.
CO3: Translate the requirement models into design models.
CO4: Apply planning and estimation to any project.
CO5: Use quality attributes and testing principles in software development life cycle.
CO6: Discuss recent trends in Software engineering by using CASE and agile tools.</td></tr>
<tr><td colspan="4" align="center">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td colspan="2">Introduction To Software Engineering</td><td>06 hrs</td></tr>
<tr><td colspan="4">Software Engineering Fundamentals: Nature of Software, Software Engineering Practice, Software Process, Software Myths.
Process Models : A Generic Process Model, Linear Sequential Development Model, Iterative Development Model, The incremental Development Model
Agile software development: Agile manifesto, agility principles, Agile methods, myth of planned development, Introduction to Extreme programming and Scrum.
Agile Practices: test driven development, pair programming, continuous integration in DevOps , Refactoring</td></tr>
<tr><td>Case Study</td><td colspan="3">An information system – Library Management system</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="3">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">Requirements Engineering & Analysis</td><td>06 hrs</td></tr>
<tr><td colspan="4">Requirements Engineering: User and system requirements, Functional and non-functional requirements, requirements engineering (elicitation, specification, validation, negotiation) prioritizing requirements (Kano diagram), requirement traceability matrix(RTM)
Software Requirements Specification (SRS): software requirements Specification document,</td></tr>
</table>

structure of SRS, writing a SRS, structured SRS for online shopping, **Requirements Analysis:** Analysis Model, data modeling, scenario based modeling, class based modeling, Flow oriented modeling, behavioral modeling-Introduction to UML diagrams		
Case Study : Library Management system		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Design Engineering**	**06 hrs**
Design Engineering : Design Process & quality, Design Concepts, design Model, Pattern-based Software Design. Architectural Design :Design Decisions, Views, Patterns, Application Architectures, **Component level Design:** component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps& Analysis, Design Evaluation		
Case Study : Web App Design / Library Management System		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Project Planning, Management And Estimation**	**6 hrs**
Project Planning: Project initiation, Planning Scope Management, Creating the Work Breakdown Structure, scheduling: Importance of Project Schedules, Developing the Schedule using Gantt Charts, PERT/ CPM **Project Management:** The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement: size &function-oriented metrics(FP & LOC), Metrics for Project **Project Estimation:** Software Project Estimation, Decomposition Techniques, Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.		
Case Study: Project Management tool like OpenProj or MS Project		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Software Quality And Testing**	**06 hrs**
Quality Concepts: Quality, software quality, Quality Metrics, software quality dilemma, achieving software quality **Software Testing:** Introduction to Software Testing, Principles of Testing, Test plan, Test case, Types of Testing, Verification & Validation, Testing strategies, Defect Management, Defect Life Cycle, Bug Reporting, debugging.		
Case Study : Software testing tool like selenium		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Formal Methods Recent Trends In Software Engineering**	**06 hrs**
Recent Trends in SE : SCM, Risk Management, Technology evolution, process trends, collaborative development, software reuse, test-driven development, global software development challenges, CASE – taxonomy, tool-kits, workbenches, environments, components of CASE, categories (upper, lower and integrated CASE tools), Introduction to agile tools Jira, Kanban		
Case Study : CASE software/ HP Quality Center (QC) / Jira		

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Roger Pressman, “Software Engineering:A Practitioner’s Approach”, McGraw Hill,ISBN 0-07-337597-7
2. Ian Sommerville, “Software Engineering”,Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Joseph Phillips, “IT Project Management-On Track From start to Finish”, Tata Mc Graw-Hill,ISBN13:978-0-07106727-0,ISBN-10:0-07-106727-2
2. Pankaj Jalote, “Software Engineering: A Precise Approach”,Wiley India, ISBN: 9788-1265-2311-5
3. Marchewka, “Information Technology Project Management”,Willey India, ISBN: 9788-1265-4394-6
4. Rajib Mall, “Fundamentals of Software Engineering”,Prentice Hall India, ISBN-13:9788-1203-4898-1

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214455: Programming Skill Development Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory(TH) :02hrs/week	01	PR: 25Marks TW: 25Marks

Prerequisites: Computer Organization and Architecture

Course Objectives:

1. To learn embedded C programming and PIC18FXXXmicrocontrollers.
2. To learn interfacing of real-world input and output devices to PIC18FXXX microcontroller

Course Outcomes:

On completion of this course student will be able to --

CO1: Apply concepts related to embedded C programming.

CO2: Develop and Execute embedded C program to perform array addition, block transfer, sorting operations

CO3: Perform interfacing of real-world input and output devices to PIC18FXXX microcontroller.

CO4: Use source prototype platform like Raspberry-Pi/Beagle board/Arduino.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant. The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration- concept, objectives, outcomes, algorithm, sample test cases etc.

Guidelines for Student's Lab Journal

1. The laboratory assignments should be submitted by students in the form of journal. The Journal consists of Certificate, table of contents, and write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).
2. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of program listing to journal may be avoided.
3. Use of Digital media like shared drive containing students' programs maintained by lab In-charge is highly encouraged.
4. Practical Examination will be based on the term work submitted by the student in the form of journal.
5. Candidate is expected to know the theory involved in the experiment.
6. The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.
7. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for

implementation of practical assignment, timely submission of assignment in the form of write-up along with results of implemented assignment, attendance etc.

2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Necessary knowledge of usage of software and hardware of PIC18FXXX microcontrollers and its interfacing kits should be checked by the concerned faculty members.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

Suggested List of Laboratory Assignments

Suggested List of Laboratory Assignments Group A (Any Three):

Mapping of Course Outcomes for Group A -- CO1 , CO2

1. Study of Embedded C programming language (Overview, syntax, One simple program like addition of two numbers).
2. Write an Embedded C program to add array of n numbers.
3. Write an Embedded C program to transfer elements from one location to another for following:
   i) Internal to internal memory transfer
   ii) Internal to external memory transfer
4. Write an Embedded C menu driven program for :
   i) Multiply 8 bit number by 8 bit number
   ii) Divide 8 bit number by 8 bit number
5. Write an Embedded C program for sorting the numbers in ascending and descending order.

Group B (Any Three):

Mapping of Course Outcomes for Group B -- CO3

6. Write an Embedded C program to interface PIC 18FXXX with LED & blinking it using specified delay.
7. Write an Embedded C program for Timer programming ISR based buzzer on/off.
8. Write an Embedded C program for External interrupt input switch press, output at relay.
9. Write an Embedded C program for LCD interfacing with PIC 18FXXX.

Group C (Any two):

Mapping of Course Outcomes for Group C -- CO3

10. Write an Embedded C program for Generating PWM signal for servo motor/DC motor. **11.** Write an Embedded C program for PC to PC serial communication using UART. **12.** Write an Embedded C program for Temperature sensor interfacing using ADC & display on LCD.
Group D:
Mapping of Course Outcomes for Group D -- CO4
13. Study of Arduino board and understand the OS installation process on Raspberry-pi. **14.** Write simple program using Open source prototype platform like Raspberry-Pi/Beagle board/Arduino for digital read/write using LED and switch Analog read/write using sensor and actuators.
Reference Books :
1. Mazidi, Rolin McKinlay and Danny Causey, 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2. "Raspberry Pi for Beginners", 2nd Edition book" e-book. 3. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE, 4. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications In Embedded Systems (with the PIC18 Microcontroller Family)"Thomson/Delmar Learning; 1 edition (January 8, 2007), ISBN:978-1401879143.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214456: Database Management System Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR):04hrs/week	02	PR: 25 Marks TW: 25 Marks

Prerequisites: Data structures and Software engineering principles and practices.

Course Objectives :

1. Understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation.
2. To provide a strong formal foundation in database concepts, recent technologies and best industry practices.
3. To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. To learn the SQL database system.
5. To learn and understand various Database Architectures and its use for application development.
6. To program PL/SQL including stored procedures, stored functions, cursors and packages.

Course Outcomes :

On completion of this course student will be able to --

CO1: Install and configure database systems.
CO2: Analyze database models & entity relationship models.
CO3 : Design and implement a database schema for a given problem-domain
CO4: Implement relational database systems.
CO5: Populate and query a database using SQL DDL / DML / DCL commands.
CO6 : Design a backend database of any one organization: CASE STUDY

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical and Oral Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted only if the journal of the candidate is complete in all respects.

Guidelines for Oral /Practical Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Suggested List of Laboratory Assignments

Group A: Study of Databases

Mapping of Course Outcomes Group A -- CO1

1. Study of MySQL Open source software. Discuss the characteristics like efficiency, scalability, performance and transactional properties
2. Install and configure client and server of MySQL.(Show all commands and necessary steps for installation and configuration)
3. Study of SQLite: What is SQLite? Uses of Sqlite. Building and installing SQLite.

Group B: MySQL

Mapping of Course Outcomes Group B -- CO2, CO3, CO4, CO5

1. Design any database with at least 3 entities and relationships between them. Draw suitable ER/EER diagram for the system.
2. Design and implement a database (for assignment no 1) using DDL statements and apply normalization on them
3. Create Table with primary key and foreign key constraints.
   a. Alter table with add n modify   b. Drop table
4. Perform following SQL queries on the database created in assignment 1.
   • Implementation of relational operators in SQL
   • Boolean operators and pattern matching
   • Arithmetic operations and built in functions
   • Group functions
   • Processing Date and Time functions
   • Complex queries and set operators
5. Execute DDL/DML statements which demonstrate the use of views. Update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.

Group C: PL/SQL

Mapping of Course Outcomes Group C -- CO6

1. Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.
2. Write and execute suitable database triggers .Consider row level and statement level triggers.
3. Write a PL/SQL block to implement all types of cursor.

Group D: Relational Database Design

Mapping of Course Outcomes Group D -- CO5, CO6

Design and case study of any organization (back end only), Project Proposal and High Level SRS

To prepare for project, do the following:

1. Form teams of around 3 to 4 people
2. Create requirements document with the following information:-
    a. Give one or two paragraph description of your goals for the topic(s).
    b. List what all types of users will be accessing your application
    c. List the various functionalities that your application will support. Explain each in about a paragraph worth of detail.
    d. List the hardware and software requirements at the backend and at the front end.
    e. Give an estimate of the number of users of each type, the expected load (transactions per day), and the expected database size.

Project ER Diagram and Database Design

For ER diagram and Database design following guidelines can be used:

1. Draw an ER diagram of your project.
2. Reduce this ER diagram into the tables and complete database design.
3. Subsequently, list all the functional dependencies on each table that you expect will hold.
4. Check that the database schema is in 3NF/BCNF. If it is not, apply normalization. Use non-loss decomposition and bring the database schema in 3NF/BCNF.

Give the ER diagram and the data dictionary as part of the requirement specifications file which you created for the project proposal.

Reference Books:

1. Dr. P. S. Deshpande, “SQL and PL/SQL for Oracle 10g Black Book”, DreamTech
2. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPB Publication
3. Reese G., Yarger R., King T., Williums H, “Managing and Using MySQL”, Shroff Publishers and Distributors Pvt. Ltd., ISBN: 81 - 7366 - 465 – X, 2nd Edition
4. Eric Redmond, Jim Wilson, “Seven databases in seven weeks”, SPD, ISBN: 978-93-5023-91
5. Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019 Course)
214457: Computer Graphics Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) :02hrs/week	02	PR : 25 Marks TW: 25 Marks

Prerequisites: Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms

Course Objectives :

1. To acquaint the learners with the concepts of OpenGL.
2. To acquaint the learners with the basic concepts of Computer Graphics.
3. To implement the various algorithms for generating and rendering the objects.
4. To get familiar with mathematics behind the transformations.
5. To understand and apply various methods and techniques regarding animation.

Course Outcomes :

On completion of this course student will be able to --

CO1: Apply line& circle drawing algorithms to draw the objects.
CO2: Apply polygon filling methods for the object.
CO3: Apply polygon clipping algorithms for the object.
CO4: Apply the 2D transformations on the object.
CO5: Implement the curve generation algorithms.
CO6: Demonstrate the animation of any object using animation principles.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical and Oral Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of write-ups along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried

out.

3. Appropriate knowledge of usage of software related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

1. All the assignments should be implemented in C++ with OpenGL libraries.
2. Assignment 1 (week 1) should cover all the basic functions of openGL to get students familiar with Graphics Environment. Hence, this assignment is not included in Practical Exam.
3. The different objects/shapes/patterns should be drawn for implementation of drawing algorithm.
4. All the assignments should explore the conceptual understanding of students.
5. The keyboard/Mouse interfaces should be used wherever possible.

Guidelines for PRACTICAL EXAM conduction

1. There will be 2 problem statements options and student will have to perform any one.
2. All the problem statements carry equal weightage.

Virtual Laboratory

- https://cse18-iiith.vlabs.ac.in/
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Suggested List of Laboratory Assignments

1. Install and explore the OpenGL -- **CO1**

2. Implement DDA and Bresenham line drawing algorithm to draw: i) Simple Line ii) Dotted Line iii) Dashed Line iv) Solid line ;using mouse interface Divide the screen in four quadrants with center as (0, 0). The line should work for all the slopes positive as well as negative.

3. Implement Bresenham circle drawing algorithm to draw any object. The object should be displayed in all the quadrants with respect to center and radius- **C02**

4. Implement the following polygon filling methods : i) Flood fill / Seed fill ii) Boundary fill ; using mouse click, keyboard interface and menu driven programming**- CO4**

5. Implement Cohen Sutherland polygon clipping method to clip the polygon with respect the viewport and window. Use mouse click, keyboard interface - **CO4**

6.Implement following 2D transformations on the object with respect to axis : – **CO5**

i) Scaling ii) Rotation about arbitrary point iii) Reflection

7. Generate fractal patterns using i) Bezier ii) Koch Curve - **CO5**

8. Implement animation principles for any object - **CO6**

Text Books

1. S. Harrington, “Computer Graphics”, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0-07-100472-6

2. D. Rogers, “Procedural Elements for Computer Graphics”, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0-07-047371-4
3. F.S. Hill JR, “Computer Graphics Using OpenGL”, Pearson Education

Reference Books

1. Graphics Principles and Practice”, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9
2. D.Hearn, M. Baker, “Computer Graphics – C Version”, 2nd Edition, Pearson Education, 2002, ISBN81 – 7808 – 794 – 4
3. D. Rogers, J. Adams, “Mathematical Elements for Computer Graphics”, 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8
4. Zhigang Xiang, Roy Plastock, “Computer Graphics”, Schaum’s Series outlines
5. Shirley, Marschner, “Fundamentals of Computer Graphics”, Third Ed, A K Peters SPD
6. D.P. Mukharjee, Debasish Jana, “Computer Graphics Algorithms and implementation”, PHI Learning
7. Samuel R. Buss, “3D Computer Graphics”, Cambridge University Press
8. Mario Zechner, Robert Green, “Beginning Android 4 Games Development”, Apress, ISBN: 978-81-322-0575-3
9. Maurya, “Computer Graphics with Virtual Reality Systems, 2ed.”, Wiley, ISBN-9788126550883
10. Foley, “Computer Graphics: Principles & Practice in C”, 2e, ISBN 9788131705056, Pearson

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019 Course)

214458: Project Based Learning

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR): 04hrs/week	02	TW : 50 Marks

Prerequisite Courses, if any:

Preamble:

Project Based Learning (PBL) is an instructional approach that emphasizes critical-thinking, collaboration and personalized learning. In PBL, student groups engage in meaningful inquiry that is of personal interest to them. These projects are based on problems, which are real-life oriented, curriculum-based and often interdisciplinary. Students decide how to approach a problem and what activities or processes they will perform. They collect information from a variety of sources, analyze, synthesize and derive understanding from it. The real-world focus of PBL activities is central to the process because it motivates students and adds value to their work. Their learning is connected to something real and involves life skills such as collaboration and reflection. The faculty assigned to the group is referred as mentor. Technology enables students and Mentor in various phases of the PBL process. At the end of the PBL, students demonstrate their newly acquired knowledge and are evaluated by how much they have learned and how well they communicate it. Students also conduct self-evaluation to assess their own growth and learning. Throughout this process, the mentor's role is to guide and advise students, rather than to direct and manage student work.

Companion Course: Online courses relevant to the project, along with expert lecture on Intellectual property rights, patents and software engineering.

Course Objectives :

1. To learn the various processes involved in project based learning.
2. To develop critical thinking and engineering problem solving skills amongst the students.
3. To explain the roles and responsibilities of IT engineers to the solution of engineering problems within the social, environmental and economic context.
4. To equip the students with knowledge and skills require to develop solutions for the problems coming from various Hackathon.

Course Outcomes

On completion of the course, student will be able to --

CO1: Design solution to real life problems and analyze its concerns through shared cognition.

CO2: Apply learning by doing approach in PBL to promote lifelong learning.

CO3: Tackle technical challenges for solving real world problems with team efforts.

CO4: Collaborate and engage in multi-disciplinary learning environments.

COURSE CONTENTS
Group Structure

Group structure should enable students to work in mentor–monitored groups. The students plan, manage and complete a task/project / activity which addresses the stated problem.

1. There should be a team of 3 to 6 students who will work cohesively.
2. A Mentor should be assigned to individual groups who will help them with learning and development process.

Selection of Project/Problem

1. The project scope/topic can be from any field/area, but selection related to IT technical aspect is desirous.
2. The project/problem done in first year engineering could be extended further, based on its potential and significance analysis.
3. Project/problem requiring solutions through conceptual model development and use of software tools should be preferred.
4. Different alternate approaches such as theoretical, practical, working model, demonstration or software analysis should be used in solving/implementing of project/problem.
5. The project/problem requiring multi-disciplinary approach to solve it, should be preferred.
6. Problem may require in depth study of specific practical, scientific or technical domain.
7. Hands-on activities, organizational and field visits, interacting with research institutes and expert consultation should be included in the approach to make students aware of latest technologies.

Assessment

The department should be committed to assess and evaluate both student performance and solution impact.

Progress of PBL will be monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured by mentor.

Students must maintain an institutional culture of authentic collaboration, self- motivation, peer-learning and personal responsiveness. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in assessment and evaluation processes. Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project).

2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness.

3. Documentation and presentation.

Evaluation and Continuous Assessment

It is recommended that the all activities are to be recorded in PBL workbook, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor.

The PBL workbook will reflect accountability, punctuality, technical writing ability and work flow of the task undertaken. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department.

Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (5%)
2. Outcomes of PBL/Problem Solving Skills/Solution provided/Final product**(40%)** (Individual assessment and team assessment)
3. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents **(25 %)**
4. Potential for the patent**(10%)**
5. Demonstration (Presentation, User Interface, Usability etc.) **(10%)**
6. Contest Participation/ publication **(5%)**
7. Awareness /Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%).**

Design the rubrics based on the above parameters for evaluation of student performance

Faculty / Mentor is expected to perform following activities

Faculty/ Mentor is expected to perform following activities:

Revision of PBL concepts
Skill assessment of students
Formation of diversified and balanced groups
Share information about patent, copyright and publications to make students aware about it
Discussion of sample case studies
Design of the rubrics for evaluation of student performance
Discussion of the rubrics with students
Weekly Assessment of the deliverables such as Presentation, Report, Concept map, logbook
Scaffolding of the students
Summative and Formative assessment

Reference Books:

1. Project-Based Learning, Edutopia, March 14,2016.
2. What is PBL? Buck Institute forEducation.
3. www.schoology.com
4. www.wikipedia.org
5. www.howstuffworks.com

Home

Savitribai Phule Pune University, Pune

Second Year Information Technology (2019Course)

214459 (A) : Mandatory Audit course 4: Water Supply and Management

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses: Basic knowledge of environmental science and mathematics

Course Objectives:

1. Enable the student to understand the various components of environment in and around the earth crust and understand the effects of it over plants, animals, etc
2. Understand the important concepts of good water supply system to a city/town or a village
3. Understand the need of conservation of rain water and its applications
4. Understand the sources, effects, prevention and control measures of water pollution and its legislative aspects.

Course Outcomes:

On completion of the course, learner will be able to --

- **CO1:**Relate the relations between the environment and ecology, estimating water requirement for public water supply scheme.
- **CO2:**Assess the quality of water as per BIS and select the appropriate treatment method required for the water source.
- **CO3:** Analyze the suitable distribution system for a locality and know the appurtenances used.
- **CO4:** Summarize the arrangement of water supply and fittings in a building.
- **CO5:** Determine the need of conservation of water and rural water supply.
- **CO6:** Identify the sources of water pollution and suitable control measures.

COURSE CONTENTS

Unit I	Introduction To Environment, Water Requirement And Water Sources	02 hrs

ENVIRONMENT AND ECOLOGY: Atmosphere, Lithosphere, Hydrosphere, Biosphere. Relation between Plant, Animals and Environment. Eco System, Man and Ecology.

WATER REQUIREMENT: Necessity of water supply, Methods of population forecasting (Arithmetical, Geometrical and Incremental Increase method), Water Requirements for a) Domestic Purpose b) Industrial Use c) Fire Fighting d) Public Purpose e) Losses. Per Capita Demand and Factors affecting it. Total Quantity of Water Required for a Town.

SOURCES OF WATER: Surface Sources - Lakes, Streams, Rivers. Impounded Reservoirs. Underground Sources - Infiltration Galleries, Infiltration Wells and Springs

Mapping of Course Outcomes for Unit I	CO1

Unit II	Quality And Treatment Of Water	02 hrs

QUALITY OF WATER: Impurities of water - organic and inorganic classification and examination of water. Physical - temperature, color, turbidity, taste and odour. Chemical - pH Value, Total Solids, Hardness, Chlorides, Iron and Manganese, Fluoride and Dissolved Oxygen. Bacteriological- E-coli, Most Probable Number (MPN), Quality Standards for Domestic purpose as perBIS.

TREATMENT OF WATER: Flow diagram of different units of treatment, brief description of constructional details, working and operation of the following units - plain sedimentation, sedimentation with coagulation, flocculation, filtration-Slow sand filters, Rapid sand filters and pressure filters (nodesign) Disinfection of water, Chlorination		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Water Distribution System**	**02 hrs**
DISTRIBUTION SYSTEM: General Requirements, Systems of Distribution- Gravity System, Combined System, Direct Pumping. Maintenance of required pressure in Distribution Systems. Storage- Underground, Ground Level And OverheadServiceReservoirs– Sketch,NecessityandAccessories.Typesoflay- out : dead end, grid iron, radial and ring systems, their merits and demerits and their suitability **APPURTENANCES IN DISTRIBUTION SYSTEM:** Use of Sluice Valves, Check Valves, Air Valves, Scour Valves, Zero Velocity Valves, Fire Hydrants, Water Meter		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Water Supply In Buildings**	**02 hrs**
Water Supply arrangement in Buildings: General lay-outofwatersupplyarrangementforsingleandmulti-storiedbuildingsasperB.I.S code of practice. Pipe Materials- Plastic Pipes, High Density Polythene Pipes, Densified cast iron pipes, Merits and Demerits. Connections from water main to buildings. Water supply fittings - their description and uses, water main, service pipes, supply pipe, distribution pipe, domestic storage tank, stop cock, ferrule, goose neck, water tap, Modern systems of Potable water purification-(RO, UV, Activated carbon), Hot water supply - electric and solar waterheaters.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Water Conservation**	**02hrs**
WATER CONSERVATION: Conservation of rain water, roof water harvesting, recharging of ground water. RURAL WATER SUPPLY: Rural water supply systems, Disinfection of well water.		
Case Studies:	Refer suggested list of Case studies/ Students activities	
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Water Pollution And Pollution control**	**02 hrs**
WATER POLLUTION AND CONTROL: Sources of water pollution, types and its effects, Prevention and control measures of water pollution, Legal aspects regarding water pollution control.		

Mapping of Course Outcomes for Unit V	CO6

Reference Books :

1. S.K.Garg, Water Supply Engineering Vol-I, Khanna Publishers
2. G.S.Birdie,Water Supply & Sanitary Engineering-including Environmental Engineering, water And air pollution and Ecology, Dhanpat RaiandSons publishers,ISBN:81-87433-31-0
3. Dr. P.N. Modi, Environmental Engg.-Vol-I, Standard BookHouse
4. A.K.Chatterji,WaterSupply,WasteDisposalandEnvironmentalPollution Engineering, Khanna publishers

SUGGESTED LIST OF CASE STUDIES/STUDENTACTIVITIES

1. Collect the information about biotic and a biotic component of surrounding environment and frame relation among them
2. Estimatethetotalquantityofwaterrequiredforatown/locality/Institute
3. Prepare map and written report for surface and underground sources of water in the neighborhood
4. Visit nearby Certified Water testing laboratories and identify various tests conducted on water
5. Visit Water Treatment Plant and collect details of unit operations and processes involved in it.
6. Study the distribution system of water supply of your locality
7. Visit a newly constructed building and study plumbing work
8. Study a rooftop rain water harvesting system of existing building
9. Study a Solar water heating system and collect necessary data
10. Collect a necessary data/information about issues related to water pollution and Prepare report/presentation

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune Second Year Information Technology (2019Course) 214459 (B): Mandatory Audit course 4 : Language Study Japanese : Module - II		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
01hrs/week	**Non Credit**	**Audit Course**

Prerequisite Courses: Audit Course 3: Language Study Japanese: Module-I

Course Objectives :

1. To develop the Japanese communicative competence of students with small sentence formation.to make primitive social conversation in Japanese.
2. To enable students with comprehension ability of Japanese grammar.
3. To enable students to translate simple conversations from English to Japanese and vice a versa.
4. To make students aware about Japanese Culture and Customs.

Course Outcomes :

On completion of the course, learner will be able to --

CO1: Have Japanese Communicative competence for primitive Social conversation in Japanese
CO2: Comprehend Grammar of Japanese Script
CO3: Translate simple sentences from Japanese to English and vice a versa
CO4: Be aware about Japanese society and people

COURSE CONTENTS

Unit I	**Japanese Conversation**	**(02 hrs +04hrs Self Study)**
Oral practice of conversation in situations such as declining an invitation, reporting an event, narrating a story, short formal speeches on occasions such as welcoming, introducing and thanking a guest, talking about Japanese and Indian festivals, hostel life etc		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Japanese Text and Kanji**	**(02hrs +04 hrs Self Study)**
Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately 400 *kanji*.		
Mapping of Course Outcomes for Unit II	**CO2,CO3**	
Unit III	**Japanese Grammar and Composition**	**(02 hrs +04 hrs Self Study)**
Basic sentence patterns to be applied in self introduction, identifying things; time of the day; calendar; counting using Japanese numerical classifiers; describing things; making comparisons; talking of daily activities; kinship terms used for address and reference; seasons; giving and receiving; shopping; making requests; talking of one's likes and dislikes		

Mapping of Course Outcomes for Unit III	**CO2, CO3**	
Unit IV	**Japanese – English Translation**	**(02hrs +04 hrs Self Study)**
Practice in English to Japanese and Japanese to English translation of short passages on various topics such as culture, society, religion and life style taken from books, newspapers, magazines, internet etc.		
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Language and Literature of Japan**	**(02 hrs.)**
History of Japanese language, literary trends, religions, spread of Chinese influence, development of art and culture in Japan.		
Mapping of Course Outcomes for Unit V	**CO4**	

E-Resources for Learning Support:

1. https://www.duolingo.com/course/ja/en/Learn-Japanese
2. https://www.freejapaneselessons.com/
3. https://minato-jf.jp/**(Japan Foundation)**

Text Books:

1. EriBanno, Genki I: An Integrated Course in Elementary Japanese , 3rd Edition 2020, The Japan Times, (ISBN13: 9784789017305)
2. George Trombley , Yukari Takenaka, Japanese From Zero, 6th Edition, Learn From Zero Publishers (ISBN10- 0976998122, ISBN13-9780976998129)
3. Tae Kim, A Guide to Japanese Grammar, 2012, CreateSpace Publishing, (ISBN-1469968142, ISBN13- 9781469968148) http://www.guidetojapanese.org/learn/grammar

Reference Books:

1. Yukiko Ogata, Kana Sumitani, Yasuko Hidari, Yukiko Watanabe, Nihongo fun and Easy -II, Basic Grammar for Conversation
2. Nobuo Akiyama, Carol Akiyama, Japanese Grammar (Barron's Grammar), 3rd edition 2012, Barrons Educational Series
3. Storry Richard, A History Of Modern Japan, 1973, Penguin Books Ltd,
4. James W. Heisig, Remembering the Kanji 1 : A Complete Course on How Not To Forget the Meaning and Writing of Japanese Characters, 6h Edition, University of Hawai'i Press (ISBN10-0824835921, ISBN13-9780824835927)

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019Course)
214459 (C): Mandatory Audit course 4 :
e-Waste Management and Pollution Control

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit course	Audit Course

Prerequisite Courses: if any: --

Course Objectives :

1. To make the students aware about importance of environmental study.
2. To study impact of professional engineering products in societal contexts.
3. To understand impact of professional engineering products in environmental contexts.
4. To learn e-waste management and e-waste recycling process.
5. To understand causes, effects and control measures of environment pollutions.
6. To learn impact of environment controlling methods on human health.

Course Outcomes :

On completion of the course, learner will be able to --

CO1: Discuss various types of e-waste sources.
CO2: Understand impact of various e-wastes.
CO3: Identify characteristics of various e-Waste pollutants.
CO4: Understand process of e-Waste Recycling and relevant technologies.
CO5: Discuss causes, effects and control measures of different environment pollution.
CO6: Demonstrate Safe methods for disposal of e-waste and controlling the pollution.

COURSE CONTENTS

Unit I	**E-Waste Overview and Sources**	**02 hrs**
e-waste Overview: What is e-waste, E-waste growth- An overview, hazards of e-waste **Sources of e-wastes:** Discarded computers, televisions. VCRs. stereos, copiers, fax machines, electric lamps, cell phones, audio equipment and batteries if improperly disposed.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Impact of various e-wastes**	**02 hrs**
Solder in printed circuit boards, glass panels and monitors, Chip resistors and semiconductors, Relays and switches, Printed Circuit Boards, Cabling and computer housing, Plastic housing of electronic equipment and circuit boards, Front panel of CRTs, Motherboards.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**E- Waste pollutants and Characteristics**	**02 hrs**
Digital dump yard, how to minimize e-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic		

components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**E-Waste Recycling**	**02 hrs**
Overview of e-Waste recycling, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Environmental Pollution**	**02 hrs**
Causes and effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards, Role of an individual in prevention of pollution, Pollution case studies: Pollution caused because of electronic waste material and measures for controlling.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Impact on human health and Pollution Controlling**	**02 hrs**
Impact of products from e-waste in human health, Current disposal methods of e-waste, e-waste recycling technologies and methods recycling pose a risk to environmental and human health. Safe methods for disposal of e-waste and controlling relevant pollution.		
Mapping of Course Outcomes for Unit VI	**CO6**	

E-Resources from Learning Support

1.https://nptel.ac.in/courses/105/105/105105169/
2.https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

Text Books

1. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi,ICFAI University Press,2007.
2. Text Book of Environmental Studies for undergraduate Courses by Bharucha Erach,University Press, II- Edition 2013 Available online free edition.

Reference Books

1. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by Rakesh Johri, The Energy and Resources Institute, New Delhi,2008

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Home

Savitribai Phule Pune University, Pune
Second Year Information Technology (2019Course)
214459 (D): Mandatory Audit course 4 :
Intellectual Property Rights

Teaching Scheme:	Credit Scheme:	Examination Scheme:
01hrs/week	Non Credit	Audit Course

Prerequisite Courses, if any: ---

Course Objectives

1. To introduce fundamental aspects of Intellectual property Rights (IPR)
2. To disseminate knowledge about types of IP like Patents, Copyrights, Trade Secrets
3. To make students aware about current trends in IPR and their importance
4. To motivate students for innovative thinking and making inventions

Course Outcomes

On completion of the course, learner will be able to --

CO1: Exhibit the concepts of Intellectual Property Rights

CO2: Differentiate among different IPR

CO3: Formulate and characterize innovative ideas and inventions into IPR

CO4: Demonstrate knowledge of advances in patent law and IP regulations

COURSE CONTENTS

Unit I	Overview Of Intellectual Property	02 hrs
Introduction and the need for intellectual property right (IPR) - Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret.		
Mapping of Course Outcomes for Unit I	CO1, CO2	
Unit II	**Patents**	**04 hrs**
What is invention? Patentability criteria: Novelty, Non-Obviousness (Inventive Steps), Industrial Application, Non- Patentable Subject Matter, Patent Search, Patent Registration Procedure, Rights and Duties of Patentee, Assignment and license, Infringement.		
Mapping of Course Outcomes for Unit II	CO3, CO4	
Unit III	**Copyrights**	**02 hrs**
Concept of Copyright –Copyright Subject matter: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement		
Mapping of Course Outcomes for Unit III	CO3	

Unit IV	**Trademarks**	**02 hrs**
Nature of Trademarks - Different kinds of trademarks (, logos, signatures, symbols, well known marks, brand names, certification and service marks) – Trademarks that can't be registered– Trademarks registration procedure - Rights of holder and assignment and licensing of marks - Infringement		
Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**Advances in IP Laws and Government policies**	**02 hrs**
Amendments and India`s New National IP Policy, Promoting IPR policy for Start-ups, Career Opportunities in IP - IPR in current scenario		
Mapping of Course Outcomes for Unit V	**CO4**	

Text Books

1. Niraja Pandey, Khush deep Dharni (2014), "Intellectual Property Rights", PHI
2. Nithyananda K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited

Reference Books

1. Mishra, "An introduction to Intellectual property Rights", Central Law Publications
2. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis

Evaluation:

Students should select any one of the above topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Faculty of Science & Technology

Savitribai Phule Pune University,

Pune,Maharashtra, India

Curriculum For

Third Year of Information Technology

(2019 Course)

(With effect from AY 2021-22)

INDEX

Savitribai Phule Pune University, Pune Bachelor of Information Technology	
Program Educational Objectives	
PEO1	**Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.**
PEO2	**Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.**
PEO3	**Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science and Information Technology.**
PEO4	**Have commitment ethical practices, societal contributions through communities and life-long learning.**
PEO5	**Possess better communication, presentation, time management and team work skills leading to responsible & competent professional sand will be able to address challenges in the field of IT at global level.**

Program Outcomes		
Students are expected to know and be able to–		
PO1	**Engineering knowledge**	**An ability to apply knowledge of mathematics, computing, science, engineering and technology.**
PO2	**Problem analysis**	**An ability to define a problem and provide a systematic solutionwith the help of conducting experiments, analyzing the problem and interpreting the data.**
PO3	**Design / Development ofSolutions**	**An ability to design, implement, and evaluate software or asoftware /hardware system ,component ,or process to meet desired need switch in realistic constraints.**
PO4	**Conduct Investigation of Complex Problems**	**An ability to identify, formulate, and provide essay schematicsolutions to complex engineering /Technology problems.**
PO5	**Modern Tool Usage**	**An ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional.**
PO6	**The Engineer and Society**	**An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions.**
PO7	**Environment and Sustainability**	**An ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society.**
PO8	**Ethics**	**An ability to understand professional, ethical, legal, security and socialissues and responsibilities.**
PO9	**Individual and Team Work**	**An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).**
PO10	**Communication Skills**	**An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies /tools with the help of electives, profession along animations and extra-curricular activities.**
PO11	**Project Management and Finance**	**An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.**
PO12	**Life-long Learning**	**An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.**

Program Specific Outcomes(PSO)	
A graduate of the Information Technology Program will demonstrate-	
PSO1	**An ability to apply the theoretical concepts and practical knowledge of Informatior Technology in analysis, design, development and management of informatior processing systems and applications in the interdisciplinary domain.**
PSO2	**An ability to analyze a problem, and identify and define the computing infrastructure and operations requirements appropriate to its solution. IT graduates should be able to work on large-scale computing systems.**
PSO3	**An understanding of professional, business and business processes, ethical, legal, security and social issues and responsibilities.**
PSO4	**Practice communication and decision-making skills through the use of appropriate technology and be ready for professional responsibilities.**

SEMESTER – V

Savitribai Phule Pune University
Third Year of Information Technology (2019 course)
(With effect from Academic Year 2021-22)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/ week)			Examination Scheme and Marks						Credit Scheme			
		Theory	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
314441	Theory of Computation	03	-	-	30	70	-	-	-	100	3	-	-	3
314442	Operating Systems	03	-	-	30	70	-	-	-	100	3	-	-	3
314443	Machine Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
314444	Human Computer Interaction	03	-	-	30	70	-	-	-	100	3	-	-	3
314445	Elective-I	03	-	-	30	70	-	-	-	100	3	-	-	3
314446	Operating Systems Lab	-	04	-	-	-	25	25	-	50	-	2	-	2
314447	Human Computer Interaction- Lab	-	02	-	-	-		-	50	50	-	1		1
314448	Laboratory Practice-I	-	04	-	-	-	25	25		50	-	2	-	2
314449	Seminar	-	01	-	-	-	50	-	-	50	-	1	-	1
314450	Audit Course 5	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Credit										15	06	-	21
	Total	15	11	-	150	350	100	50	50	700	15	06	-	21

Abbreviations: TH: Theory, TW: Term Work, PR: Practical , OR: Oral ,TUT: Tutorial

Elective-I:
314445A- Design and Analysis of Algorithm
314445B- Advanced Database and Management System
314445C- Design Thinking
314445D- Internet of Things

Audit Course 5:
314450A-Banking and Insurance
314450B-Startup Ecosystems
314450C- Foreign Language–(Japanese Language- III)

Laboratory Practice-I:
Assignment from Machine Learning and Elective I

Note: Students of T.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

Savitribai Phule Pune University
Third Year of Information Technology (2019 Course)
(With effect from Academic Year 2021-22)

Semester-VI

Course Code	Course Name	Teaching Scheme (Hours/ week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term Work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
314451	Computer Networks& Security	03	-	-	30	70	-	-	-	100	03			03
314452	Data Science and Big Data Analytics	03	-	-	30	70	-	-	-	100	03			03
314453	Web Application Development	03	-	-	30	70	-	-	-	100	03			03
314454	Elective-II	03	-	-	30	70	-	-	-	100	03			03
314455	Internship	-	04	-	-	-	100	-	-	100		04		04
314456	Computer Networks& Security-Lab	-	04	-	-	-	25	-	50	75		02		02
314457	DS & BDA-Lab	-	02	-	-	-	25	25	-	50		01		01
314458	Laboratory Practice-II	-	04	-	-	-	50	25	-	75		02		02
314459	Audit Course 6	-	-	-	-	-	-	-	-	-	-	-	-	-
										Total	12	09	-	21
	Total	12	14	-	120	280	200	50	50	700	12	09	-	21

Abbreviations: TH: Theory, TW: Term Work, PR: Practical , OR: Oral, TUT: Tutorial

Elective-II:
314454A- Artificial Intelligence
314454B- Cyber Security
314454C -Cloud Computing
314454D- Software Modeling and Design

Audit Course 6:
314459A - Green and Unconventional Energy
314459B - Leadership and Personality Development
314459C- Foreign Language-(Japanese Language- IV)

Laboratory Practice-II:
Assignments from Web Application Development and Elective-II.

Note: Students of T.E. (Information Technology) can opt any one of the audit course from the list of audit courses prescribed by BoS (Information Technology)

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314441: Theory of Computation		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses:

1. Discrete Structures.
2. Data structures.

Companion Course, if any: NA

Course Objectives:

1. To know the applicability of the model of computation to different problems.
2. To understand in detail the relationship among formal languages, formal grammars and automata.
3. To learn the design of Finite Automata, Pushdown Automata and Turing Machine for processing of formal languages.
4. To study the theory of computability and complexity for algorithm design.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Construct finite automata and its variants to solve computing problems.

CO2: Write regular expressions for the regular languages and finite automata.

CO3: Identify types of grammar, design and simplify Context Free Grammar.

CO4: Construct Pushdown Automata machine for the Context Free Language.

CO5: Design and analyze Turing machines for formal languages.

CO6: Understand decidable and undecidable problems, analyze complexity classes.

COURSE CONTENTS

Unit I	FINITE AUTOMATA	(06 hrs)

Basic Concepts: Symbols, Strings, Language, Formal Language.

Finite Automata (FA): Formal definition and notations for FSM, Concept of state transition diagram and transition table for FA, Construction of DFA, NFA, NFA with epsilon moves. Conversion of NFA with epsilon moves to NFA, Conversion of NFA to DFA, and Conversion of NFA with epsilon moves to DFA, Minimization of FA, Equivalence of FAs, and Applications of FA.

Finite State Machine with output: Moore and Mealy machines - Definition, Construction, Inter-Conversion.

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	REGULAR EXPRESSIONS AND LANGUAGES	(06 hrs)

Regular Expressions (RE) : Definition and Identities of RE, Operators of RE, Equivalence of two regular expressions, Equivalence of regular expressions and regular languages (RL), Conversion of RE to FA using direct method, Conversion of FA to RE using Arden's theorem, Pumping lemma for RLs, Closure properties of RLs, Applications of Regular Expressions.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**CONTEXT FREE GRAMMAR AND LANGUAGE**	**(06 hrs)**
Grammar: Introduction and representation, Chomsky Hierarchy, Formal definition of Regular **Grammar(RG), Conversions:** LRG to RLG, RLG to LRG, RG to FA, FA to RG. **Context Free Grammar (CFG):** Definition of CFG, Derivation tree, sentential forms, Leftmost and Rightmost derivations, Ambiguous Grammar and unambiguous grammar, Context Free Language (CFL). **Grammar Simplification, Normal forms:** Chomsky Normal Form, Greibach Normal Form. Closure properties of CFL, Pumping lemma for CFL.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**PUSHDOWN AUTOMATA AND POST MACHINE**	**(06 hrs)**
Pushdown Automata(PDA) : Introduction and formal definition of PDA, Construction of Transition diagram and Transition table for PDA, Instantaneous Description of PDA, Equivalence of Acceptance by Final State & Empty stack, Deterministic PDA and Nondeterministic PDA, Context Free Language and PDA Conversion of CFG to PDA and PDA to CFG. **Post Machine (PM):** Definition and construction of Post Machine.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**TURING MACHINE**	**(06 hrs)**
Turing Machine (TM) : Formal definition of a Turing machine, Design of Turing machines, Variants of **Turing Machines:** Deterministic TM, Nondeterministic TM, Multi-tape TM, Universal Turing Machine, Halting problem of TM , Church-Turing thesis, Recursive Languages and Recursively Enumerable Languages, Post Correspondence Problem.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**COMPUTATIONAL COMPLEXITY**	**(06 hrs)**
Decidability: Decidable problems concerning regular languages, Decidable problems concerning context free languages, Un-decidability. **Computational Complexity:** Measuring Complexity, The Class P, Examples of problems in P, The Class NP, and Examples of problems in NP, Reducibility, Mapping Reducibility, Polynomial Time Reduction and NP Completeness. Satisfiability Problem, NP Completeness of the SAT Problem, Normal Forms for Boolean Expressions, Cook's theorem, Node-C over Problem.		

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. John C. Martin, Introduction to Language and Theory of Computation, TMH, 3rd Edition, ISBN: 978-0070660489.
2. Vivek Kulkarni, Theory of Computation, Oxford University Press,ISBN-13 : 978-0198084587.

Reference Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, Introduction to Automata Theory Languages and Computation, Addison-Wesley, ISBN 0-201-44124-1.
2. K.L.P Mishra, N. Chandrasekaran, Theory of Computer Science : Automata, Languages and Computation, Prentice Hall India, 2nd Edition.
3. Michael Sipser, Introduction to the Theory of Computation, CENGAGE Learning, 3rd Edition ISBN- 13:978-81-315-2529-6.
4. Daniel Cohen, “Introduction to Computer Theory”, Wiley & Sons, ISBN 97881265133454.
5. Kavi Mahesh, “Theory of Computation: A Problem-Solving Approach”, Wiley India, ISBN-1081265331106.

E- Books / E- Learning References :

1. https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
2. https://theory.cs.princeton.edu/complexity/book.pdf

NPTEL video lecture link :

1. https://nptel.ac.in/courses/106/104/106104148/
2. https://nptel.ac.in/courses/106/104/106104028/

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)

314442: Operating Systems

HOME

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:

1. Computer Organization and Architecture
2. Fundamentals of Data Structures

Companion Course, if any: NA

Course Objectives:

1. To introduce basic concepts and functions of modern operating systems.
2. To understand the concept of process, thread management and scheduling.
3. To learn the concept of concurrency control.
4. To study various Memory Management techniques.
5. To know the concept of I/O and File management.
6. To learn concept of system software.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Explain the role of Modern Operating Systems.

CO2: Apply the concepts of process and thread scheduling.

CO3: Illustrate the concept of process synchronization, mutual exclusion and the deadlock.

CO4: Implement the concepts of various memory management techniques.

CO5: Make use of concept of I/O management and File system.

CO6: Understand Importance of System software.

COURSE CONTENTS

Unit I	OVERVIEW OF OPERATING SYSTEM	(06 hrs)

Operating System Objectives and Functions, The Evolution of Operating Systems, Developments Leading to Modern Operating Systems, Virtual Machines, Introduction to Linux OS, BASH Shell scripting: Basic shell commands.

Mapping of Course Outcomes for Unit I	CO1

Unit II	PROCESS MANAGEMENT	(06 hrs)

Process: Concept of a Process, Process States, Process Description, Process Control

Threads: Processes and Threads, Concept of Multithreading, Types of Threads, Thread programming Using Pthreads.

Scheduling: Types of Scheduling, Scheduling Algorithms, First Come First Served, Shortest Job First, Priority, Round Robin

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**CONCURRENCY CONTROL**	**(06 hrs)**
Process/thread Synchronization and Mutual Exclusion: Principles of Concurrency, Requirements for Mutual Exclusion, Mutual Exclusion: Operating System Support (Semaphores and Mutex). **Classical synchronization problems:** Readers/Writers Problem, Producer and Consumer problem, Inter-process communication (Pipes, Shared Memory). **Deadlock:** Principles of Deadlock, Deadlock Modeling, and Strategies to deal with deadlock: Prevention, Avoidance, Detection and Recovery. Example: Dining Philosophers Problem / Banker's Algorithm.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**MEMORY MANAGEMENT**	**(06 hrs)**
Memory Management: Memory Management Requirements, **Memory Partitioning:** Fixed Partitioning, Dynamic Partitioning, Buddy System, Relocation, Paging, Page table structure, Segmentation **Virtual Memory:** Background, Demand Paging, Page Replacement (FIFO, LRU, Optimal), Allocation of frames, Thrashing		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**INPUT/OUTPUT AND FILE MANAGEMENT**	**(06 hrs)**
I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, I/O Buffering, Disk Scheduling (FIFO, SSTF, SCAN, C-SCAN, LOOK, C-LOOK). **File Management:** Overview-Files and File Systems, File structure. File Organization and Access, File Directories, File Sharing, Record Blocking, Secondary Storage Management.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**SYSTEMS SOFTWARE AND ITS IMPORTANCE**	**(06 hrs)**
Need of System Software, study of various components of system software. **Assemblers:** Elements of Assembly Language Programming, A simple Assembly Scheme and pass structure of Assemblers. **Introduction to compilers:** Phase structure of Compiler and entire compilation process. Introduction to Macro processors, Macro Definition and call, Macro Expansion Loaders and Linkers. General Loader Scheme, Subroutine Linkages, Relocation and linking Linkages, Relocation and linking		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition,2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons ,Inc., 9th Edition,2012, ISBN 978-1-118-06333-0
3. D. M. Dhamdhere, "Systems Programming and Operating Systems", Tata McGraw-Hill, ISBN 13:978-0-07-463579-7, Second Revised Edition.

Reference Books:

1. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, ISBN-10: 0596009526, ISBN-13: 978-0596009526.
2. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13: 978-0131828278.
3. Thomas W. Doeppner, Operating System in depth: Design and Programming, WILEY, ISBN: 978-0-471-68723-8.
4. Mendel Cooper, Advanced Shell Scripting, Linux Documentation Project.
5. Andrew S. Tanenbaum & Herbert Bos, Modern Operating System, Pearson, ISBN-13: 9780133592221, 4th Edition.
6. J. J. Donovan, Systems Programming, McGraw-Hill, ISBN 13:978-0-07-460482-3, Indian Edition.

E- Books / E- Learning References :

E-learning references:

1. **https://repository.dinus.ac.id/docs/ajar/Operating_System.pdf**

NPTEL video lecture link:

1. https://nptel.ac.in/courses/106/102/106102132/#
2. https://nptel.ac.in/courses/106/106/106106144/

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314443: Machine Learning</td></tr>
<tr><td align="center">Teaching Scheme:</td><td align="center">Credit Scheme:</td><td align="center">Examination Scheme:</td></tr>
<tr><td align="center">Theory (TH) :3hrs/week</td><td align="center">03 Credits</td><td align="center">Mid_Semester : 30 Marks
End_Semester :70 Marks</td></tr>
</table>

HOME

Prerequisite Courses:

1. Basics of Statistics **2.** Linear Algebra **3.** Calculus **4.** Probability

Companion Course:

1. Artificial Intelligence **2.** Deep Learning

Course Objectives:

1. To understand the basic concepts of machine learning and apply them for the various problems.
2. To learn various machine learning types and use it for the various machine learning tasks.
3. To optimize the machine learning model and generalize it.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Apply basic concepts of machine learning and different types of machine learning algorithms.

CO2: Differentiate various regression techniques and evaluate their performance.

CO3: Compare different types of classification models and their relevant application.

CO4: Illustrate the tree-based and probabilistic machine learning algorithms.

CO5: Identify different unsupervised learning algorithms for the related real-world problems.

CO6: Apply fundamental concepts of ANN.

<table>
<tr><td colspan="3" align="center">COURSE CONTENTS</td></tr>
<tr><td align="center">Unit I</td><td align="center">INTRODUCTION TO MACHINE LEARNING</td><td align="center">(06 hrs)</td></tr>
<tr><td colspan="3">Introduction: What is Machine Learning, Definition, Real life applications, Learning Tasks- Descriptive and Predictive Tasks, Types of Learning: Supervised Learning Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning.
Features: Types of Data (Qualitative and Quantitative), Scales of Measurement (Nominal, Ordinal, Interval, Ratio), Concept of Feature, Feature construction, Feature Selection and Transformation, Curse of Dimensionality.
Dataset Preparation: Training Vs. Testing Dataset, Dataset Validation Techniques – Hold-out, k-fold Cross validation, Leave-One-Out Cross-Validation (LOOCV).</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td align="center">Unit II</td><td align="center">CLASSIFICATION</td><td align="center">(06 hrs)</td></tr>
</table>

Binary Classification: Linear Classification model, Performance Evaluation- Confusion Matrix, Accuracy, Precision, Recall, ROC Curves, F-Measure

Multi-class Classification: Model, Performance Evaluation Metrics – Per-class Precision and Per-Class Recall, weighted average precision and recall -with example, Handling more than two classes, Multiclass Classification techniques -One vs One, One vs Rest

Linear Models: Introduction, Linear Support Vector Machines (SVM) – Introduction, Soft Margin SVM, Introduction to various SVM Kernel to handle non-linear data – RBF, Gaussian, Polynomial, Sigmoid.

Logistic Regression – Model, Cost Function.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**REGRESSION**	**(06 hrs)**

Regression: Introduction, Univariate Regression – Least-Square Method, Model Representation, Cost Functions: MSE, MAE, R-Square, Performance Evaluation, Optimization of Simple Linear Regression with Gradient Descent - Example. Estimating the values of the regression coefficients

Multivariate Regression: Model Representation

Introduction to Polynomial Regression: Generalization- Overfitting Vs. Underfitting, Bias Vs. Variance.

Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**TREE BASED AND PROBABILISTIC MODELS**	**(06 hrs)**

Tree Based Model: Decision Tree – Concepts and Terminologies, Impurity Measures -Gini Index, Information gain, Entropy, Tree Pruning -ID3/C4.5, Advantages and Limitations

Probabilistic Models: Conditional Probability and Bayes Theorem, Naïve Bayes Classifier, Bayesian network for Learning and Inferencing.

Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**DISTANCE AND RULE BASED MODELS**	**(06 hrs)**

Distance Based Models: Distance Metrics (Euclidean, Manhattan, Hamming, Minkowski Distance Metric), Neighbors and Examples, K-Nearest Neighbour for Classification and Regression, Clustering as Learning task: K-means clustering Algorithm-with example, k-medoid algorithm-with example, Hierarchical Clustering, Divisive Dendrogram for hierarchical clustering, Performance Measures

Association Rule Mining: Introduction, Rule learning for subgroup discovery, Apriori Algorithm, Performance Measures – Support, Confidence, Lift.

Mapping of Course Outcomes for Unit V	**C05**	
Unit VI	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORK**	**(6 hrs)**

Perceptron Learning– Biological Neuron, Introduction to ANN, McCulloch Pitts Neuron, Perceptron and its Learning Algorithm, Sigmoid Neuron, Activation Functions: Tanh, ReLu
Multi-layer Perceptron Model – Introduction, Learning parameters: Weight and Bias, Loss function: Mean Square Error
Introduction to Deep Learning

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
3. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012
4. Tom M. Mitchell, Machine Learning, 1997, McGraw-Hill, First Edition

Reference Books:

1. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
2. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition
3. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.
4. Parag Kulkarni: Reinforcement and Systematic Machine Learning for Decision Making, Wiley IEEE Press, Edition July 2012.
5. Shalev-Shwartz S., Ben-David S., Understanding Machine Learning: From Theory to Algorithms, CUP, 2014
6. Jack Zurada: Introduction to Artificial Neural Systems, PWS Publishing Co. Boston, 2002

E- Books / E- Learning References:

1. Introduction to Machine Learning: https://nptel.ac.in/courses/106/106/106106139/
2. Machine Learning: https://nptel.ac.in/courses/106/106/106106202/
3. Machine Learning for Science and Engineering applications: https://nptel.ac.in/courses/106/106/106106198/
4. Introduction to Machine Learning: https://nptel.ac.in/courses/106/105/106105152/
5. Deep Learning (Part-I): https://nptel.ac.in/courses/106/106/106106184/
6. Deep Learning: https://onlinecourses.nptel.ac.in/noc19_cs54/preview
7. Naive Bayes from Scratch: https://courses.analyticsvidhya.com/courses/naive-bayes
8. Getting Started with Neural Networks: https://courses.analyticsvidhya.com/courses/getting-started-with-neural-networks
9. Machine Learning – Offered by Stanford Online - https://www.coursera.org/learn/machine-learning

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314444: Human Computer Interaction		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses:

1. Problem Solving and Object Oriented Technologies

Course Objectives:

1. To introduce to the field of human-computer-interaction study.
2. To gain an understanding of the human part of human-computer-interactions.
3. To learn to do design and evaluate effective human-computer-interactions.
4. To study HCI models and theories.
5. To understand HCI design processes.
6. To apply HCI to real life use cases.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Explain importance of HCI study and principles of user-centered design (UCD) approach.

CO2: Develop understanding of human factors in HCI design.

CO3: Develop understanding of models, paradigms, and context of interactions.

CO4: Design effective user-interfaces following a structured and organized UCD process.

CO5: Evaluate usability of a user-interface design.

CO6: Apply cognitive models for predicting human-computer-interactions.

COURSE CONTENTS

Unit I	**INTRODUCTION**	**(06 hrs)**
What is HCI?, Disciplines involved in HCI, Why HCI study is important? The psychology of everyday things Donald A. Norman, Principles of HCI, User-centered Design. Measurable Human factors.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**UNDERSTANDING THE HUMAN and HUMAN INTERACTION**	**(06 hrs)**
Input-output channels, Human memory, Human emotions, Individual differences, Psychology. Ergonomics, Human errors, Models of interaction, Paradigms of Interactions, Interaction styles, Interactivity, Context of interaction, User experience.		

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**HCI MODELS AND THEORIES**	**(06 hrs)**
User Profiles, categorization of users, Goal and task hierarchy model, Linguistic model, Physical and device models, GOMS, Norman's 7 stage model, Cognitive architectures, Hierarchical task analysis (HTA), Uses of task analysis, Diagrammatic dialog design notations.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**DESIGN PROCESS**	**(06 hrs)**
Design Rules : Principles that support usability, Design standards, Design Guidelines, What is interaction design?, The software design process, User focus, Scenarios, Navigation Design, Screen Design, Prototyping techniques, Wire-Framing, Understanding the UI Layer and Its Execution Framework, Model-View-Controller(MVC) Framework		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**HCI GUIDELINES AND EVALUATION TECHNIQUES**	**(06 hrs)**
Using toolkits, User interface management system (UIMS), Goals of evaluation, Categorization of Evaluation techniques, Choosing an Evaluation Method. DECIDE, Heuristic Evaluation, cognitive walk through, Usability testing		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**FUTURE TRENDS**	**(06 hrs)**
Ubiquitous Computing, Design thinking, Finding things on web, Augmented Reality, Virtual Reality, Challenges in designing interfaces for smart homes, smart devices, handheld devices, smart wrist watch, Future of HCI		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Alan Dix (2008). Human Computer Interaction. Pearson Education. ISBN 978-81-317-1703-5.
2. Ben Shneiderman; Catherine Plaisant; Maxine Cohen; Steven Jacobs (29 August 2013).
3. Designing The User Interface: Strategies for Effective Human-Computer Interaction. Pearson Education Limited. ISBN 978-1-292-03701-1.

Reference Books:

1. Gerard Jounghyun Kim (20 March 2015). Human–Computer Interaction: Fundamentals and Practice.CRC Press. ISBN 978-1-4822-3390-2.
2. Donald A. Norman (2013). The Design of Everyday Things Basic Books. ISBN 978-0-465-07299-6.
3. Jeff Johnson (17 December 2013). Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines. Elsevier. ISBN 978-0-12-411556-9.
4. Alan Cooper; Robert Reimann; David Cronin; Christopher Noessel (13 August 2014). About Face: The Essentials of Interaction Design. Wiley. ISBN 978-1-118-76658-3.
5. Alan Cooper (1 January 1999). The Inmates are running the Asylum, Sam's. ISBN 978-0-672-31649-4.
6. John M. Carroll (21 May 2003). HCI Models, Theories, and Frameworks: Toward a MultidisciplinaryScience. Morgan Kaufmann. ISBN 978-0-08-049141-7.
7. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, About Face: The Essentials of Interface Design, Wiley India, ISBN: 9788126559718,4th Ed
8. Rogers, Sharp, Preece, Interaction Design: Beyond Human Computer Interaction, Wiley India, ISBN:11. 9788126544912,3ed
9. Wilbert O. Galitz, The Essential Guide to user Interface Design, Wiley India, ISBN: 9788126502806

E- Books / E- Learning References:

1. http://hcibib.org/
2. Andriod Design Guidelines --- https://developer.android.com/guide/practices/ui_guidelines/index.html
3. iOS Human Interface Guidelines -- https://developer.apple.com/ios/human-interfaceguidelines/ overview/design-principles/
4. MacOS Human Interface Guidelines ---- https://developer.apple.com/library/content/documentation/UserExperience/Conceptual/OSX HIGuidelines/
5. www.baddesigns.com

HOME

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314445(A) : Elective -I : Design and Analysis of Algorithm

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:

1. Data Structures and Algorithms.
2. Discrete Structures.
3. Basic mathematics: Induction, probability theory, logarithms.

Course Objectives:

1. To understand the problem solving and problem classification.
2. To know the basics of computational complexity analysis of various algorithms.
3. To provide students with foundations to deal with a variety of computational problems using different design strategies.
4. To select appropriate algorithm design strategies to solve real world problems.
5. To understand the concept of nondeterministic polynomial algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Calculate computational complexity using asymptotic notations for various algorithms.

CO2: Apply Divide & Conquer as well as Greedy approach to design algorithms.

CO3: Understand and analyze optimization problems using dynamic programming.

CO4: Illustrate different problems using Backtracking.

CO5: Compare different methods of Branch and Bound strategy.

CO6: Classify P, NP, NP-complete, NP-Hard problems.

COURSE CONTENTS

Unit I	INTRODUCTION	(07 hrs)

Proof Techniques: Contradiction, Mathematical Induction, Direct proofs, Proof by counter example, Proof by contraposition.

Analysis of Algorithm: Efficiency- Analysis framework, asymptotic notations – big O, theta and omega.

Analysis of Non-recursive and recursive algorithms: Solving Recurrence Equations using Masters theorem and Substitution method.

Brute Force method: Introduction to Brute Force method & Exhaustive search, Brute Force solution to 8 queens' problem.

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**DIVIDE AND CONQUER AND GREEDY METHOD**	**(06 hrs)**
Divide & Conquer: General method, Quick Sort – Worst, Best and average case. Binary search, Finding Max-Min, Large integer Multiplication (for all above algorithms analysis to be done with recurrence). **Greedy Method:** General method and characteristics, Kruskal's method for MST (using nlogn complexity), Dijkstra's Algorithm, Fractional Knapsack problem, Job Sequencing, Max flow problem and Ford-Fulkerson algorithm in transport network		
Mapping of Course Outcomes for Unit II	**CO1, CO2**	
Unit III	**DYNAMIC PROGRAMMING**	**(06 hrs)**
General strategy, Principle of optimality, 0/1 knapsack Problem, Coin change-making problem, Bellman-Ford Algorithm, Multistage Graph problem (using Forward computation), Travelling Salesman Problem		
Mapping of Course Outcomes for Unit III	**CO1, CO3**	
Unit IV	**BACKTRACKING**	**(06 hrs)**
General method, Recursive backtracking algorithm, Iterative backtracking method. n-Queen problem, Sum of subsets, Graph coloring, 0/1 Knapsack Problem.		
Mapping of Course Outcomes for Unit IV	**CO1, CO4**	
Unit V	**BRANCH AND BOUND**	**(06 hrs)**
The method, Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem – LC branch and bound and FIFO branch and bound solution, Traveling salesperson problem- LC branch and bound		
Mapping of Course Outcomes for Unit V	**CO1, CO5**	
Unit VI	**COMPUTATIONAL COMPLEXITY**	**(05 hrs)**
Non Deterministic algorithms, The classes: P, NP, NP Complete, NP Hard, Satisfiability problem, Proofs for NP Complete Problems: Clique, Vertex Cover		
Mapping of Course Outcomes for Unit VI	**CO1, CO6**	
Text Books:		
1. Horowitz and Sahani, Fundamentals of computer Algorithms, Galgotia, ISBN 81-7371-612-9. **2.** Anany Levitin, Introduction to the Design & Analysis of Algorithm, Pearson, ISBN 81- 7758-835-4.		

Reference Books:

1. Jon Kleinberg, Algorithm Design, Pearson, ISBN : 0-321-29535-8
2. S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN 10 : 0-19-809369-1.
3. Thomas H Cormen and Charles E.L Leiserson, Introduction to Algorithm, PHI, ISBN: 9788120340077
4. Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3.
5. R. C. T. Lee, SS Tseng, R C Chang, Y T Tsai, Introduction to Design and Analysis of Algorithms, A Strategic approach, Tata McGraw Hill, ISBN-13: 978-1-25-902582-2. ISBN-10: 1-25-902582-9.
6. Steven S Skiena, The Algorithm Design Manual, Springer, ISBN 978-81-8489-865-1.
7. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Desktop Quick Reference, O'Reilly, ISBN: 9789352133611.
8. Michael T. Goodrich, Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet
9. Examples, Wiley India, ISBN: 9788126509867
10. Rod Stephens, Essential Algorithms: A Practical Approach to Computer Algorithms, Wiley India, ISBN:9788126546138

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

314445(B): Elective -I : Advanced Database Management System

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

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Prerequisite Courses:

1. Database Management System

Course Objectives:

1. To understand the fundamental concepts of Relational and Object-oriented databases.
2. To learn and understand various Parallel and Distributed Database Architectures and Applications.
3. To understand and apply the basic concepts, categories and tools of NoSQL Database.
4. To learn and understand Data warehouse and OLAP Architectures and Applications.
5. To learn data mining architecture, algorithms, software tools and applications.
6. To learn enhanced data models for advanced database applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate relational and object-oriented databases.

CO2: Illustrate parallel & distributed database architectures.

CO3: Apply concepts of NoSQL Databases.

CO4: Explain concepts of data warehouse and OLAP technologies.

CO5: Apply data mining algorithms and various software tools.

CO6: Comprehend emerging and enhanced data models for advanced applications.

COURSE CONTENTS

Unit I	REVIEW OF RELATIONAL DATA MODEL AND RELATIONAL DATABASE CONSTRAINTS	(06 hrs)

Relational model concepts, Relational model constraints and relational database schemas, Update operations, anomalies, dealing with constraint violations, Types and violations. **Overview of Object-Oriented Concepts** – Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism examples.

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	PARALLEL AND DISTRIBUTED DATABASES	(06 hrs)

Introduction to Parallel Databases, Architectures for parallel databases, Parallel query evaluation Parallelizing individual operations, Parallel query optimizations. **Introduction to distributed databases**, Distributed DBMS architectures, storing data in a Distributed DBMS, Distributed catalog management, Distributed Query processing, Updating distributed data, Distributed transactions, Distributed Concurrency control and Recovery.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**NOSQL DATABASES**	**(06 hrs)**
Introduction, **Overview, and History of NoSQL Databases**- The definition of Four Types of No SQL Databases. NoSQL Key/Value Database: MongoDB, **Column-Oriented Database:** Apache Cassandra, Comparison of Relational and NoSQL databases, NoSQL database Development Tools (Map Reduce/Hive) and Programming Languages (XML/JSON)		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**DATA WAREHOUSING**	**(06 hrs)**
Architectures and components of data warehouse, Characteristics and limitations of data warehouse, Data warehouse schema (Star, Snowflake), OLAP Architecture (ROLAP/MOLAP/HOLAP), Introduction to decision support system, Views and Decision support		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**DATA MINING**	**(06 hrs)**
Introduction to Data Mining, KDD seven step process, Architecture of data mining, Introduction to predictive and descriptive algorithms, Data mining software and applications		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**ENHANCED DATA MODELS FOR ADVANCED APPLICATIONS**	**(06 hrs)**
Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Silberschatz A., Korth H., Sudarshan S, Database System Concepts, McGraw Hill Publication, ISBN-0-07-120413-X, Sixth Edition.
2. S. K. Singh, Database Systems: Concepts, Design and Application, Pearson Publication, ISBN-978-81-317-6092-5.

Reference Books:

1. Kristina Chodorow, Michael Dirolf, “MongoDB: The Definitive Guide”, O’Reilly Publications
2. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, Elsevier
3. Mario Piattini, Oscar Diaz “Advanced Database Technology and Design”- online book.
4. M. Tamer Özsu, Patrick Valduriez, “Principles of Distributed Database Systems” Prentice Hall, 1999.
5. Ramez Elmasri and Shamkant B. Navathe “Fundamentals of Database System” 7th Edition

HOME

<table>
<tr><td colspan="3">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314445(C) : Elective -I : Design Thinking</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH) : 3 hrs/week</td><td>03 Credits</td><td>Mid_Semester : 30 Marks
End_Semester : 70 Marks</td></tr>
<tr><td colspan="3">Prerequisite Courses:
1. Software Engineering, 2. Problem Solving</td></tr>
<tr><td colspan="3">Companion Course: Human Computer Interaction</td></tr>
<tr><td colspan="3">Course Objectives:
1. To learn the Design thinking basic concepts.
2. To identify the opportunities and challenges for design thinking innovation.
3. To describe the define and ideate process of design thinking.
4. To summarize the prototyping techniques.
5. To enlist the activities carried out in Test and reflect phase of design thinking.
6. To Interpret Design Thinking case studies.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able to–
CO1: Identify need and features of design thinking.
CO2: Identify the opportunities and challenges for design thinking innovation.
CO3: Learn the process of design thinking using various tools.
CO4: Summarize and learn the various prototyping techniques.
CO5: Enlist the activities carried out in Test and reflect phase of design thinking.
CO6: Interpret the design thinking disruptive innovations through case studies.</td></tr>
<tr><td colspan="3">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>INTRODUCTION TO DESIGN THINKING</td><td>(06 hrs)</td></tr>
<tr><td colspan="3">Introduction to Design and Design Thinking, Definition of Design Thinking, Need of Design Thinking, Features of Design Thinking, Problem Solving and Design, Design thinking as Strategy of Innovation, Use of Design Thinking, Design Thinking-Attributes, The Principles of Design Thinking, The Five-step Process of Design Thinking(Empathize, Define, Ideate, Prototype, Test),Design Thinking-A Solution based thinking: Design Thinking vs. Scientific Method, Problem Focused vs. Solution Focused, Analysis vs. Synthesis, Divergent Thinking vs. Convergent Thinking , Roots of Design Thinking in Human Centric Design Process.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>EXPLORE AND EMPATHIZE</td><td>(06 hrs)</td></tr>
</table>

Explore- STEEP Analysis, Activity Systems, Stakeholder Analysis, Framed Opportunities Empathise- Observation, Problem statement, User Interviews- Interview for Empathy, Explorative Interview, Ask 5x Why, 5W+H questions (Design Thinking Toolbox), Needs Finding, Empathy Map, Persona Development, Customer Journey Map		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**DEFINE AND IDEATE**	**(06 hrs)**
Define- Define Point of view, "How might we ..." question, Storytelling, Context Mapping Ideate-Brainstorming, 2x2 Matrix Ideate- Purpose, Methods & Tools, SCAMPER, SCAMPER for Ideation, SCAMPER template, Analogous Inspiration, IDEATION using Deconstruct & Reconstruct, User Experience Journey		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**PROTOTYPE**	**(06 hrs)**
Get Visual, Design Principals, Determine What to Prototype, Storyboard Prototype- How to carry out Prototyping? Frequently used kinds of prototypes, Focused experiments – Critical Experience Prototype (CEP) & Critical Function Prototype (CFP), Crazy experiments – Dark horse Prototype, Combined experiments – Funky prototype Prototyping -Paper Prototyping, Digital Prototyping- Wireframe vs Realistic Prototypes, HTML vs WYSIWYG Editors, Additional Tools for Prototyping, Working with a Developer, Prototype Examples		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**TEST AND REFLECT**	**(06 hrs)**
Test- Testing Sheet, Feedback Capture Grid, Powerful questions in experience testing, Solution interview Structured Usability Testing, A/B Testing, Design Testing with Users, Exploring Visual Design Mock-Ups Choosing a Design Testing, Usability Testing, Reflect- I like, I wish, I wonder, Create a pitch, lean canvas lessons learned, Road map for implementation Evolve- Concept Synthesis, Viability Analysis(Impact Evaluation), Innovation Tool using user needs, CAP, 4s.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**DISRUPTIVE INNOVATION**	**(06 hrs)**
Reimagining the Trade Show Experience at IBM, Redesigning the Customer Contact Center at Toyota, Social Networking at MeYou Health, Rethinking Subsidized Meals for the Elderly at The Good Kitchen THE SOCIAL PROBLEM Design Thinking in Healthcare with IDEO, Design Thinking Transformed Airbnb, IBM Design Thinking: A Framework To Help Teams Continuously Understand and Deliver, UberEATS.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Text Books:		

1. Michael Lewrick, Patrick Link, Larry Leifer , "The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods", March 2020 edition, ISBN: 978-1-119- 62921-4, WILEY Publication.

2. Mr Lee Chong Hwa (Lead Facilitator), "The Design Thinking: Guidebook"

Reference Books:

1. IDEO (Firm), "The Field Guide to Human-centered Design: Design Kit", 1st edition, ISBN-978099140631-9, IDEO 2015.
2. Russ Unger, Carolyn Chandler, "A Project Guide to UX Design For user experience designers inthe field or in the making (Voices That Matter)", 2nd Edition, ISBN 13: 978-0-321-81538-5
3. Karl T Ulrich, "Design – Creation of Artifacts in Society", 1st edition, ISBN 978-0-9836487-0-3, University of Pennsylvania.
4. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", ISBN- 9780061937743, Harper Collins, 2009.
5. Eli Woolery, "Design Thinking Handbook", In-Vision publisher.
6. Jeanne Liedtka, Andrew King, Kevin Bennett, "Solving Problems with Design Thinking: TenStories of What Works", Columbia Business School Publishing, E-ISBN 978-0-231-53605-9
7. Jake Knapp, John Zeratsky, Braden Kowitz, "Sprint: How to Solve Big Problems and Test New Ideasin Just Five Days", ISBN 9780593076118, Bantam Press, 2016.
8. Don Norman, "The Design of Everyday Things: Revised and Expanded Edition", ISBN9780465072996, Basic Books, 2013.
9. Tom Kelly, "Creative Confidence: Unleashing the Creative Potential Within Us All", October 2013 edition, ISBN: 978-0-385-34936-9

E -Books / E -Learning References:

1. Creating Customer Journey Maps - MODULE 4: Design Thinking and Customer Journey Maps Coursera
2. The IBM Story: https://www.coursera.org/lecture/uva-darden-design-thinking-innovation/the- ibm-story-iq0kE
3. Design Thinking - A Primer online course video lectures by IIT Madras (freevideolectures.com)
4. NPTEL: Humanities and Social Sciences - NOC: Understanding Design Thinking & People Centered Design
5. NPTEL: Management - NOC: Design Thinking - A Primer
6. Design Thinking Transformed Airbnb: https://review.firstround.com/How-design-thinking-transformed-Airbnb-from-failing-startup-to-billion-dollar-business
7. UberEATS: https://medium.com/uber-design/how-we-design-on-the-ubereats-team-ff7c41fffb76
8. IBM Design Thinking: A Framework To Help Teams Continuously Understand and Deliver: https://www.ibm.com/blogs/think/2016/01/ibm-design-thinking-a-framework-for-teams-to-continuously-understand-and-deliver/
9. https://www.tutorialspoint.com/design_thinking/index.htm
10. https://www.designkit.org/case-studies
11. https://www.innovationtraining.org/design-thinking-workshop-resources/

HOME

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

314445(D): Elective -I : Internet of Things

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credits	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:

1. Basics of Computer Network
2. Processor Architecture

Course Objectives:

1. To know the IoT fundamentals and understanding the technologies.
2. To learn the concept of M2M (machine to machine) with necessary protocols.
3. To understand the Python Scripting Language and controlling hardware for IoT.
4. To learn the IoT Platforms widely used in IoT applications.
5. To understand the implementation of web-based services on IoT devices with cloud interface.
6. To introduce the IoT applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Discuss fundamentals, architecture and framework of IoT.

CO2: Select suitable sensors and actuators for real time scenarios.

CO3: Justify the significance of protocol for wireless communication and IoT challenges

CO4: Understand the Python programming for development of IoT applications.

CO5: Understand the cloud interfacing technologies.

CO6: Design and Implement real time IoT applications.

COURSE CONTENTS

Unit I	INTRODUCTION TO IOT	(06 hrs)

Definition and Characteristics of IoT, IoT Framework and Architecture, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT Levels and Templates, **IoT Enabled Technologies** – Wireless Sensor Networks, Cloud Computing, Embedded Systems, Big Data Analysis, UAV, Web Services, IoT & M2M- Machine to Machine, Difference between IoT and M2M,
Software Defined Network & NFV

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	THINGS IN IOT	(06 hrs)

Introduction to Sensors - Light sensor, voltage sensor, Temperature and Humidity Sensor, Motion Detection Sensors, Wireless Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasonic sensor Introduction to Actuators- Connecting LED, Buzzer, Controlling- AC Power devices, Servo motor, Speed DC Motor. Electronic Communication Protocols (Device Interfacing) Protocols: I2C, SPI, UART, USRT, CAN.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**COMMUNICATION PROTOCOLS AND IOT CHALLENGES**	**(06 hrs)**
Introduction to Non-IP Based Protocol (IEEE 802.11, IEEE 802.15.4), BlueTooth, ZigBee, IP Based Protocol (IPV4, IPV6, 6LoWPAN), Application Layer Protocols (MQTT, AMQP) Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**IOT PLATFORMS AND ITS PROGRAMMING**	**(06 hrs)**
Introduction to Arduino and Raspberry Pi- Installation, Interfaces (Serial, SPI, I2C), Introduction to Python program with Raspberry Pi with focus on interfacing external gadgets (Bluetooth Speaker, CCTV Camera, Robotic Arm etc.), controlling output, and reading input from pins. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**IOT PHYSICAL SERVERS AND CLOUD OFFERINGS**	**(06 hrs)**
Introduction to Cloud Storage models (SaaS, Paas, IaaS) and communication APIs Web server – Web server for IoT, Cloud for IoT (ThingSpeak, Ubidots), Python web application framework, Designing a RESTful web API. **IoT Security**: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modelling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non repudiation and availability, Security model for IoT.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**DOMAIN SPECIFIC APPLICATIONS Of IOT**	**(06 hrs)**
Home Automation - Smart Appliances, Intrusion Detection, Smoke/Gas Detector, Smart City -Smart Parking, Smart Road, Structural Health Monitoring, Surveillance applications, Health - Fitness and Health Monitoring, Wearable Electronics, Agriculture - Smart Irrigation, Greenhouse Control, Environment - Weather Monitoring, Noise Pollution Monitoring, Logistic - Root Generation and Scheduling, Shipment Monitoring, Retail Management - Inventory Management, Smart Payments, **Industry Applications** - Machine Diagnosis and Prognosis, Indoor Air Quality Monitoring.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Text Books:		

1. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach” , 2014, Universities Press(India) Pvt Ltd., ISBN: 9788173719547
2. Matt Richardson & Shawn Wallac, “Getting Started with Raspberry Pi”, 2014, O'Reilly (SPD), ISBN:9789350239759
3. Pethuru Raj and Anupama C Raman, “The Internet of Things: Enabling Technologies, Platforms and Use Cases”, 2017, CRC Press, ISBN: 13:978-1-4987-6128-4.
4. Rushi Gajjar, “Raspberry Pi Sensors”, 2015, Packt Publishing, ISBN : 978-1-78439-361-8
5. Robert H. Bishop, “The Mechatronics Handbook”, 2002, CRC Press , ISBN: 0-8493-0066-5/02

Reference Books:

1. Peter Waher, “Learning Internet of Things”, 2015, Packt Publishing, ISBN: 978-1-78355-353-2
2. Peter Friess, “Internet of Things – From Research and Innovation to Market Deployment”, 2014, River Publishers, ISBN: 978-87-93102-94-1
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 2010, Wiley Publication, ISBN: 978-0-470-99765-9
4. Simon Monk, “Raspberry Pi Cookbook, Software and Hardware Problems and solutions”, 2019, O'Reilly, ISBN 9781492043225

E- Books **/ E- Learning References:**

1. Introduction to Arduino and its Setup: https://www.arduino.cc/en/software
2. Introduction to Raspberry Pi and its OS (Raspbian Lit): https://www.raspberrypi.org/software/operating- systems/
3. Cloud for IoT– ThingSpeak: https://thingspeak.com/
4. Cloud for IoT - Ubidots: https://ubidots.com/stem/

Overall IoT Course Contents: https://onlinecourses.nptel.ac.in/noc21_cs17/preview

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314446 : Operating Systems Lab</td></tr>
<tr><td align="center">Teaching Scheme:</td><td align="center">Credit Scheme:</td><td align="center">Examination Scheme:</td></tr>
<tr><td align="center">Practical (PR) : 4 hrs/week</td><td align="center">02 Credits</td><td align="center">PR: 25 Marks
TW: 25 Marks</td></tr>
</table>

HOME

Prerequisites:

1. C Programming
2. Fundamentals of Data Structure

Course Objectives:

1. To introduce and learn Linux commands required for administration.
2. To learn shell programming concepts and applications.
3. To demonstrate the functioning of OS basic building blocks like processes, threads under the LINUX.
4. To demonstrate the functioning of OS concepts in user space like concurrency control (process synchronization, mutual exclusion), CPU Scheduling, Memory Management and Disk Scheduling in LINUX.
5. To demonstrate the functioning of Inter Process Communication under LINUX.
6. To study the functioning of OS concepts in kernel space like embedding the system call in any LINUX kernel.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Apply the basics of Linux commands.

CO2: Build shell scripts for various applications.

CO3: Implement basic building blocks like processes, threads under the Linux.

CO4: Develop various system programs for the functioning of OS concepts in user space like concurrency control, CPU Scheduling, Memory Management and Disk Scheduling in Linux.

CO5: Develop system programs for Inter Process Communication in Linux.

Guidelines for Instructor's Manual

1. The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.

2. Practical Examination will be based on the term work.

3. Candidate is expected to know the theory involved in the experiment.

4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student's programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at
Laboratory.

List of Laboratory Assignments

Group A

Assignment No. 1 :
A. Study of Basic Linux Commands: echo, ls, read, cat, touch, test, loops, arithmetic comparison, conditional loops, grep, sed etc.

B. Write a program to implement an address book with options given below: a) Create address book. b) View address book. c) Insert a record. d) Delete a record. e) Modify a record. f) Exit

Assignment No. 2:

Process control system calls: The demonstration of FORK, EXECVE and WAIT system calls along with zombie and orphan states.

A. Implement the C program in which main program accepts the integers to be sorted. Main program uses the FORK system call to create a new process called a child process. Parent process sorts the integers using sorting algorithm and waits for child process using WAIT system call to sort the integers using any sorting algorithm. Also demonstrate zombie and orphan states.

B. Implement the C program in which main program accepts an array. Main program uses the FORK system call to create a new process called a child process. Parent process sorts an array and passes the sorted array to child process through the command line arguments of EXECVE system call. The child process uses EXECVE system call to load new program which display array in reverse order.

Assignment No. 3:

Implement the C program for CPU Scheduling Algorithms: Shortest Job First (Preemptive) and Round Robin with different arrival time.

Assignment No. 4:

A. Thread synchronization using counting semaphores. Application to demonstrate: producer-consumer problem with counting semaphores and mutex.

B. Thread synchronization and mutual exclusion using mutex. Application to demonstrate: Reader-Writer problem with reader priority.

Assignment No. 5:

Implement the C program for Deadlock Avoidance Algorithm: Bankers Algorithm.

Assignment No. 6:

Implement the C program for Page Replacement Algorithms: FCFS, LRU, and Optimal for frame size as minimum three.

Assignment No. 7:

Inter process communication in Linux using following.

A. FIFOS: Full duplex communication between two independent processes. First process accepts sentences and writes on one pipe to be read by second process and second process counts number of characters, number of words and number of lines in accepted sentences, writes this output in a text file and writes the contents of the file on second pipe to be read by first process and displays on standard output.

B. Inter-process Communication using Shared Memory using System V. Application to demonstrate: Client and Server Programs in which server process creates a shared memory segment and writes the message to the shared memory segment. Client process reads the message from the shared memory segment and displays it to the screen.

Assignment No. 8: Implement the C program for Disk Scheduling Algorithms: SSTF, SCAN, C-Look considering the initial head position moving away from the spindle.

Study Assignment: Implement a new system call in the kernel space, add this new system call in the Linux kernel by the compilation of this kernel (any kernel source, any architecture and any Linux kernel distribution) and demonstrate the use of this embedded system call using C program in user space.

Reference Books:
1. Das, Sumitabha, UNIX Concepts and Applications, TMH, ISBN-10: 0070635463, ISBN-13: 978-0070635463, 4th Edition. **2.** Kay Robbins and Steve Robbins, UNIX Systems Programming, Prentice Hall, ISBN-13: 978-0134424071, ISBN-10: 0134424077, 2nd Edition. **3.** Mendel Cooper, Advanced Shell Scripting Guide, Linux Documentation Project, Public domain. **4.** Yashwant Kanetkar, UNIX Shell Programming, BPB Publication.

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314447: Human Computer Interaction Laboratory

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 2 hrs/week	01 Credits	OR: 50 Marks

HOME

Prerequisites:

1. Problem Solving and Object-Oriented Technologies

Course Objectives:

1. To study the field of human-computer-interaction.
2. To gain an understanding of the human part of human-computer-interactions.
3. To learn to do design and evaluate effective human-computer-interactions.
4. To study HCI models and theories.
5. To understand HCI design processes.
6. To apply HCI to real life use cases.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Differentiate between good design and bad design.

CO2: Analyze creative design in the surrounding.

CO3: Assess design based on feedback and constraint.

CO4: Design paper-based prototypes and use wire frame.

CO5: Implement user-interface design using web technology.

CO6: Evaluate user-interface design using HCI evaluation techniques.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments, and it should bemade available to students and laboratory instructor/Assistant.
The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by students in the form of journals. The Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept, printouts of the code written using coding standards, sample test cases etc. To support Go-green, printouts should be asked to any 2 students from each batch. However, all students must submit the soft copy and should be maintained by batch teacher.
2. Oral Examination will be based on the HCI theory and HCI lab term work.
3. Candidate is expected to know the theory involved in the experiment.

4. The Oral examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.
5. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware such as tags, coding standards, design flow to be implemented etc. should be checked by the concerned faculty member(s).

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. All the assignments should be conducted on 64-bit
open-source software.

Guidelines for Oral Examination

Both internal and external examiners should jointly conduct Oral examination. During assessment, the examiners should give the maximum weightage to the satisfactory answer of the problem statement in question. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation.

List of Laboratory Assignments

Group A: CO1,2,3

1. Identify and observe bad designs

Students are expected to submit minimum of 3 to 5 photographs of bad designs in their surrounding or home or any product or neighborhood and create a report mentioning why is it bad? They can submit word/pdf file having photos and description, source of photos and place and mention why is it bad and discuss the outcome during lab session.

2. "The Jugad":

Humans are very creative and often use it to get work done with available set up and resources. Students are expected to identify Jugad (things used creatively but not meant for that) things and submit minimum of 3 to 5 photographs of jugad in their surrounding or home or neighborhood. Prepare a report mentioning the Jugad and source of photos. Discuss the outcome during lab session.

3. Feedback and Constraint:

Products or interfaces should offer useful feedback to understand the state and have constraints to avoid mistakes while using them. Students are expected to identify and analyze minimum of 5 interfaces or products offering feedback and constraint. Prepare a report clearly showcasing feedback and constraint and support it with minimum of 5 photographs taken in their surrounding or home or neighborhood. Discuss the outcome during lab session

Group B: CO 4,5

4. Prototype and wire frame:

Students are expected to choose a problem statement and identify –

Types of users going to use (age, experience, environmental conditions during use etc..) Minimum 3 scenarios of use Create paper-based prototypes for scenarios.
Use any open-source tool to wire frame scenarios.

5. CSS:
Students are expected to design minimum of 5 web pages using CSS for the problem statement chosen in assignment no. 4. Apply CSS properties Border, margins, Padding, Navigation, dropdown list to page

Group C: CO 5,6

1. CMS tool:
Develop website using any CMS tool which falls into one of the categories blog, social networking, News updates, Wikipedia, E-commerce store. Website must include home page, and at least 5 forms. Use WordPress/ Joomla/ Drupal /PHP/ CSS/Bootstrap/ JavaScript.

2. Evaluation of Interface:
Students are expected to evaluate minimum of two products / software interface against known HCI evaluation.

Reference Books:

1. Alan Dix (2008). Human Computer Interaction. Pearson Education. ISBN 978-81-317-1703-5
2. Ben Shneiderman; Catherine Plaisant; Maxine Cohen; Steven Jacobs (29 August 2013). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Pearson Education Limited.ISBN 978-1-292-03701-1.
3. https://www.w3schools.com

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314448 : Laboratory Practice-I (Machine Learning)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 4 hrs/week	**02 Credits**	**PR : 25 Marks** **TW: 25 Marks**

HOME

Prerequisites:

1. Python programming language

Course Objectives:

1. The objective of this course is to provide students with the fundamental elements of machine learning for classification, regression, clustering.
2. Design and evaluate the performance of a different machine learning models.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Implement different supervised and unsupervised learning algorithms.

CO2: Evaluate performance of machine learning algorithms for real-world applications.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Students should submit term work in the form of a handwritten journal based on a specified listof assignments.
2. Practical Examination will be based on the term work.
3. Students are expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratories should be as a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in a journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student programs should be attached to the journal by every student and the same to be maintained by the department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory Conduction

1. All the assignments should be implemented using python programming language
2. **Implement any 4 assignments out of 6**
3. **Assignment clustering with K-Means is compulsory**
4. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic.
5. The instructor may frame multiple sets of assignments and distribute them among batches of students.
6. All the assignments should be conducted on multicore hardware and 64-bit open-sources software

Guidelines for Practical Examination

1. Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
2. The supplementary and relevant questions may be asked at the time of evaluation to judge the student 's understanding of the fundamentals, effective and efficient implementation.
3. The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

Group A

1. **Data preparation:**

   Download heart dataset from following link.
   https://www.kaggle.com/zhaoyingzhu/heartcsv
   Perform following operation on given dataset.
   a) Find Shape of Data
   b) Find Missing Values
   c) Find data type of each column
   d) Finding out Zero's
   e) Find Mean age of patients
   f) Now extract only Age, Sex, ChestPain, RestBP, Chol. Randomly divide dataset in training (75%) and testing (25%).

   Through the diagnosis test I predicted 100 report as COVID positive, but only 45 of those were actually positive. Total 50 people in my sample were actually COVID positive. I have total 500 samples.

   Create confusion matrix based on above data and find
   I. Accuracy
   II. Precision
   III. Recall
   IV. F-1 score

2. **Assignment on Regression technique**

   Download temperature data from below link. https://www.kaggle.com/venky73/temperatures-of-india?select=temperatures.csv

   This data consists of temperatures of INDIA averaging the temperatures of all places month wise. Temperatures values are recorded in CELSIUS
   a. Apply Linear Regression using suitable library function and predict the Month-wise

temperature.

b. Assess the performance of regression models using MSE, MAE and R-Square metrics
c. Visualize simple regression model.

3. **Assignment on Classification technique**

Every year many students give the GRE exam to get admission in foreign Universities. The data set contains GRE Scores (out of 340), TOEFL Scores (out of 120), University Rating (out of 5), Statement of Purpose strength (out of 5), Letter of Recommendation strength (out of 5), Undergraduate GPA (out of 10), Research Experience (0=no, 1=yes), Admitted (0=no, 1=yes). Admitted is the target variable.

Data Set Available on kaggle (The last column of the dataset needs to be changed to 0 or 1)Data Set : https://www.kaggle.com/mohansacharya/graduate-admissions

The counselor of the firm is supposed check whether the student will get an admission or not based on his/her GRE score and Academic Score. So to help the counselor to take appropriate decisions build a machine learning model classifier using Decision tree to predict whether a student will get admission or not.

Apply Data pre-processing (Label Encoding, Data Transformation….) techniques if necessary.

Perform data-preparation (Train-Test Split)

C. Apply Machine Learning Algorithm

D. Evaluate Model.

4. **Assignment on Improving Performance of Classifier Models**

A SMS unsolicited mail (every now and then known as cell smartphone junk mail) is any junk message brought to a cellular phone as textual content messaging via the Short Message Service (SMS). Use probabilistic approach (Naive Bayes Classifier / Bayesian Network) to implement SMS Spam Filtering system. SMS messages are categorized as SPAM or HAM using features like length of message, word depend, unique keywords etc.

Download Data -Set from : http://archive.ics.uci.edu/ml/datasets/sms+spam+collection

This dataset is composed by just one text file, where each line has the correct class followed by the raw message.

a. Apply Data pre-processing (Label Encoding, Data Transformation….) techniques if necessary
b. Perform data-preparation (Train-Test Split)
c. Apply at least two Machine Learning Algorithms and Evaluate Models
d. Apply Cross-Validation and Evaluate Models and compare performance.
e. Apply Hyper parameter tuning and evaluate models and compare performance.

5. **Assignment on Clustering Techniques**

Download the following customer dataset from below link:

Data Set: https://www.kaggle.com/shwetabh123/mall-customers

This dataset gives the data of Income and money spent by the customers visiting a Shopping Mall. The data set contains Customer ID, Gender, Age, Annual Income, Spending Score. Therefore, as a mall owner you need to find the group of people who are the profitable customers for the mall owner. Apply at least two clustering algorithms (based on Spending Score) to find the group of customers.

a. Apply Data pre-processing (Label Encoding , Data Transformation….) techniques if necessary.
b. Perform data-preparation(Train-Test Split)

c. Apply Machine Learning Algorithm
d. Evaluate Model.
e. Apply Cross-Validation and Evaluate Model

6. **Assignment on Association Rule Learning**

Download Market Basket Optimization dataset from below link.

Data Set: https://www.kaggle.com/hemanthkumar05/market-basket-optimization

This dataset comprises the list of transactions of a retail company over the period of one week. It contains a total of 7501 transaction records where each record consists of the list of items sold in one transaction. Using this record of transactions and items in each transaction, find the association rules between items.

There is no header in the dataset and the first row contains the first transaction, so mentioned header = None here while loading dataset.

a. Follow following steps :
b. Data Preprocessing
c. Generate the list of transactions from the dataset
d. Train Apriori algorithm on the dataset
e. Visualize the list of rules
F. Generated rules depend on the values of hyper parameters. By increasing the minimum confidence value and find the rules accordingly

7. **Assignment on Multilayer Neural Network Model**

Download the dataset of National Institute of Diabetes and Digestive and Kidney Diseases from below link :

Data Set: https://raw.githubusercontent.com/jbrownlee/Datasets/master/pima-indians-diabetes.data.csv

The dataset is has total 9 attributes where the last attribute is “Class attribute” having values 0 and 1. (1=”Positive for Diabetes”, 0=”Negative”)

a. Load the dataset in the program. Define the ANN Model with Keras. Define at least two hidden layers. Specify the ReLU function as activation function for the hidden layer and Sigmoid for the output layer.
b. Compile the model with necessary parameters. Set the number of epochs and batch size and fit the model.
c. Evaluate the performance of the model for different values of epochs and batch sizes.
d. Evaluate model performance using different activation functions Visualize the model using ANN Visualizer.

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
3. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012
4. Tom M. Mitchell , Machine Learning, 1997, McGraw-Hill, First EditionC. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
5. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition
6. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012.

7. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.
8. Shalev-Shwartz S., Ben-David S., Understanding Machine Learning: From Theory to Algorithms, CUP, 2014
9. Jack Zurada: Introduction to Artificial Neural Systems, PWS Publishing Co. Boston, 2002

Virtual Laboratory:
1. http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

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Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314448 (A) : Laboratory Practice-I (Design and Analysis of Algorithm)

Teaching Scheme:	Credit Scheme	Examination Scheme:
Practical (PR) : 4 hrs/week	02 Credits	PR: 25 Marks TW: 25 Marks

Prerequisites:
1. Data Structures and Algorithms.
2. Discrete Structures.
3. C/C++ programming

Course Objectives:
1. To learn the various algorithmic design strategies.
2. To apply efficiently in problem solving.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Implement the various algorithmic design strategies and use it to solve real time problems/ applications

CO2: Apply Divide & Conquer as well as Greedy approach to design algorithms.

CO3: Analyze optimization problems using dynamic programming.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Students should submit term work in the form of a handwritten journal based on a specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratories should be as a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in a journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student programs

should be attached to the journal by every student and the same to be maintained by the department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory Conduction

1. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic.
2. The instructor may set multiple sets of assignments and distribute them among batches of students. It is appreciated if the assignments are based on real world problems/applications.
3. All the assignments should be conducted on multicore hardware and 64-bit open-source software

Guidelines for Practical Examination

1. Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
2. The supplementary and relevant questions may be asked at the time of evaluation to judge the student 's understanding of the fundamentals, effective and efficient implementation.

The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

1. Write a program to implement Fractional knapsack using Greedy algorithm and 0/1 knapsack using dynamic programming. Show that Greedy strategy does not necessarily yield an optimal solution over a dynamic programming approach.
2. Write a program to implement Bellman-Ford Algorithm using Dynamic Programming and verify the time complexity
3. Write a recursive program to find the solution of placing n queens on the chessboard so that no two queens attack each other using Backtracking.
4. Write a program to solve the travelling salesman problem and to print the path and the cost using LC Branch and Bound.

Reference Books

1. Horowitz and Sahani, Fundamentals of computer Algorithms, Universities Press, ISBN : 9788173716126

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314448 (B) : Laboratory Practice-I (ADBMS)

Teaching Scheme:	Credit Scheme	Examination Scheme:
Practical (PR) :4 hrs/week	02 Credits	PR : 25 Marks TW : 25 Marks

Prerequisites:

1. Database Management System

Course Objectives:

1. To learn and understand Database Modeling, Architectures.
2. To learn and understand Advanced Database Programming Frameworks.
3. To learn NoSQL Databases (Open source) such as MongoDB.
4. To design and develop application using NoSQL Database.
5. To design data warehouse schema for given system.

Course Outcomes:

On completion of the course, students will be able to

CO1: Apply advanced Database Programming Languages.

CO2: Apply the concepts of NoSQL Databases.

CO3: Install and configure database systems.

CO4: Populate and query a database using MongoDB commands.

CO5: Design data warehouse schema of any one real-time: CASE STUDY

CO6: Develop small application with NoSQL Database for back-end.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.
2. Practical Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.
3. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student's programs should be attached to the journal by every student and same to be maintained by department/lab In- charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory Conduction

1. Group A assignments are compulsory and should be performed by individual student.
2. Group B case study may be performed in group of 3/4.
3. Mini project of Group C can be implemented using any suitable front-end. But back-end must be MongoDB.

Guidelines for Practical Examination

1. Practical Examination will be based on the all topics covered.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.

List of Laboratory Assignments

Group A : MongoDB

1. Create a database with suitable example using MongoDB and implement

- Inserting and saving document (batch insert, insert validation)
- Removing document
- Updating document (document replacement, using modifiers, up inserts, updating multipledocuments, returning updated documents)
- Execute at least 10 queries on any suitable MongoDB database that demonstrates following:
  a. Find and find One (specific values)
  b. Query criteria (Query conditionals, OR queries, $not, Conditional semantics) Type-specific queries (Null, Regular expression, Querying arrays)
  c. $ where queries
  d. Cursors (Limit, skip, sort, advanced query options)

2. Implement Map-reduce and aggregation, indexing with suitable example in MongoDB. Demonstrate the following:

- Aggregation framework
- Create and drop different types of indexes and explain () to show the advantage of the indexes.

3. Case Study: Design conceptual model using Star and Snowflake schema for any one database.

4. Mini Project

Pre-requisite: Build the mini project based on the requirement document and design prepared as a part of Database Management Lab in second year.

1. Form teams of around 3 to 4 people.

2. Develop the application:

Build a suitable GUI by using forms and placing the controls on it for any application. Proper data entry validations are expected.

Add the database connection with front end. Implement the basic CRUD operations.

3. Prepare and submit report to include: Title of the Project, Abstract, List the hardware and software requirements at the backend and at the front end, Source Code , Graphical User Interface, Conclusion.

Reference Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", 6thEdition, McGraw Hill Publishers, ISBN 0-07-120413-X.
2. Kristina Chodorow, MongoDB The definitive guide, O'Reilly Publications, ISBN:978-93-5110-269-4,2nd Edition.
3. Jiawei Han, Micheline Kamber, Jian Pei "Data Mining: concepts and techniques", 2nd Edition, Publisher: Elsevier/Morgan Kaufmann.
4. http://nosql-database.org/.

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

314448 (C) : Laboratory Practice-I (Design Thinking)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 4 hrs/week	02 Credits	PR : 25 Marks TW: 25 Marks

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Prerequisites: NA

Course Objectives:

1. To identify the opportunities and challenges for design thinking innovation and empathize and ideate for it.
2. To describe the solution by prototyping the design.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Frame and Design Challenge by performing STEEP Analysis, Conduct Interviews, design and ask 5x Why and 5W+H questions.

CO2: Demonstrate the activities to empathize with the users by creation of Empathy Map, Persona Development, Customer Journey Map.

CO3: Define and ideate process of design thinking and perform brainstorming, selection of ideas, create a storyboard and design paper prototyping or digital prototyping for chosen design challenge.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of journal with write-ups based on specified list of assignments.
2. Practical Examination will be based on all the assignments in the lab manual
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted only if the journal of the candidate is complete inall respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the student based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of write-ups along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out
3. Appropriate knowledge of usage templates related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction
1. Students should be asked to form a group of 3 to 4 students and identify design challenge to provide the solution to real life engineering problems within the social, environmental and economic context. **2.** All the assignments should be conducted using the templates provided in the reference books. **3.** The faculty member should help student to identify Online free or open source tools like diagrams.net, LucidChart, Draw.io, Creatly, Openboard, Microsoft whiteboard etc. which will help students to collaborate and draw diagram. **4.** After every assignment, student group should be asked to demonstrate their design and discuss findings.
Guidelines for Practical Examination
1. Students will be provided with 2 problem statements options covering the detail design challenge statements and student will have to perform any one. **2.** All the problem statements carry equal weightage.
List of Laboratory Assignments
Group A- CO1, C02, CO3
Assignment-I- Inspiration Phase: Perform STEEP analysis by using MAKING SENSE OF STEEP ANALYSIS & STRATEGIC PRIORITIES TEMPLATE and Frame Your Design Challenge. Conduct Interviews, design and ask 5x Why and 5W+H questions **Assignment-II-Empathize Phase:** Observe the user and design Empathy Map, Generate persona/User profile and Customer Journey map **Assignment-III- Define and Ideate:** Share Stories and learning from research- Cluster Insights into themes, Create Insights statements, create 'How might we' questions **Assignment-IV Prototype Phase:** Brainstorm, select your ideas, create a storyboard, determine what to prototype, start prototyping, Design Paper Prototype/digital Prototype, test your prototype and get feedback, Create your Action plan, create pitch, share your solution, perform reflection
Reference Books:
1. Michael Lewrick, Patrick Link, Larry Leifer , "The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods", March 2020 edition, ISBN: 978-1-119-62921-4, WILEY Publication. **2.** Mr Lee Chong Hwa (Lead Facilitator), "The Design Thinking: Guidebook" **3.** IDEO (Firm), "The Field Guide to Human-centered Design: Design Kit", 1st edition, ISBN-978099140631-9, IDEO 2015. **4.** https://www.innovationtraining.org/

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314448 (D) : Laboratory Practice-I (Internet of Things)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme</td><td>Examination Scheme:</td></tr>
<tr><td>Practical (PR) :4 hrs/week</td><td>02 Credits</td><td>TW: 25 Marks
PR: 25 Marks</td></tr>
</table>

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Prerequisites:

1. Programming Skill Development Lab.

Course Objectives :

1. To learn interfacing of sensor and actuators using Arduino Uno/Raspberry Pi
2. To learn and understand IoT platforms and its significance for real time applications
3. To learn and understand the steps involved in python programming for IoT applications

Course Outcomes:

On completion of the course, students will be able to–

CO1: Design and implement real time applications with sensors and actuators.

CO2: Design and develop real time IoT based application by cloud interfacing.

Guidelines for Instructor's Manual

Faculty Member should prepare lab manual by taking the review of latest IoT devices with specifications and made it available for students/Lab assistant

Guidelines for Student's Lab Journal

1. Student should submit term work after the completion of entire assignment, only.
2. Practical Examination will be fully based on entire assignment set as per the given instructor manual.
3. Student should know the theory involved in the experiment.
4. Student will be eligible for practical examination only after the submission of term work in stipulated time.

Guidelines for Lab /TW Assessment

1. Instructor/Examiners will assess the student only based on performance of students considering the parameters such as timely submission of assignment, use of proper methodology for implementation of assignment.
2. Student must have appropriate basics and fundamental of software and hardware usage and its relevance with submitted assignment. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal andthe same will be submitted for future reference to Lab Instructor.

Guidelines for Laboratory Conduction

1. All assignments are compulsory and should be performed by individual student.

Guidelines for Practical Examination

1. Practical Examination will be fully based on entire laboratory assignments.
2. Examiners will judge the students based on practical performed in the examination and by asking some questions related to implementation of experiments, which he/she has carried out.

Group A
1. Design and implement IoT system using Arduino Uno/ Raspberry Pi using 'Ultrasonic sensor and Servo motor' such as 'Door opener in home automation'. **2.** Design and implement parameter monitoring IoT system keeping records on Cloud such as 'environment humidity and temperature monitoring'. **3.** Design and implement real time monitoring system using android phone (Blynk App.) such as 'soilparameter monitoring'. **4.** Design and implement IoT system for one of the applications like: Traffic Application, Medical/Health application, Social Application etc.
Text Books:
1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach" , 2014, Universities Press (India) Pvt Ltd., ISBN: 9788173719547 **2.** Matt Richardson & Shawn Wallac, "Getting Started with Raspberry Pi", 2014, O'Reilly (SPD), ISBN: 9789350239759 **3.** Rushi Gajjar, "Raspberry Pi Sensors", 2015, Packt Publishing, ISBN : 978-1-78439-361-8
Reference Books:
1. Peter Waher, "Learning Internet of Things", 2015, Packt Publishing, ISBN: 978-1-78355-353-2 **2.** Simon Monk, "Raspberry Pi Cookbook, Software and Hardware Problems and solutions", 2019, O'Reilly, ISBN 9781492043225 **3.** Simon Monk,"Programming Arduino-Getting Started with Sketches", 2012, ISBN: 978-0-07-178423-8, McGraw Hill
E- Books / E- Learning References :
1. Introduction to Arduino and its Setup : https://www.arduino.cc/en/software **2.** Introduction to Raspberry Pi and its OS (Raspbian Lit) : https://www.raspberrypi.org/software/operating-systems/ **3.** Introduction to header files and support : https://github.com/ Cloud for IoT - ThingSpeak : https://thingspeak.com/ **4.** Cloud for IoT - Ubidots : https://ubidots.com/stem/ **5.** Overall IoT Course Contents: https://onlinecourses.nptel.ac.in/noc21_cs17/preview

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314449 : Seminar		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 01 hrs/week	**01 Credits**	**TW : 50 Marks**

Prerequisites:

1. Project Based Learning
2. Software Engineering

Course Objectives:

Seminar should make the student attain skills like:

1. To gather the literature of specific area in a focused manner.
2. To summarize the literature to find state-of-the-art in proposed area.
3. To identify scope for future work.
4. To present the case for the intended work to be done as project.
5. To report literature review and proposed work in scientific way.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Understand, interpret and summarize technical literature.

CO2: Demonstrate the techniques used in the paper.

CO3: Distinguish the various techniques required to accomplish the task. CO4: Identify intended future work based on the technical review.

CO5: Prepare and present the content through various presentation tools and techniques in effective manner.

CO6: Keep audience engaged through improved interpersonal skills.

Guidelines for Seminar Selection and Presentation

1) Student shall identify the area or topics in Information Technology referring to recent trends and developments in consultation with industry (for their requirement) and institute guide.
2) Student must review sufficient literature (reference books, journal articles, conference papers, white papers, magazines, web resources etc.) in relevant area on their topic as decided.
3) Seminar topics should be based on recent trends and developments. Guide should approve the topic by thoughtfully observing different techniques, comparative analysis of the earlier algorithms used or specific tools used by various researchers in the domain.
4) Research articles could be referred from IEEE, ACM, Science direct, Springer, Elsevier, IETE,CSI orfrom freely available digital libraries like Digital Library of India (dli.ernet.in), National Science Digital Library, JRD Tata Memorial Library, citeseerx.ist.psu.edu, getcited.org, arizona.openrepository.com, Open J-Gate, Research Gate, worldwidescience.org etc.
5) Student shall present the study as individual seminars in 20 – 25 minutes in English which is followed by Question Answer session.
6) Guide should ensure that students are doing literature survey and review in proper manner.
7) Guide should give appropriate instructions for effective presentation.
8) Attendance of all other students in the class for presentation is mandatory.

Timeline is suggested to follow throughout the semester:

1) **Week– 01:** Discussion to understand what is technical paper, how to search, where to search?
2) **Week– 02:** Download technical papers (minimum four), getting approved from Guide and Prepare abstract summary of all papers downloaded.
3) **Week– 03 & 04:** Read and understand in detail the decided research papers about the problem statement, techniques used, experimental details and results with conclusion from identified papers.
4) **Week– 05:** Review of the studied papers by Guide / Panel.
5) **Week – 06 & 07:** Search / Find equivalent techniques (other than the one proposed in technical paper) so performance / complexities can be improved (by amortized analysis, not actual implementation).
6) **Week – 08 & 09:** Prepare presentation with outline as The topic, its significance, The research problem, Studied solutions (through research papers) with strengths and weaknesses of each solution, comparison of the solutions to research problem, future directions of work, probable problem statement of project, tentative plan of project work
7) **Week – 10:** Write Seminar report.
8) **Week – 11:** Deliver Presentation to Guide/ Panel.
9) **Week –12:** Verification of Seminar report and Submission.

Guidelines for Seminar report

1. Each student shall submit two copies of the seminar report in appropriate text editing tool/software as per prescribed format duly signed by the guide and Head of the department/Principal.
2. Broad contents of review report (20-25 pages) shall be
   - **a)** Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution, Year & University.
   - **b)** Seminar Approval Sheet/Certificate.
   - **c)** Abstract and Keywords.
   - **d)** Acknowledgments.
   - **e)** Table of Contents, List of Figures, List of Tables and Nomenclature.
   - **f)** Chapters need to cover topic of discussion-
     - **i.** Introduction with section including organization of the report,
     - **ii.** Literature Survey
     - **iii.** Motivation, purpose and scope and objective of seminar
     - **iv.** Details of design/technology/Analytical and/or experimental work, if any/
     - **v.** Discussions and Conclusions,
     - **vi.** Bibliography/References (in IEEE Format),
     - **vii.** Plagiarism Check report,
3. Students are expected to use open source tools for writing seminar report, citing the references and plagiarism detection.

Guidelines for Lab /TW Assessment:

1. A panel of reviewers constituted by seminar coordinator (where guide is one of the member of the panel) will assess the seminar during the presentation.
2. Student's attendance for all seminars is advisable.
3. Rubric for evaluation of seminar activity:
   - **i.** Relevance of topic - 05 Marks
   - **ii.** Relevance + depth of literature reviewed - 10 Marks
   - **iii.** Seminar report (Technical Content) - 10 Marks
   - **iv.** Seminar report (Language) - 05 Marks
   - **v.** Presentation Slides - 05 Marks
   - **vi.** Presentation & Communication Skills - 05 Marks
   - **vii.** Question and Answers - 10 Marks

   TOTAL: **50 Marks**

Reference Book:

1. Andrea J. Rutherfoord, Basic Communication Skills for Technology, Pearson Education Asia, 2ndEdition.
2. Lesikar, Lesikar's Basic Business Communication, Tata McGraw, ISBN: 256083274, 1st Edition.

Text Book :

1. Sharon J. Gerson, Steven M. Gerson, Technical Writing: Process and Product, Pearson Education Asia, ISBN: 130981745, 4thEdition.

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) Mandatory Audit Course 5 314450 (A): Banking and Insurance		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 1 hrs/week	**No Credits**	**Audit Course**

HOME

Prerequisite Courses : If any

Course Objectives: -

1. To understand banking system in India.
2. To understand negotiable instruments.
3. To learn attributes of different types of insurance policies.
4. To create awareness about nature and functioning of annuities.

Course Outcomes: -

On completion of the course, students will be able to–

CO1: Differentiate between types of banks and their working.
CO2: Carry out banking transactions on their own.
CO3: Decide which insurance policy they should buy.
CO4: Handle investing in annuities and claim settlements.

COURSE CONTENTS

Unit I	INTRODUCTION TO BANKING	(03 hrs)

Definition of Bank - Basic functions of Banker
Banking System in India : Banker and Customer: Relationship between Banker and Customer, Special Types of Customers, Retail & Wholesale Banking, Deposit Accounts – Savings Accounts, Current Accounts, Fixed Deposit Accounts, Opening and operation of Accounts, Nomination, KYC requirements, Pass Book, Minors Partnerships & Companies.

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	BANK FUNDS AND INSTRUMENTS	(03 hrs)

Employment of Bank Funds: Liquid Assets-Cash in Hand, Cash with RBI & Cash with other Banks, Investment in securities, Advances - Secured and Unsecured, Loans, Term Loans, Cash Credit, Overdraft, Discounting of Bills of Exchange, Modes of creating charge on Securities, Types of Securities.

Negotiable Instruments: Definition & Characteristics of Cheques, Bills of Exchange & Promissory Notes, Crossings, Endorsements, Collection and payment of Cheques, Liabilities of Parties.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**INTRODUCTION TO INSURANCE**	**(03 hrs)**

Concept of Insurance, Need for Insurance.

Brief history of Insurance industry in India: (a) Enactment of Insurance Act, 1938. (b) Nationalization of Life Insurance Companies in 1955. (c) Nationalization of General insurance Companies in 1972. (d) Malhotra Committee Report – Opening up of Insurance sector to Private Companies in 2000. (e) Setting up o Insurance Regulatory and Development Authority in 1999.

Life Insurance: Present Organizational set-up of Insurance Companies in India – L.I.C. and Private Companies with foreign joint ventures, selling Insurance through Agents and Banks.

Objectives of Life Insurance – Protection and Investment, Different types of Life Insurance Policies – Chief characteristics and similarity. Online vs Offline policies

Basic Pre-requites for Life Insurance – Insurable Interest and utmost Good Faith.

Procedure for taking a policy: (a) Selection of the Plan. (b) Consultation of Premium tables. (c) Filling up of Proposal Form. (d) Document regarding proof of age. (e) Important clauses of the Policy – eg. Suicide Clause. (f) Nomination

Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**ULIPs AND POLICY MATTERS**	**(03hrs)**

Annuities and Unit Linked Policies: Concept of Annuity, Objectives of Annuity, Procedure followed for obtaining Annuities, Meaning of Unit Linked Insurance Policies, Procedure for obtaining Unit linked insurance Policies.

General Insurance: General Insurance companies, types of general insurance

Post - Issue Matters: Lapse of the Policy due to Non-Payment of Premium, Revival of the Lapsed Policies, Surrender of the Policy – Payment of surrender value, Assignment of the Policies, Settlement of claims – Procedure to be followed.

Mapping of Course Outcomes for Unit IV	**CO4**

Text Books:

1. Sunil Kumar, Essentials of Banking and Insurance, JSR PUBLISHING HOUSE LLP; 2ndEd edition, ISBN-10 :938768461X.
2. D.D. Chaturvedi, Arun Mittal, Saumya Chaturvedi, Banking and Insurance, Scholar Tech Press, ASIN : B08S3H36K1

E- Books / E- Learning References:

1. https://onlinecourses.swayam2.ac.in/cec21_ge04/preview

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) **Mandatory Audit Course 5** **314450 (B): Startup Ecosystems**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 1 hrs/week	**No Credits**	**Audit Course**
Prerequisite Courses: NA		

Course Objectives:

To familiarize students-

1. New venture creation opportunities, its resources, and requirements for Enterprise Startup
2. Legal requirements for new ventures
3. Financial issues and strategies related to startups

Course Outcomes:

completion of the course, students will be able to–

CO1: Identify Startup opportunities

CO2: Explain legal and other requirements for new ventures

CO3: Analyze financial Issues of startups

COURSE CONTENTS		
Unit I	**STARTUP OPPORTUNITIES**	**(04 hrs)**
Current industrial revolution, Idea Generation with brainstorming, Business Startup, ideation, choices of venture, the rise of Startup economy, forces of change, startup equation, the entrepreneurial ecosystem, Indian government initiatives, Entrepreneurship in India, Case Study: MEITY Startup Hub		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**STARTUP ECOSYSTEM**	**(04 hrs)**
Startups ecosystem: Support organizations, big companies, universities, funding organizations, service providers, research organizations, Startup development phases: Ideating, conception, committing, validating, scaling, establishing, Startup business partnering, Startup culture, Co-founders, FFF (Fools, friends and family), Angels		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**STARTUP CAPITAL REQUIREMENTS AND LEGAL ENVIRONMENT**	**(04 hrs)**
Identification of capital resource requirements of startup, estimating startup finance requirements, deciding a process map, Positioning the venture in the value chain – Framing risk reduction strategy, Startup financing metrics, Legal perspectives- New Ventures approval procedures- Taxes or duties payable for new ventures, Case Study: Technology Incubation and Development of Entrepreneurs (TIDE)		

Mapping of Course Outcomes for Unit III	**CO3**

Text Books:

1. Kathleen R Allen, "Launching New Ventures, An Entrepreneurial Approach", Cengage Learning, 2016.
2. Anjan Raichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International, 2010.
3. S.R. Bhowmik and M. Bhowmik, Entrepreneurship, New Age International, 2007.
4. Steven Fisher, Ja-nae Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Mc Graw Hill Education India Pvt. Ltd, 2016.

Reference Books:

1. Donald F Kuratko, Jeffrey S. Hornsby, New Venture Management: The Entrepreneurs Road Map, 2e, Routledge, 2017.
2. Vijay Sathe, Corporate Entrepreneurship, 1e, Cambride, 2009.
3. Bruce R. Barringer, R.Duane Ireland, Entrepreneurship successfully, launching new ventures.Pearson,2019

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
Mandatory Audit Course 5
314450 (C) :Foreign Language- (Japanese Language-III)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) :1 hrs/week	Non Credit	Audit Course

HOME

Prerequisite Courses, if any:

1. Students must have already studied can read/write Hiragana and Katakana script
2. Students must have studied Japanese for beginners that includes the syllabus of Audit course Module 1 and 2

Course Objectives:

To familiarize students with-

1. Japan Market needs: To meet the needs of ever growing industry with respect to the Japanese language support.
2. Japanese Culture and Mindset: To get introduced to Japanese society and culture through language.
3. Career opportunities: To know more about Higher studies, Career opportunities in Japan / Japanese companies across the world.
4. Soft skills and self-development: To learn the manners, business culture and develop the confidence by gaining the knowledge of global perspective and cross-cultural studies.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Do basic communication**.**
CO2: Demonstrate knowledge of Japanese script (reading, writing and listening skills).
CO3: Demonstrate knowledge about Japanese culture, life style, manners and etiquettes.
CO4: Pursue professional Japanese Language course.

COURSE CONTENTS

Unit I	JAPANESE-BEGINNERS LEVEL	(3 hrs Lecture + 3 hrs Self-study)

Greeting, Self-introduction, Nationality, Languages, Hiragana, Katakana rules, History of Kanji, Numbers, Days and Dates, Time, Age, Mobile number, Places, Relatives, Colors, Things, Vehicles. Introduction to grammar of basic particles, verbs and adjectives, Culture/Others: Business card exchange, Seasons and festivals in Japan, Kanjis: 1 to 10, Listening practice, Vocabulary and conversation practice.

Reference:

a. Revision of beginner level studied in Module1-2
b. Nihongo Challenge Kanji - Lesson 1

<table>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">JAPANESE SCRIPT</td></tr>
<tr><td colspan="3">Introduction to Demonstrative pronouns (ko-so-a-do),Asking/requesting for something, Making sentences using various question words, Stating/asking age, nationality, profession ,Culture/Others: Information about Japanese standardized test (JLPT, NAT etc.),Kanjis:11 to 20,Listening practice Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I: Lesson 1 and 2 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 2</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>BASIC JAPANESE GRAMMAR</td><td>(3 hrs Lecture + 3 hrs Self-study)</td></tr>
<tr><td colspan="3">Conversation at the shop, asking price, location, Telling time and scheduling tasks, Introduction to Verb groups (root, present, past, negative), Culture/Others: Conversation and Behavior at the shop, How to buy train tickets, Train manners, Introduction to social issues and Japanese society,Kanjis:21to 30,Listening practice Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I : Lesson 3 and 4 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 3</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>JAPANESE FOR DAILY COMMUNICATION</td><td>(3 hrs Lecture + 3 hrs Self-study)</td></tr>
<tr><td colspan="3">Directions and heading towards (use of particle de, he and relevant vocabulary) , Actions (use of particle wo and relevant vocabulary),Types of adjectives (root, negative, past, past negative),Culture/Others: Party, gifts related conversation, Gifting culture in Japan, Introduction to Japanese economy and market needs ,Kanjis:31 to 40,Listening practice, Vocabulary and conversation practice.
Reference:
a. Minna no Nihongo I : Lesson 5 and 6 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 4</td></tr>
</table>

Mapping of Course Outcomes for Unit IV	**CO4**

Text Books:

1. Minna no Nihongo I –Main Text book with audio and video files (Books by Goyal Publishers - Available in shops / Online)
2. Minna no Nihongo - Translation and grammatical notes for self-study (Books by Goyal Publishers - Available in shops / Online)
3. Nihongo Challenge – Kanji (Available with Japanese Language schools/teachers)

Reference Books:

1. Nihongo Shoho: For better understanding and practice of Basic Japanese Grammar
2. Marugoto : For scenario based Japanese conversation practice

E -Books / E- Learning References :

1. nihongo ichiban
   a. https://nihongoichiban.com/home/jlpt-n5-study-material/
2. jlpt sensei
   a. https://jlptsensei.com/how-to-pass-jlpt-n5-study-guide/

SEMESTER – VI

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) **314451: Computer Network and Security**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credit**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses:

1. Basics of Computer Network

Companion Course:

1. Cyber Security

Course Objectives:

To familiarize students with-

1. The application layer services, responsibilities and protocol.
2. Fathom wireless network and different wireless standards
3. Differences in different wireless networks and to learn different mechanism used at layers of wireless network.
4. The concept of network security.
5. Basic cryptographic techniques in application development.
6. Cyber security vulnerabilities & study typical threats to modern digital systems.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Explain Responsibilities, services offered and protocol used at application layer of network

CO2: Apply concepts of wireless network and different wireless standards.

CO3: Recognize the Adhoc Network's MAC layer, routing protocol and Sensor network architecture. **CO4:** Implement the principal concepts of network security and Understand network security threats, security services, and countermeasures

CO5: Apply basic cryptographic techniques in application development.

CO6: Gain a good comprehension of the landscape of cyber security Vulnerabilities & describe typical threats to modern digital systems.

COURSE CONTENTS

Unit I	**APPLICATION LAYER**	**(06 hrs)**

Client Server Paradigm: Communication using TCP and UDP, Peer to Peer Paradigm, Application Layer Protocols: DNS, FTP, TFTP, HTTP, SMTP, POP, IMAP, MIME, DHCP, TELNET.

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**WIRELESS STANDARDS**	**(06 hrs)**
Wireless LANs: Fundamentals of WLAN, Design goals, Characteristics, Network Architecture, IEEE 802.11 components in IEEE 802.11 network, Physical Layer, **MAC Sub Layers :** DCF, PCF, Hidden and exposed station problem, Frame format, Addressing Mechanism, IEEE 802.15.1 **Bluetooth:** ArchitectureLayers, operational states, **IEEE 802.16 WiMax:** Services, Architecture, Layers, comparison between Bluetooth, IEEE 802.11 and IEEE 802.16.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**ADHOC AND WSN**	**(06 hrs)**
Infrastructure Network and Infrastructure-less Wireless Networks, Issues in Adhoc Wireless Network, Adhoc Network MAC Layer: Design Issues, Design Goal, Classification, MACAW, **Adhoc Network Routing Layer:** Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks – Classifications of Routing Protocols, DSDV, AODV, DSR, **Applications of Sensor Network**, Comparison with Ad Hoc Wireless Network, Sensor node architecture Issues and Challenges in Designing a Sensor Network, Classification of sensor network protocols, SENSOR NETWORK ARCHITECTURE: Layered Architecture, Clustered Architecture		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**INTRODUCTION TO NETWORK SECURITY**	**(06 hrs)**
Importance and Need for Security, Network Attacks- Passive, Active Network Security Threats: Unauthorized access, Distributed Denial of Service (DDoS) attacks, Man in the middle attacks, **Concept of Security Principles:** Confidentiality and Privacy, Authentication, Authorization and Access Control, Integrity, Non- repudiation, Stream Ciphers: Substitution Cipher – Mono alphabetic Cipher, Polyalphabetic Substitution Cipher., Transposition Cipher: Rail-Fence **Block Ciphers modes:** Electronic Code Book (ECB) Mode., Cipher Block Chaining (CBC) Mode., Cipher Feedback Mode (CFB) , Output Feedback (OFB) Mode.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**CRYPTOGRAPHIC ALGORITHM**	**(06 hrs)**
Mathematical preliminaries: Groups, Rings, Fields, Prime numbers, Symmetric key algorithms: Data Encryption Standards, Advanced Encryption Standard, **Public Key Encryption and Hash function:** RSA Digital signatures, Digital Certificates and Public Key Infrastructure: Private Key Management, Diffie Hellman key exchange, The PKIX Model		

Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**INTRODUCTION TO CYBER SECURITY**	**(06 hrs)**
Introduction to Cyber Security: Basic Cyber Security Concepts, Layers of security, Vulnerability, Threat, Harmful Acts-Malware, Phishing, MIM Attack, DOS Attack, SQL Injection, Internet Governance – Challenges and Constraints, Computer Criminals, Assets and Threat, Motive of Attackers, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber Stalking, Cyber Terrorism, Cyber Espionage, Comprehensive Cyber Security Policy		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, McGraw Hill Education, ISBN: 978-0-07-070652-1, 4th Edition.
2. C. Siva Ram Murthy, B. S. Manoj, Adhoc Wireless Networks: Architecture and Protocols, PearsonEducation, ISBN: 978-81-317-0688-6, 1st Edition.
3. Atul Kahate Cryptography and Network Security, 3e, McGraw Hill Education,
4. B. A. Forouzan Cryptography and Network Security McGraw Hill Education
5. William Stallings Cryptography and Network Security: Principles and Practice, 4th Edition.
6. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

Reference Books:

1. Kazem Sohraby, Daniel Minoli, TaiebZnati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley India, ISBN: 9788126527304
2. Schneir, Bruce, "Applied Cryptography: Protocols and Algorithms"
3. Charles E. Perkins, Adhoc Networking, Pearson Education, 978-81-317-2096-7
4. Andrew S. Tanenbaum, David J. Wethrall, Computer Network, Pearson Education, ISBN: 978-0-13-212695-3.
5. Kurose Ross, Computer Networking: A Top Down Approach Featuring the Internet, Pearson Education, ISBN: 978-81-7758-878-
6. Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN- 978-81-203-5082-3

E- Books / E- Learning References :

1. https://nptel.ac.in/courses/106/105/106105160/
2. https://nptel.ac.in/courses/106/105/106105031/
3. An Introduction to Cyber Security A Beginner's Guide

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314452: Data Science and Big Data Analytics		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) :03 Hrs/week	**03 Credit**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisites:

1. Engineering and discrete mathematics.
2. Database Management Systems, Data warehousing and Data mining.
3. Programming skill.

Companion Course:

1. Machine Learning
2. Advance Database Management

Course Objectives:

1. To introduce basic need of Big Data and Data science to handle huge amount of data.
2. To understand the basic mathematics behind the Big data.
3. To understand the different Big data processing technologies.
4. To understand and apply the Analytical concept of Big data using Python.
5. To visualize the Big Data using different tools.
6. To understand the application and impact of Big Data.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Understand Big Data primitives.

CO2: Learn and apply different mathematical models for Big Data.

CO3: Demonstrate Big Data learning skills by developing industry or research applications.

CO4: Analyze and apply each learning model comes from a different algorithmic approach and it will perform differently under different datasets.

CO5: Understand, apply and analyze needs, challenges and techniques for big data visualization.

CO6: Learn different programming platforms for big data analytics.

COURSE CONTENTS

Unit I	INTRODUCTION: DATA SCIENCE AND BIG DATA	(06 Hrs)

Introduction to Data science and Big Data, Defining Data science and Big Data, Big Data examples, **Data Explosion:** Data Volume, Data Variety, Data Velocity and Veracity. Big data infrastructure and challenges **Big Data Processing Architectures:** Data Warehouse, Re-Engineering the Data Warehouse, shared everything and shared nothing architecture, Big data learning approaches. **Data Science** – The Big Picture: Relation between AI, Statistical Learning, Machine Learning, Data Mining and Big Data Analytics

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**MATHEMATICAL FOUNDATION OF BIG DATA**	**(07 Hrs)**
Probability: Random Variables and Joint Probability, Conditional Probability and concept of Markov chains, Tail bounds, Markov chains and random walks, Pair-wise independence and universal hashing Approximate counting, Approximate median. **Data Streaming Models and Statistical Methods:** Flajole Martin algorithm, Distance Sampling and Random Projections, Bloom filters, Mode, Variance, standard deviation, Correlation analysis and Analysis of Variance.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**BIG DATA PROCESSING**	**(06 Hrs)**
Big Data Analytics- Ecosystem and Technologies, Introduction to Google file system, Hadoop Architecture, **Hadoop Storage:** HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration, Introduction to NOSQL, Textual ETL processing.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**BIG DATA ANALYTICS**	**(06 Hrs)**
Big Data Analytics- Architecture and Life Cycle, Types of analysis, Analytical approaches, Data Analytics with Mathematical manipulations, Data Ingestion from different sources (CSV, JSON, html, Excel, mongoDB, mysql, sqlite), Data cleaning, Handling missing values, data imputation, Data transformation, Data Standardization, handling categorical data with 2 and more categories, statistical and graphical analysis methods, Hive Data Analytics.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**BIG DATA VISUALIZATION**	**(06 Hrs)**
Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Propriety Data Visualization tools, Open – source data visualization tools, **Case Study:** Analysis of a business problem of Zomato using visualization, Analytical techniques used in Big data visualization, Data Visualization using Tableau Introduction to: Candela, D3.js, Google Chart API		

Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**BIG DATA TECHNOLOGIES APPLICATION AND IMPACT**	**(05 Hrs)**

Social media analytics, Text mining, Mobile analytics, Data analytics life cycle of case studies, Organizational impact, understanding decision theory, creating big data strategy, big data value creation drivers, Michael Porter's valuation creation models, Big data user experience ramifications, Identifying big data use cases, Big Data Analytics Challenges and Research directions.

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Krish Krishnan, Data warehousing in the age of Big Data, Elsevier, ISBN: 9780124058910, 1st Edition.

2. DT Editorial Services, Big Data, Black Book, DT Editorial Services, ISBN: 9789351197577, 2016Edition.

Reference Books:

1. Mitzenmacher and Upfal, Probability and Computing: Randomized Algorithms and ProbabilisticAnalysis, Cambridge University press, ISBN : 521835402 .

2. Dana Ron, Algorithmic and Analysis Techniques in Property Testing, School of EE.

3. Graham Cormode, Minos Garofalakis, Peter J. Haas and Chris Jermaine, Synopses for Massive Data: Samples, Histograms, Wavelets, Sketches, Foundation and trends in databases, ISBN:10.1561/1900000004.

4. Alex Holmes, Hadoop in practice, Dreamtech press, ISBN:9781617292224.

5. AmbigaDhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends forToday's Business, Wiely CIO Series.

6. ArvindSathi, Big Data Analytics: Disruptive Technologies for Changing the Game, IBMCorporation, ISBN:978-1-58347-380-1.

7. EMC Education Services, Data Science and Big Data Analytics- Discovering, analyzing Visualizingand Presenting Data.

8. Li Chen, Zhixun Su, Bo Jiang, Mathematical Problems in Data Science, Springer, ISBN :978-3-319-25127-1.

9. Philip Kromer and Russell Jurney, Big Data for chips, O'Reilly, ISBN :9789352132447.

10. EMC Education services, Data Science and Big Data Analytics, EMC2 Wiley, ISBN :978812655653-

11. Mueller Massaron, Python for Data science, Wiley, ISBN :9788126557394.

12. EMC Education Services, Data Science and Big Data Analytics, Wiley India, ISBN:9788126556533

13. Benoy Antony, Konstantin Boudnik, Cheryl Adams, Professional Hadoop, Wiley India,ISBN :9788126563029

14. Judith Hurwitz, Alan Nugent, Big Data For Dummies, Wiley India, ISBN : 9788126543281

E Books / E Learning References :
1. Zomato dataset Link: https://www.kaggle.com/shrutimehta/zomato-restaurants-data **2.** Link for dataset: https://www.kaggle.com/tanmoyie/us-graduate-schools-admission-parameters

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314453: Web Application Development

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	**03 Credit**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

HOME

Prerequisite Courses:

1. Programming languages C++, Java.

Companion Course:

1. Advanced Database Management system
2. Design Thinking

Course Objectives: -

1. To familiarize students with Web Programming basic concepts

2. To learn and understand Web scripting languages.

3. To explore the Front end& Backend web programming skills.

4. To understand and learn Mobile web development.

5. To understand and learn Web application deployment.

Course Outcomes: -

On completion of the course, students will be able to–

CO1: Develop Static and Dynamic website using technologies like HTML, CSS, Bootstrap.

CO2: Demonstrate the use of web scripting languages.

CO3: Develop web application with Front End & Back End Technologies.

CO4: Develop mobile website using JQuery Mobile.

CO5: Deploy web application on cloud using AWS.

COURSE CONTENTS

Unit I	INTRODUCTION TO WEB TECHNOLOGIES	(06 hrs)

HTML: Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links, Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements.

CSS: Why CSS, Types of CSS, How to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.

BOOTSTRAP: Why Bootstrap, CSS over Bootstrap, How to Use Bootstrap, Bootstrap Grid System, Bootstrap Responsive, Bootstrap Classes, Bootstrap Components (i.e., Button, Table, List, etc.), Bootstrap as a Cross Platform.

W3C: What is W3C , How W3C handles/Supports Web Technologies.

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**WEB SCRIPTING LANGUAGES**	**(06 hrs)**

JavaScript: Introduction to Scripting languages, Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events.

Advanced JavaScript: JSON - JSON Create, Key-Value Pair, JSON Access, JSON Array, JS Arrow Functions, JS Callback Functions, JS Promises, JS Async-Await Functions, JS Error Handling.

AJAX: Why AJAX, Call HTTP Methods Using AJAX, Data Sending, Data Receiving, AJAX Error Handling.

JQUERY : Why JQuery, How to Use, DOM Manipulation with JQuery, Dynamic Content Change with JQuery, UI Design Using JQuery.

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**FRONT END TECHNOLOGIES**	**(06 hrs)**

Front-End Frameworks: What is web framework? Why Web Framework? Web Framework Types.

MVC: What is MVC, MVC Architecture, MVC in Practical, MVC in Web Frameworks.

TypeScript: Introduction to TypeScript (TS), Variables and Constants, Modules in TS.

AngularVersion 10+: Angular CLI, Angular Architecture, Angular Project Structure, Angular Lifecycle, Angular Modules, Angular Components, Angular Data Binding, Directives and Pipes, Angular Services and Dependency Injections (DI), Angular Routers, Angular Forms.

ReactJS: Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux- Architecture, Hooks- Basic hooks, useState() hook, useEffect() hook useContext() hook.

Mapping of Course Outcomes For Unit III	**CO3**	
Unit IV	**BACK END TECHNOLOGIES**	**(06 hrs)**

Node.JS: Introduction to Node.JS, Environment Setup, Node.JS Events, Node.JS Functions, Node.JS Built-in Modules, File System, NPM, Install External Modules, Handling Data I/O in Node.JS, Create HTTP Server, Create Socket Server, Microservices- PM2.

ExpressJS: Introduction to ExpressJS, Configure Routes, Template Engines, ExpressJS as Middleware, Serving Static Files, REST HTTP Method APIs, Applying Basic HTTP Authentication, Implement Session Authentication.

MongoDB: NoSQL and MongoDB Basics, MongoDB-Node.JS Communication, CRUD Operations using Node.JS, Mongoose ODM for Middleware, Advanced MongoDB.

Mapping of Course Outcomes for Unit IV	**CO3**	
Unit V	**MOBILE WEB DEVELOPMENT**	**(06 hrs)**
Mobile-First: What is Mobile-First? What is Mobile Web? Understanding Mobile Devices and Desktop. **JQuery Mobile:** Introduction to the jQuery Mobile Framework, Set-up jQuery Mobile, Pages, Icons, Transitions, Layouts Widgets, Events, Forms, Themes, Formatting Lists, Header and Footer, CSS Classes, Data Attributes, Building a Simple Mobile Webpage.		
Mapping of Course Outcomes for Unit V	**CO4**	
Unit VI	**WEB APPLICATION DEPLOYMENT**	**(06 hrs)**
Cloud: AWS Cloud, AWS Elastic Compute, AWS Elastic Load Balancer and its types, AWS VPC and Component of VPC, AWS storage, Deploy Website or Web Application on AWS, Launch an Application with AWS Elastic Beanstalk.		
Mapping of Course Outcomes for Unit VI	**CO5**	

Text Books:

1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496.
2. Raymond Camden, Andy Matthews, JQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891.

Reference Books:

1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265-1635-3
2. Dr.Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93-5004-088-1
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265-1635-3
4. Ivan Bayross, "Web Enabled Commercial Application Development Using HTML, JavaScript,DHTML and PHP, BPB Publications,4th Edition, ISBN:978-8183330084.
5. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81- 8404-817-9
6. Adam Bretz& Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.
7. JavaScript: The Definitive Guide - Master The World's Most-Used Programming Language, Seventh Edition
8. Java Script, D.Flanagan, O'Reilly, SPD.
9. Programming Typescript: Making Your JavaScript Applications Scale, Boris Cherny

E- Books / E- Learning References :

1. Learning Amazon Web Services AWS - A Hands-on Guide to the Fundamentals of AWS Cloud Author: Mark Wilkins.
2. https://www.meanacademy.in/web-technologies
3. https://www.meanacademy.in/angular
4. https://www.meanacademy.in/ mongodb
5. https://www.meanacademy.in/ nodejs
6. https://www.meanacademy.in/ aws
7. https://www.w3schools.com/Css
8. https://www.javatpoint.com/angularjs-tutorial
9. https://www.tutorialspoint.com/reactjs/index.htm
10. https://www.tutorialspoint.com/web_development_tutorials.htm
11. https://www.tutorialspoint.com/angular_material/index.htm
12. https://www.javaguides.net/2020/07/angular-10-example-tutorial.html
13. https://www.javatpoint.com/reactjs-tutorial
14. https://www.tutorialspoint.com/jquery_mobile/index.htm
15. https://www.tutorialspoint.com/nodejs/index.htm
16. https://www.tutorialspoint.com/expressjs/index.htm
17. https://www.tutorialspoint.com/mongodb/index.htm
18. https://www.tutorialspoint.com/mongodb/mongodb_tutorial.pdf
19. https://www.tutorialspoint.com/ajax/index.htm.
20. https://www.udemy.com/ajax/online-course.

Savitribai Phule Pune Univeristy, Pune
Third Year Information Technology (2019 Course)
314454 (A): Elective-II (Artificial Intelligence)

HOME

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credit	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:
1. Discrete Mathematics, 2. Machine Learning, 3. Data Structures and Algorithms 4. Any Programming Knowledge (Java, Python)

Companion Course:
1. Lab Practice - II

Course Objectives:
1. To understand Fundamental concepts of Artificial Intelligence and different search strategies.
2. To explore Various knowledge representations and reasoning schemes.
3. To understand Fundamentals of NLP and Game Theory.
4. To explore of AI applications.

Course Outcomes:

On completion of the course, students will be able to –

CO1: Apply the fundamental concepts of Artificial Intelligence

CO2: Choose appropriate search strategies for any AI problem

CO3: Illustrate knowledge reasoning and knowledge representation methods (for solving real world problems)

CO4: Analyze the suitable techniques of NLP to develop AI applications

CO5: Correlate the appropriate methods of Game Theory to design AI applications

CO6: Understand the concept of deep learning and AI applications

COURSE CONTENTS

Unit I	INTRODUCTION TO AI And SEARCH	(06 hrs)

Artificial Intelligence: Introduction, Components of Artificial Intelligence, Characteristics of Artificial Intelligence Systems, Intelligent Agents, Types of Intelligent Agents

Statistical Analysis: Correlation coefficient, Rank Correlation, Residual Error, Mean Square Error, RMSE, Probability Distributions, Concept of Discrete PD and Continuous PD

Search Strategies: Problem spaces (states, goals and operators), problem solving by search, Uninformed search (breadth-first, depth-first, depth first with iterative deepening)

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**PROBLEM SOLVING**	**(06 hrs)**
Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best-first Search; Problem Reduction. **Constraint Satisfaction problem:** Interference in CSPs; Backtracking search for CSPs; Local Search for CSPs; structure of CSP Problem. **Beyond Classical Search:** Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**KNOWLEDGE REPRESENTATION AND REASONING**	**(06 hrs)**
Knowledge Representation: Introduction to Knowledge Representation, Knowledge agent, Predicate logic, WFF, Inference rule & theorem proving: forward chaining, backward chaining, resolution; Propositional knowledge, Boolean circuit agents. Rule Based Systems, **Knowledge Reasoning:** Forward reasoning: Conflict resolution, backward reasoning: Use of backtracking, **Structured Knowledge Reasoning:** Semantic Net - slots, inheritance, Frames- exceptions and defaults attached predicates, Conceptual Dependency formalism, **Reasoning Under Uncertainty:** Source of Uncertainty, Probabilistic Reasoning and Uncertainty; Probability theory; Bayes Theorem and Bayesian networks, Certainty Factor, Dempster-Shafer theory, Non Monotonic Reasoning, Truth maintenance Systems, Overview of Fuzzy Logic.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**UNDERSTANDING Of NLP**	**(06 hrs)**
Introduction: What is NLP, Steps in Natural Language Processing, Syntactic Analysis(Parsing): Grammars and Parsers, Augmented Transition Networks, Unification grammars **Semantic Analysis:** Semantic grammar, Case grammars, Conceptual parsing, Approximately Compositional Semantic Interpretation. **Discourse and Pragmatic Processing:** Using focus in Understanding, Modeling Beliefs, Using Goals and Plans for Understanding, Speech Acts, Conversational Postulates Text classification (Spell Checking), Probabilistic Language Models, Implementation aspects of Syntactic Analysis(Parsing)		

Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**INTRODUCTION TO GAME THEORY**	**(06 hrs)**
Game Playing: Overview and Examples. **Domain: Overview**, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**RECENT AND FUTURE TRENDS IN AI**	**(06 hrs)**
Deep Learning: Introduction, Why to go deep? Architecture of Deep Network, Restricted Boltzmann Machines, Deep belief Network, Tensor Flow, Deep Learning libraries, Deep Learning platform, The no, Caffe, Deep Learning Use Cases. **Applications:** Overview of Artificial Intelligence Domains, AI-Robotics, AI-Neural Networks, AI-IOT, Computer Vision in AI **Case Studies:** Automatic Bird Identification using Deep Learning, Tumkur monitoring using Computer Vision, Text to Speech Conversion using APIs		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Stuart Russel, Peter Norvig, “AI – A Modern Approach”, Third Edition, Pearson Education, 2009
2. Elaine Rich, Kevin Knight and Shivashankar B Nair”, Artificial Intelligence “, Tata McGraw Hill Edition 3rd Edition, 2009
3. James Allen, Natural Language Understanding. Benjamin/Cummings, 2ed, 1995

Reference Books:

1. Algorithmic Game theory Edited by N Nishan, T Roughgarden; Cambridge University Press
2. Allen B. Downey, "Think Stats", Second Edition, O’Reilly Media, ISBN: 978-1-491-90733-7
3. Game Theory - D Fudenberg& J Tirole; MIT Press
4. K. Boyer, L. Stark, H. Bunke, “Applications of AI, Machine Vision and Robotics, World Scientific PubCo, 1995

E- Books / E- Learning References

1. http://onlinestatbook.com/Online_Statistics_Education.pdf
2. https://london.ac.uk/sites/default/files/study-guides/introduction-to-natural-language-processing.pdf
3. https://www.deeplearningbook.org/contents/TOC.html
4. https://cvlesalfabegues.com/search/natural-language-understanding-2nd-edition/

HOME

SavitribaiPhule Pune University, Pune **Third Year Information Technology (2019 Course)** **314454 (B): Elective-II (Cyber Security)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 3 hrs/week	**03 Credit**	**Mid_ Semester: 30 Marks** **End_ Semester: 70 Marks**

Prerequisite Courses: if Any

Companion Course:

1. Computer Networks & Security

Course Objectives:

1. To learn fundamental concepts of cyber security
2. To learn different types of threats and cyber-crimes.
3. To understand the basics cyber forensics, network forensics, Email forensics, web forensics andcrypto currency forensics.
4. To understand the basic digital forensics concepts and techniques for conducting the forensic examination on different digital devices.
5. To analyze how particular social engineering attacks take advantage of specific features of the Internet and of human nature.
6. To learn the IT laws and cyber-crime basics.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Develop basic understanding of cyber security.

CO2: Differentiate among different types of cyber threats and cyber-crimes.

CO3: Illustrate cyber forensic techniques to identify the criminal activities.

CO4: Apply forensic analysis tools to recover important evidence for identifying computercrime

CO5: Distinguish and classify the forms of cybercriminal activity and the technological and social engineering' methods used to undertake such crimes

CO6: Evaluate the effectiveness of cyber-security, cyber-laws and other countermeasures against cybercrime

COURSE CONTENTS

Unit I	INTRODUCTION TO CYBER SECURITY	(06 hrs.)

Introduction: Introduction to Cyber Security, Need, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyber-warfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cyber security - Organizational Implications.

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**CYBER CRIMES AND HACKING**	**(06 hrs)**
Overview of Cyber-Attacks and Vulnerabilities, **Types of Threats** – Malware, spyware, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors. **Types of Cyber Crime -** cyber stalking, forgery, software piracy, cyber terrorism, phishing, computer vandalism, computer hacking, creating and distributing viruses over internet, spamming, cross site scripting, online auction fraud, cyber-squatting, logic bombs, web jacking, internet time thefts, DoS attack, salami attack, data diddling, email spoofing. **Types of Hacker** Hacking and Cracking, Hacking: Ethical issues, Ethical Hacking.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**CYBER FORENSICS**	**(06 hrs)**
Introduction to Cyber Forensics: What are cyber forensics, cyber forensics investigation process,digital evidence, challenges in cyber forensics; **Web Attack Forensics:** Intrusion forensics, database forensics, preventive forensics; Anti- forensics practices, Anti-forensics detection techniques, Network forensics analysis tools; **Malware Forensics:** Malware types, Malware Analysis, Tools for analysis; **Email Forensics:** e-mail Protocols, e-mail crimes, email forensics; Bitcoin **Forensics:** crypto currency, crimes related to bitcoin; **Case Study:** A detailed case study on cyber forensics and its Investigation Reports.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**DIGITAL FORENSICS**	**(06 hrs)**
Introduction to Digital Forensics, Cyber Forensics vs Digital Forensics, the role of digital forensics and its environment, Forensic Software and Hardware, properties of digital evidence, recovering and preserving digital evidence, Advanced forensic Tools, selecting and analyzing digital evidence, validating the evidence, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis **Case Study:** A detailed case study on Digital Forensics		
Mapping of Course Outcomes for Unit IV	**CO3, CO4**	
Unit V	**SOCIAL ENGINEERING**	**(06 hrs)**
Introduction of social engineering and cyber security, social engineering conceptual evolution, defining social engineering-categories, Phases, attack spiral model, Attack Vendors-social approach, socio-technical approach. Advanced social engineering attack, Phishing Attack, Insider Attack, Identity Theft, Preventing Insider Threats, Social Engineering Targets and Defense Strategies. Case Study: Phishing and Identity Theft Online Scams		

Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**CYBER ETHICS AND LAWS**	**(06 hrs.)**
Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under ISO 27001, IT Act 2000, Positive Aspects and weak areas of ITA 2000, **Digital signatures and the Indian ITA act**, ITA 2008, and International Standards maintained for Cyber Security, Security Audit, Investigation by Investing Agency, Intellectual Property Rights in Cyberspace.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA. ISBN 978-81-265-2179-1
2. Practical Cyber Forensics an Incident-Based Approach to Forensic Investigations, Niranjan Reddy, Apress, ISBN-13: 978-1-4842-4459-3
3. Practical Digital forensics – Richard Boddingtion, PACKT Publishing ISBN 978-1-78588-710-9

Reference Books:

1. William Stallings, Computer Security: Principles and Practices, Pearson 6th Ed, ISBN: 978-0- 13-335469-0
2. Bernard Menezes, Network Security and Cryptography, Cengage Learning, ISBN-978-81- 315-1349-1
3. Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN- 978- 81-203-5082-3

E- Books / E- Learning References:

1. Z. Wang, L. Sun and H. Zhu, "Defining Social Engineering in Cyber security," in IEEE Access, vol.8, pp. 85094-85115, 2020, Doi: 10.1109/ACCESS.2020.2992807.
2. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", ELSVIER, May 2011, ISBN 978-0-12-374268-1

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314454 (C): Elective-II- (Cloud Computing)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 3 hrs/week	**03 Credit**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses:

1. Basics of Computer Networks
2. Operating Systems

Course Objectives:

1. To provide students with the fundamentals and essentials of cloud computing
2. To learn basics of virtualization and its importance
3. To provide students a sound foundation of the cloud computing so that they are able to startusing and adopting cloud computing services and tools in their real life scenarios
4. To enable students exploring some important cloud computing driven commercial systems and applications
5. To understand cloud storage technologies and relevant file systems
6. To be exposed to Ubiquitous Cloud and Internet of Things

Course Outcomes:

On completion of the course, students will be able to–

CO1: Articulate the main concepts, key technologies and fundamentals of cloud computing.

CO2: Understand cloud enabling technologies and virtualization.

CO3: Analyze various cloud programming models and apply them to solve problems on the cloud.

CO4: Explain data storage and major security issues in the cloud.

CO5: Understand trends in ubiquitous cloud and internet of things.

CO6: Explore future trends of cloud computing.

COURSE CONTENTS

Unit I	**FUNDAMENTALS Of CLOUD COMPUTING**	**(06 hrs)**
Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Intercloud, Types of Clouds.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**CLOUD-ENABLING TECHNOLOGY AND VIRTUALIZATION**	**(06 hrs)**

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology Virtualization Technology, Web Technology, Multitenant Technology, Service Technology. **Implementation Levels of Virtualization**, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**COMMON STANDARDS AND CLOUD PLATFORMS**	**(06 hrs)**
Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application **Developers:** Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP), Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security. **Amazon web services:** Compute services Storage Services Communication Services Additional services **Google AppEngine:** Architecture and core concepts, Application life cycle, Cost model **Microsoft Azure:** Azure core concepts, SQL Azure, Windows Azure platform appliance		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**DATA STORAGE AND SECURITY IN CLOUD**	**(06 hrs)**
Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. **Securing the Cloud**- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**UBIQUITOUS CLOUDS AND THE INTERNET Of THINGS**	**(06 hrs)**
Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**FUTURE OF CLOUD COMPUTING**	**(06 hrs)**
How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing. **Docker at a Glance:** Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow		

Mapping of Course Outcomes for Unit VI	**CO6**

Text Books:

1. Thomas Erl, ZaighamMahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.

Reference Books:

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill, ISBN: 978 1259029950, 1259029956.
2. GautamShrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
5. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
6. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security, and More, Jones and Bartlett, ISBN :9789380853772.
7. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.
8. Karl Matthias, Sean P. Kane, Docker: Up and Running, OReilly, ISBN:9781491917572,1491917571.
9. Barrie Sosinsky, Cloud Computing Bible, Wiley, ISBN: 978 8126529803.
10. Ronald L. Krutz and Russell D. Vines, Cloud Security: A Comprehensive guide to Secure Cloud Computing, Wiley, ISBN: 9788126528097.
11. Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason E. Robinson, OpenStack:Cloud Application Development, Wrox, ISBN :9781119194316.
12. KailashJayaswal, JagannathKallakurchi, Donald J. Houde, Cloud Computing Black Book ,Wiley Dreamtech,ISBN:9789351194187

SavitribaiPhule Pune University, Pune

Third Year Information Technology (2019 Course)

314454 (D): Elective –II (Software Modeling and Design)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 3 hrs/week	03 Credit	Mid_Semester : 30 Marks End_Semester : 70 Marks

Prerequisite Courses:

1. Basic Knowledge of Object-oriented Programming
2. Software Engineering
3. Database Management System

Course Objectives:

1. To understand and use of UML to arrive at a design solution for real world problems.
2. To understand basics of object-oriented Modeling.
3. To learn Design concepts to Model for real world problems using object modeling.
4. To explore Interaction and behavior modeling.
5. To understand Software design principles and patterns.
6. To explore the architectural design guidelines in various type of application development.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Understand basics of object oriented methodologies and Unified Modeling Language (UML).

CO2: Apply analysis process, use case modeling, domain/class modeling

CO3: Design and apply interaction and behavior modeling on a given system.

CO4: Comprehend OO design process and business, access and view layer class design.

CO5: Recognize the software design principles and patterns to be applied on system.

CO6: Illustrate architectural design principles and guidelines in the various type of applicationdevelopment.

COURSE CONTENTS

Unit I	INTRODUCTION TO OOM AND UML	(06 hrs)

Introduction to Object Oriented Methodology- Study of various design methodologies like Object Oriented Design by Booch, Object Modelling Techniques by Rumbaugh, Object-Oriented Analysis by Codd Yourdon and Object-Oriented Software Engineering by Ivar Jacobson

Unified Approach – Unification of Booch, Rumbaugh and Jacobson methodologies, Object - Oriented Analysis, Object Oriented Design, Iterative Development & Continuous Testing, Modelling based on UML , Layered Approach

Unified Modeling Language – Introduction to Modeling and UML2.0, MDA, UML2.0 Structure, UML Building Blocks, UML common Mechanisms, Introduction to all UML2.0 Diagram notational Techniques, 4+1View

Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**OBJECT ORIENTED ANALYSIS**	**(06 hrs)**

Object Oriented Analysis Process: Use Case Modeling: Actor Identification, Actor Classification, Actor Generalization, Use Case Identification, Uses/Include/Extend Association, Writing a formal use case, Forward Engineering (Use case realization)
Class Modeling: Approach for identifying class, Approaches for identifying classes, Class pattern approach, Class Responsibilities, Collaboration Approach, Naming Classes, Class associations Generalization specialization relationship, Aggregation and Composition Relationships

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**INTERACTION AND BEHAVIOR MODELING**	**(06 hrs)**

Activity Diagram: Activity and Actions, Activity Edge, Decision and Merge Points, Fork-Join, Control Flow, Constraints on Action, Swim Lanes.

Sequence Diagram: Context, Objects and Roles, Links, Object Life Line, Message or stimulus, Activation/Focus of Control, delete object, Modelling Interactions.

Collaboration Diagram: Objects and Links, Messages and stimuli, Active Objects, Communication Diagram,Iteration Expression, Parallel Execution, Guard Expression, Timing Diagram.

State Diagram: State Machine, Triggers and Ports, Transitions and conditions, Initial and Final State, nestedstate, Composite States, Submachine States.

Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**OBJECT ORIENTED DESIGN PROCESS**	**(hrs)**

Object Oriented Design Process: Designing Business Layer: Object Oriented Constraints Language (OCL), **Designing Business Classes:** The Process, Designing Well Defined Class Visibility, Attribute Refinement, Method Design Using UML Activity Diagram, Packaging and Managing Classes.
Designing Access Layer: Object Relational Systems, Object Relation Mapping, Table Class Mapping, Table — Inherited Classes Mapping, Designing the Access Layer Classes: create mirror classes, identify access layer class relationships, eliminate redundant classes, create method classes.
Designing View Layer: View Layer Classes Design, Identifying View Classes by Analyzing Use Cases, Macro-Level Design Process – identify view layer objects, and build prototype for view layer Interface.
Test Usability and User satisfaction: Component and Deployment Design using Component and Deployment Diagram.

Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**SOFTWARE DESIGN PRINCIPLES AND PATTERNS**	**(06 hrs)**
Introduction and need of Design Principles: General Responsibility Assignment Software Patterns (GRASP): Introduction, Creator, Information Expert, Low coupling, Controller, High Cohesion, Polymorphism, Pure fabrication, Indirection, Protected Variations. **Introduction to GOF design patterns :** Types of design patterns: Creational Pattern: Singleton, Factory **Structural Pattern:** Adapter, Façade Behavioral Patterns: Strategy, State		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**SOFTWARE ARCHITECTURAL DESIGN**	**(06 hrs)**
Anatomy of Software Architecture, Quality attributes in architecture design, Designing Object-Oriented Software Architecture, Designing Client/Server Software Architecture, Designing Service-Oriented Architectures, Designing Component-Based Software Architectures, Designing Concurrent and Real-Time Software Architectures. Product Line Architecture design		
Mapping of Course Outcomes for Unit VI	**CO6**	

Text Books:

1. Ali Bahrami, Object Oriented systems Development using Unified Modelling Language McGraw – Hill, International Editions 1999, ISBN: 0-07-1160090-6
2. Erich Gamma et al, Design Patterns: Elements of Reusable Object, Pearson, First Edition,ISBN:9789332555402, 9332555400
3. Erich Gamma et al, Design Patterns: Elements of Reusable Object, Pearson, First Edition, ISBN:9789332555402, 9332555400.

Reference Books:

1. Dan Pilone, Neil Pitman, UML in Nutshell, O'reilly Pub., ISBN:8184040024, 9788184040029.
2. Object-Oriented Analysis and Design with Applications, Third Edition by Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, and Kelli Houston, 2007.
3. An introduction to Software Architecture by Shaw & Garlan, http://sunnyday.mit.edu/16.355/intro_softarch.pdf
4. Hassan Gomaa, Software Modeling And Design UML, Use Cases, Pattern, & Software Architectures, Cambridge University Press, ISBN: 978-0-521-76414-8.
5. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN: 9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527.

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314455: Internship		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 4 hrs/week	**04 Credit**	**Team work: 100 Marks**

Prerequisite Courses: if Any

Course Objectives:

- To encourage and provide opportunities for students to get professional/personal experience through internships.
- To learn and apply the technical knowledge gained from academics /classroom learning in real life/industrial situations.
- To get familiar with various tools and technologies used in industries and their applications.
- To enable students to develop professional skills and expand their professional network with the development of employer-valued skills like teamwork, communication.
- To apply the experience gained from industrial internship to the academic course completion project.
- To nurture professional and societal ethics in students
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations

Course Outcomes:

On completion of the internship, learner will be able to –

CO1: Develop professional competence through industry internship.

CO2: Apply academic knowledge in a personal and professional environment

CO3: Build the professional network and expose students to future employees.

CO4: Apply professional and societal ethics in their day-to-day life.

CO5: Become a responsible professional having social, economic and administrative considerations.

CO6: Make own career goals and personal aspirations.

Guidelines:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short- term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:
Internship to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.
Internship work Identification:
Student may choose to undergo Internship at Industry/Govt./NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to makethemselves ready for the industry. Contacting various companies for Internship and Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination. Student can take internship work in the form of Online/onsite work from any of the following but not limited to: • Working for consultancy/ research project, • Participation at Events (Technical / Business)/in innovation related completions like Hackathon, • Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute / • Learning at Departmental Lab/Tinkering Lab/ Institutional workshop, • Development of new product/ Business Plan/ registration of start-up, • Participation in IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos, • Industry / Government Organization Internship, • Internship through Internshala, • In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/onle ineinternship, • Research internship under professors, IISC, IIT's, Research organizations, • NGOs or Social Internships, rural internship, • Participate in open source development.
Internship Diary/ Internship Workbook:
Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working. Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. Internship Diary/workbook may be evaluated on the basis of the following criteria: ● Proper and timely documented entries ● Adequacy & quality of information recorded ● Data recorded ● Thought process and recording techniques used ● Organization of the information

Internship Work Evaluation:
Every student is required to prepare a maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/Cell In-charge/ Project Head/ faculty mentor /faculty or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship. **Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks +Internship Diary/Workbook and Internship Report - 50 Marks**
Evaluation through Seminar Presentation/Viva-Voce at the Institute-
The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria: • Depth of knowledge and skills Communication & Presentation Skills • Team Work • Creativity • Planning & Organizational skills • Adaptability • Analytical Skills • Attitude & Behavior at work

- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Log book
- Student's Feedback from External Internship Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contactIndustrial Supervisor/ Faculty Mentor/Faculty/TPO for assigning special topics and problems and should prepare the final report on the student's presence physically, if the student is found absent without prior intimation to the department/institute/concern authority/T & P Cell, entire training can be cancelled.

The report shall be presented covering following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details- Company background-organization and activities/Scope and object of the study / personal observations
- Index/Table of Contents
- Introduction
  Title/Problem statement/objectives Motivation/Scope and
  rationale of the study Methodological details
  Results / Analysis /inferences and conclusion
  Suggestions / Recommendations for improvement to industry, if any Attendance
  Record
  Acknowledgement
  List of reference (Library books, magazines and other sources)

Feedback from internship supervisor(External and Internal)

Post internship, faculty/faculty coordinator should collect feedback about student with following recommended parameters-

Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership.

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

314456: Computer Network Security Lab

HOME

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 4 Hrs/week	02 Credit	OR: 50 Marks TW: 25 Marks

Prerequisites:

1. Fundamentals of Computer Networks.

Course Objectives:

1. To design and implement small size network and to understand various networking commands.
2. To learn various client/server environments to use application layer protocols.
3. To understand network layer routing protocols and its implementations.
4. To understand the network security by using public key cryptography algorithms.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Design and configure small size network and associated networking commands.

CO2: Understand various client/server environments to use application layer protocols.

CO3: Use basic cryptographic techniques in software and system design.

CO4: Apply methods for authentication, access control, intrusion detection.

Guidelines for Instructor's Manual

1. The faculty member should prepare the laboratory manual for all the experiments and it shouldbe made available to students and laboratory instructor/assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.

2. Practical Examination will be based on the term work.

3. Candidate is expected to know the theory involved in the experiment.

4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respect.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratoryshould be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student's programs should be attached to the journal by every student and same to be maintained by department/lab In-charge is highly encouraged.For reference one or two journals may be maintained with program prints at Laboratory.

List of Laboratory Assignments

Group A: Computer Network

1. **Using a Network Simulator (e.g. packet tracer) Configure Router for…**
   a) Configure a router using router commands and Configure Routing Information Protocol(RIP).
   b) Configure Access Control lists – Standard & Extended.
   c) Network Address Translation: Static, Dynamic & PAT (Port Address Translation)
2. **Using a Network Simulator (e.g. packet tracer) Configure Routing Protocols,**
   a) Configure EIGRP – Explore Neighbor-ship Requirements and Conditions, its K Values Metrics Assignment and Calculation.
   b) OSPF – Explore Neighbor-ship Condition and Requirement, Neighbor-ship states, OSPF MetricCost Calculation.
   c) WLAN with static IP addressing and DHCP with MAC security and filters.
3. **Socket Programming in C/C++ on Linux.**
   a) TCP Client, TCP Server
   b) UDP Client, UDP Server
4. **Introduction to server administration** (server administration commands and their applications) and configuration of below Server: (Study/Demonstration Only)
   a) FTP **b)** Web Server

Group B: Network Security

1. Implement a client and a server on different computers using python. Perform the communication between these two entities by using RSA cryptosystem.
2. Implement a client and a server on different computers using python. Perform the authentication of sender between these two entities by using RSA digital signature cryptosystem.
3. Implement a client and a server on different computers using python. Perform the encryption of message of sender between these two entities by using DES Algorithm and use Diffie Hellman method for exchange of keys.
4. Use the snort intrusion detection package to analyze traffic and create a signature to identify problem traffic.

Reference Books:

1. Andrew S. Tanenbaum, David J. Wethrall, Computer Network, Pearson Education, ISBN: 978-0-13-212695-3.
2. Kurose Ross, Computer Networking: A Top Down Approach Featuring the Internet, Pearson Education, ISBN: 978-81-7758-878-1
3. William Stallings, Cryptography and Network Security, Pearson Education, 7th Edition, ISBN 978-0-13-444428-4

<table>
<tr><th colspan="3">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314457: DS & BDA Lab</th></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Practical (PR) : 2 hrs/week</td><td>01 Credit</td><td>PR : 25 Marks
TW: 25 Marks</td></tr>
</table>

HOME

Prerequisites:

1. Discrete mathematics
2. Database Management Systems, Data warehousing, Data mining
3. Programming in Python

Course Objectives:

1. To understand Big data primitives and fundamentals.
2. To understand the different Big data processing techniques.
3. To understand and apply the Analytical concept of Big data using Python.
4. To understand different data visualization techniques for Big Data.
5. To understand the application and impact of Big Data.
6. To understand emerging trends in Big data analytics.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Apply Big data primitives and fundamentals for application development.

CO2: Explore different Big data processing techniques with use cases.

CO3: Apply the Analytical concept of Big data using Python.

CO4: Visualize the Big Data using Tableau.

CO5: Design algorithms and techniques for Big data analytics.

CO6: Design and develop Big data analytic application for emerging trends.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

Student should submit term work in the form of handwritten journal based on specified list of assignments.

Practical Examination will be based on the term work.

Candidate is expected to know the theory involved in the experiment.

The practical examination should be conducted if and only if the journal of the candidate iscomplete in all respects.

Guidelines for Lab /TW Assessment

Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.

Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.

Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

1. All assignments of Part-A, Part-B and first assignment of Part-C should be covered in Laboratory and part of SPPU Practical examination.
2. Part-C second assignments are a group activity to be carried out in group of 4-5 students and students should submit the document related to it as part of journal.

Guidelines for Practical Examination

1. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement.
2. Student 's understanding of the fundamentals, effective and efficient implementation can be evaluated by asking relevant questions based implementation of experiments he/she has carried out.

List of Laboratory Assignments

Group A: Assignments based on the Hadoop

1. Single node/Multiple node Hadoop Installation.
2. Design a distributed application using MapReduce(Using Java) which processes a log file of a system. List out the users who have logged for maximum period on the system. Use simple log file from the Internet and process it using a pseudo distribution mode on Hadoop platform.
3. Write an application using HiveQL for flight information system which will include
    - **a.** Creating, Dropping, and altering Database tables.
    - **b.** Creating an external Hive table.
    - **c.** Load table with data, insert new values and field in the table, Join tables with Hive
    - **d.** Create index on Flight Information Table
    - **e.** Find the average departure delay per day in 2008.

Group B: Assignments based on Data Analytics using Python

1. Perform the following operations using Python on the Facebook metrics data sets
   - **a.** Create data subsets
   - **b.** Merge Data
   - **c.** Sort Data
   - **d.** Transposing Data
   - **e.** Shape and reshape Data
2. Perform the following operations using Python on the Air quality and Heart Diseases data sets
   - **a.** Data cleaning
   - **b.** Data integration
   - **c.** Data transformation
   - **d.** Error correcting
   - **e.** Data model building
3. Integrate Python and Hadoop and perform the following operations on forest fire dataset
   - **a.** Data analysis using the Map Reduce in PyHadoop
   - **b.** Data mining in Hive
4. Visualize the data using Python libraries matplotlib, seaborn by plotting the graphs for assignment no. 2 and 3 (Group B)
5. Perform the following data visualization operations using Tableau on Adult and Iris datasets.
   - **a.** 1D (Linear) Data visualization
   - **b.** 2D (Planar) Data Visualization
   - **c.** 3D (Volumetric) Data Visualization
   - **d.** Temporal Data Visualization
   - **e.** Multidimensional Data Visualization
   - **f.** Tree/ Hierarchical Data visualization
   - **g.** Network Data visualization

Group C: Model Implementation

1. Create a review scrapper for any ecommerce website to fetch real time comments, reviews, ratings, comment tags, customer name using Python.
2. Develop a mini project in a group using different predictive models techniques to solve any real life problem. (Refer link dataset- https://www.kaggle.com/tanmoyie/us-graduate-schools- admission-parameters)

Reference Books:

1. Big Data, Black Book, DT Editorial services, 2015 edition.
2. Data Analytics with Hadoop, Jenny Kim, Benjamin Bengfort, OReilly Media, Inc.
3. Python for Data Analysis by Wes McKinney published by O' Reilly media, ISBN : 978-1-449-31979-3.
4. Python Data Science Handbook by Jake VanderPlas https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
5. Alex Holmes, Hadoop in practice, Dreamtech press.
6. Online References for data set

- http://archive.ics.uci.edu/ml/
- https://www.kaggle.com/tanmoyie/us-graduate-schools-admission-parameters
- https://www.kaggle.com

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314458: Laboratory Practice-II (Web Application Development)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Practical (PR) : 4 hrs/week</td><td>02 Credit</td><td>PR : 25 Marks
TW : 50 Marks</td></tr>
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HOME

Prerequisites: Programming languages C++, Java

Course Objectives:

1. To understand basic concepts of web programming and scripting languages.
2. To learn Version Control Environment.
3. To learn front end technologies and back end technologies.
4. To understand mobile web development.
5. To comprehend web application deployment.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Develop Static and Dynamic responsive website using technologies HTML, CSS, Bootstrapand AJAX.
CO2: Create Version Control Environment.
CO3: Develop an application using front end and backend technologies.
CO4: Develop mobile website using JQuery Mobile.
CO5: Deploy web application on cloud using AWS.

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. Beyond curriculum assignments, the mini-project is also included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable).

Guidelines for Student's Lab Journal

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment
Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct an internal monthly practical examination as part of continuous assessment.
Guidelines for Laboratory Conduction
Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. The Inclusion of few optional assignmentsthat are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorials may be as per guidelines of authority.
Guidelines for Practical Examination
Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.
List of Laboratory Assignments
Group A-(WAD)
Assignment 1 **a.** Create a responsive web page which shows the ecommerce/college/exam admin dashboard with sidebar and statistics in cards using HTML, CSS and Bootstrap. **b.** Write a JavaScript Program to get the user registration data and push to array/local storage with AJAX POST method and data list in new page.

Assignment 2

a. Create version control account on GitHub and using Git commands to create repository and push your code to GitHub.

b. Create Docker Container Environment (NVIDEIA Docker or any other).

c. Create an Angular application which will do following actions: Register User, Login User, Show User Data on Profile Component

Assignment 3

a. Create a Node.JS Application which serves a static website.

b. Create four API using Node.JS, ExpressJS and MongoDB for CURD Operations on assignment 2.C.

Assignment 4

a. Create a simple Mobile Website using jQuery Mobile.

b. Deploy/Host Your web application on AWS VPC or AWS Elastic Beanstalk. Mini Project

Develop a web application using full stack development technologies in any of the following domains:

1. Social Media
2. ecommerce
3. Restaurant
4. Medical
5. Finance
6. Education
7. Any other

Reference Books:

1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496.
2. Raymond Camden, Andy Matthews, jQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891.
3. Steven M. Schafer, “HTML, XHTML and CSS”, Wiley India Edition, Fourth Edition, 978- 81-265-1635-3
4. Dr.HirenJoshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93-5004-088-1
5. Steven M. Schafer, “HTML, XHTML and CSS”, Wiley India Edition, Fourth Edition, 978- 81-265-1635-3
6. Ivan Bayross,”Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084.
7. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81- 8404-817-
8. Adam Bretz & Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.

- Books / E- Learning References

1. https://www.meanacademy.in/web-technologies
2. https://www.meanacademy.in/angular
3. https://www.meanacademy.in/mongodb
4. https://www.meanacademy.in/nodejs
5. https://www.meanacademy.in/aws

HOME

SavitribaiPhule Pune University, Pune
Third Year Information Technology (2019 Course)
314458 : Lab Practice – II (Artificial Intelligence)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 4 hrs/week	02 Credit	PR : 25 Marks TW : 50 Marks

Prerequisites: Programming knowledge (Python)

Course Objectives:

1. To develop real world problem solving ability
2. To enable the student to apply AI techniques in applications which involve perception, reasoning and planning
3. To work in team to build industry compliant AI applications

Course Outcomes:

On completion of the course, students will be able to–

CO1: Evaluate and apply core knowledge of AI on various real world problems.

CO2: Illustrate and demonstrate AI tools for different dynamic applications.

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. Beyond curriculum assignments, the mini-project is also included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable).

Guidelines for Student's Lab Journal

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing student's programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment

Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct an internal monthly practical examination as part of continuous assessment.

Guidelines for Laboratory Conduction
Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are basedon real world problems/applications. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorials may be as per guidelines of authority.
Guidelines for Practical Examination
Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.
List of Laboratory Assignments
Group A
1. Identify and Implement heuristic and search strategy for Travelling Salesperson Problem **2.** Implement n-queens problem using Hill-climbing / simulated annealing / A* algorithm etc. Write a program for Water jug problem / Towers of Hanoi **3.** Write a program for sorting algorithms using appropriate knowledge representation and reasoning techniques. **4.** Write a program for the Information Retrieval System using appropriate NLP tools (such as NLTK, Open NLP, …) **a.** Text tokenization **b.** Count word frequency **c.** Remove stop words **d.** POS tagging **5.** Write a program for the Tic-Tac-Toe game.
Group B (Mini Project)
Develop a Web Based Application for any one of the following: **1.** Develop a Text Classification tool as a CRM task or Web Crawler application. **2.** Develop a Speech to Text System with the help of POS tagging **3.** E-commerce stores using Forward/backward chaining **4.** Sudoku puzzle **5.** Detection and recognition of object such as Face, Fruit, Finger print etc. using Deep Learning

Reference Books:
1. Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Loper **2.** https://www.deeplearningbook.org/contents/TOC.html **3.** https://www.nltk.org/ **4.** K. Boyer, L. Stark, H. Bunke, "Applications of AI, Machine Vision and Robotics, World Scientific PubCO, 1995

HOME

Savitribai Phule Pune University, Pune Third Year Information Technology (2019 Course) 314458: Lab Practice –II (Cyber Security)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR) : 04 hrs/week	**02 Credit**	**PR : 25 Marks** **TW : 50 Marks**

Prerequisites: Computer network and security

Course Objectives:

1. To develop and understand the placement of packet-sniffer in networking and internetworking environment.
2. To implement the cyber-attacks.
3. To implement intrusion detection and basic mail spamming.

Course Outcomes:

On completion of the course, students will be able to–

CO1: To know the different guidelines for Packet Sniffing in networking and internetworking environment.

CO2: To know the different types of cyber-attacks and will be able analyze theattacks.

CO3: Apply the knowledge of IDS to secure network and performing analysis of IDS attack on network.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/Assistant.

The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, references. Experiments to be conducted in Python/any open source language.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by students in the form of journals. The Journal consists ofprologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory Concept, printouts of the code written using coding standards, sample test cases etc. To support Go-green, printouts on paper are discouraged and should be maintained in soft copy. However, all students must submit the soft copy and should be maintained by batch teacher.
2. Practical Examination will be based on the CS theory and CS lab Assignments.
3. Candidate is expected to know the theory involved in the experiment.
4. The Practical examination should be conducted if the journal of the candidate is completed in all respects andcertified by concerned faculty and head of the department.
5. All the assignment mentioned in the syllabus must be conducted.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware such as tags, coding standards, design flow to be implemented etc. should be checked by the concerned faculty member(s).

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. All the assignments should be conducted on open-source software.

Guidelines for Practical Examination

Both internal and external examiners should jointly conduct practical examination. During assessment, the examiners should give the maximum weight age to the satisfactory answer of the problem statement In question. The supplementary and relevant questions may be asked at the time of evaluation to judge the student‘s understanding of the fundamentals, effective and efficient implementation.

List of Laboratory Assignments

1. Write a program to sniff packet sent over the local network and analyze it.
2. Create an attack using python script and implement attack and analyze the effect of attack.
   - **a)** DDOS Attack
   - **b)** IP spoofing
   - **c)** DNS Attack
3. Write a program in python script for Spam Mail Detection (Spam Filtering Implementation).
4. IDS Use Distributed IDS Attack Information to gathers log files from users around the network and prepares reports to determine if their networks have encountered intrusion attempts.

Reference Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA. ISBN 978-81-265-2179-1.
2. Practical Cyber Forensics an Incident-Based Approach to Forensic Investigations, Niranjan Reddy, Apress, ISBN-13: 978-1-4842-4459-3.
3. Practical Digital forensics – Richard Boddingtion, PACKT Publishing ISBN 978-1-78588.

Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
314458: Laboratory Practice-II (Cloud Computing)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	02 Credit	PR :25 Marks TW : 50Marks

Prerequisite Courses:
- Basics of Computer Networks
- Operating Systems

Course Objectives:
1. To develop web applications in cloud.
2. To learn the design and development process involved in creating a cloud based application.

Course Outcomes:

On completion of the course, students will be able to–

CO1: To design and develop cloud-based applications.

CO2: To Simulate a cloud scenario using CloudSim.

CO3: To design and deploy web applications in cloud environment.

LIST OF ASSIGNMENTS

1. Install Google App Engine. Create hello world app and other simple web applications using python/java.
2. Use GAE launcher to launch the web applications.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6. Design and deploy a web application in a PaaS environment.
7. Design and develop custom Application (Mini Project) using Salesforce Cloud.
8. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store.

CASE STUDIES

- Data storage security in private cloud
- Application of IoT/Ubiquitous based on cloud
- Tools for building private cloud

Text Books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiS elvi, Mastering Cloud Computing: Foundationsand Applications Programming, McGraw Hill, ISBN: 978 1259029950, 1259029956.
2. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
5. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
6. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security,and More, Jones and Bartlett, ISBN :9789380853772.
7. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.
8. Karl Matthias, Sean P. Kane, Docker: Up and Running, OReilly, ISBN:9781491917572,1491917571.
9. Barrie Sosinsky, Cloud Computing Bible, Wiley, ISBN: 978 8126529803.
10. Ronald L. Krutz and Russell D. Vines, Cloud Security: A Comprehensive guide to Secure Cloud Computing, Wiley, ISBN: 9788126528097.
11. Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason E. Robinson, OpenStack: Cloud Application Development, Wrox, ISBN :9781119194316.
12. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Cloud Computing Black Book ,Wiley Dreamtech,ISBN:9789351194187

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Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

314458 :Laboratory Practice-II (Software Modeling Design)

Teaching Scheme: Hrs	Credit Scheme:	Examination Scheme:
Practical (PR) : 04 hrs/week	02 Credit	PR : 25 Marks TW : 50 Marks

Prerequisites:

1. Problem Solving & Object-Oriented Programming.
2. Software Engineering and Project Management.

Course Objectives:

1. To teach the student Unified Modeling Language (UML 2.0)
2. To teach the student how to identify different software artifacts at analysis and design phase.
3. To explore and analyze use case modeling.
4. To explore and analyze domain/ class modeling.
5. To develop a system with design and modeling concepts.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Develop use case model with the help of UML notations.

CO2: Develop and implement analysis model and design model.

CO3: Develop and implement Interaction and behavior Model.

Guidelines for Instructor's Manual

Students should work in group of 3-4 students. Student should Identify Project title of enough complexity, which has at least 4-5 major functionalities.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical / Oral examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering theparameters such as timely conduction of practical assignment, methodology adopted for implementationof practical assignment, timely submission of assignment in the form of handwritten write-up along with diagrams specified in the assignment, implementation (wherever applicable) attendance etc.
2. Examiners will judge the understanding of the practical/ oral performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware should be checked by the concerned faculty member(s).

Guidelines for Laboratory Conduction

1. The instructor is expected to frame the assignments by understanding the prerequisites, technologicalaspects, utility and recent trends related to the topic.
2. The instructor may set multiple sets of assignments and distribute among batches of students. Students should work in group of 3-4 students. Common problem statement (minimum 3-4 major functionalities it should cover) should be considered to execute all assignment.
3. It is appreciated if the assignments are based on real world problems/applications.
4. Any open-source UML designing tool like StarUML, Visual Paradigm, Umbrello, AgroUML, can be used todraw UML diagram. Languages and databases : JAVA, MySQL, MongoDB, C#.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical/ Oral examination. During practical / Oral assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

Assignment 1: Write Problem Statement and draw Use Case diagrams for Mini Project (4Hrs)
Identify Project of enough complexity, which has at least 4-5 major functionalities.
Identify stakeholders, actors and write detail problem statement for your system.
Identify Major Use Cases, Identify actors. Write formal Use Case specification for all major Use Cases.

Assignment 2: Prepare Dynamic Model for the system (4 Hrs)
Identify Activity states and Action states.
Draw Activity diagram with Swim lanes and fork-joins using UML 2.0 Notations for major Use CasesDraw Sequence Diagram Using UML 2.0 notations for major Use Cases.

Assignment 3: Prepare Static Model for the System (6 Hrs)
Draw class diagram using UML 2.0 notations.
Prepare Data Dictionary for the databases. Draw Deployment diagram UML 2.0 notations.

Assignment 4: Outputs and Code demonstration **(10 Hrs)**
Write the code for the Mini Project.
Execute the code and record the output screens

Reference Books:

1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011
2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

Mandatory Audit Course 6

314459 (A) : Green and Unconventional Energy

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Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) : 1 hrs/week **Tutorial(TUT): 3 hrs/week** **(Assignments and Self-study)**	**Non Credit**	**Audit Course**

Prerequisite Courses, if any:

Course Objectives:

1. To know the importance of the energy and the the basic infrastructures for the economic development of the country.
2. To know about the most important renewable energy resources and the technologies for harnessing these resources within the framework of a broad range of simple to state- of -the-art energy systems.
3. To understand the application of non-conventional energy technologies.

Course Outcomes:

On completion of the course, students will be able to–

CO1: List and explain the main sources of energy and their primary applications in the India, and theworld.

CO2: Describe the challenges and problems associated with the use of various energy sources and itsconservation.

CO3: List and describe the primary renewable energy resources and technologies.

CO4: Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

COURSE CONTENTS

Unit I	INTRODUCTION TO GREEN AND UNCONVENTIONAL ENERGY STUDIES	(04 hrs)

Various Non-Conventional energy sources, Need, Availability, Classification, Relative merits & demerits, Global energy scenario, Indian energy scenario, Energy Storage, Distribution and Conservation

Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	SOLAR and WIND ENERGY	(04 hrs)

Solar energy: Introduction, Conservation of Solar energy

Applications: Solar Energy - solar water heater- Solar Cooker-Box type- Solar dryer-solar green house—Summer and winter greenhouse-solar electric power generation-Solar photovoltaic

Wind Energy: Introduction- Basic Principles of Wind energy conversion-The nature of wind- The power inthe wind. Wind energy conversion system (WECS), Advantages & Limitations of WECS
, Environmental aspect. Government Schemes.

Mapping of Course Outcomes for Unit II	**CO2, CO3**	
Unit III	**BIOMASS ENERGY, GEO THERMAL & TIDAL ENERGY.**	**(04 hrs)**

Biomass Energy: Introduction- Biomass conversion techniques -Biogas Generation-Factors affecting biogas Generation, urban waste to energy conversion.

Geothermal Sources: Hydro thermal Source (Vapor &Liquid dominated systems), geothermalenergy conversion

Tidal Energy-Basic Principles of Tidal Power, Schematic Layout of Tidal Power house, Advantages & Limitations of Tidal power.

Mapping of Course Outcomes for Unit III	**CO3, CO4**

Guidelines for Conduction (Any one or more of following but not limited to)

Guest Lectures / Group Activities / Assignments / Taking up small project for short duration
Guidelines for Assessment (Any one or more of following but not limited to) / Practical Test / Presentation / Paper / (Theory assessment test) / Report

SUGGESTED LIST OF STUDENT ACTIVITYS

1. Prepare a of monthly energy consumption of your institute and find the ways how it can be conserved
2. Conduct an energy audit of your institute; suggest the ways how the conventional energy resources utilization can be minimized. Suggest the areas ,where the non-conventional energy may be used
3. Visit solar power plant /wind power plant available in your locality/ nearer to your institute and understand different elements, working, and note the power generation by these plants
4. Visit government website for renewable energy and find out different schemes run by government.

Text Books:

1. Non-Conventional Energy Sources by G.D. Rai, Khanna Publication
2. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19- 926178-4).
3. Renewable Energy Sources & Emerging Technologies, D P Kothari, K C Singal & Rakesh Ranjan, Prentice Hall India.

Reference Books:

1. http://www.ener-supply.eu/downloads/ENER_handbook_en.pdf
2. Energy opportunities and social responsibility. Satyesh C. Chakraborty, Jaico publications
3. Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press, 619 pages (ISBN: 0-19-926179-2)
4. Ashok Desai V, Non-Conventional Energy, Wiley Eastern Ltd, 1990.
5. Mittal K.M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, 1997.

E- Books / E- Learning References :

1. RENEWABLE ENERGY SOURCES AND THEIR APPLICATIONS: http://www.ifeed.org/pdf/media/BOOK_Renewable-Energy-Sources-and-their-Applications.pdf
2. http://nptel.ac.in/courses/112105051/

Savitribai Phule Pune University, Pune

Third Year Information Technology (2019 Course)

Mandatory Audit Course 6

314459 (B): Leadership and Personality Development

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH) :1 hrs/week Tutorial(TUT): 3 hrs/week (Assignments and Self-study)	Non Credit	Audit Course

HOME

Prerequisite Courses: if Any

Course Objectives:

1. To develop inter personal skills and be an effective goal oriented leader.
2. To develop personalities of students in order to empower them and get better insights into self-responsibilities in personal life to build better human being.
3. To develop professionals with leadership quality along with idealistic, practical and moral values.
4. To re-engineer attitude and understand its influence on behavior.
5. To help students to evolve as leaders who can effectively handle real life challenges in and across the dynamic environment.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Practice responsible decision-making and personal accountability.

CO2: Demonstrate an understanding of group dynamics and effective teamwork.

CO3: Develop a range of leadership skills and abilities such as effectively leading change, resolving conflict, and motivating others.

CO4: Develop multi-dimensional personality.

COURSE CONTENTS

Unit I	PERSONALITY DEVELOPMENT	(03 hrs)

Laws of Personality Development, Different Layers of Personality, How to Change Our Character, Influence of Thought, Take the Whole Responsibility on Yourself, Self-analysis: Johari 's Window, Attitude: Factors influencing Attitude, Challenges and lessons from Attitude, Personality Traits, Sharpening MemorySkills Decision-Making, Negotiation and Problem-Solving. Importance of Self Confidence, Self Esteem, Creativity: Out of box thinking, Lateral Thinking

Mapping of Course Outcomes for Unit I	CO1

Unit II	TECHNIQUES IN PERSONALITY DEVELOPMENT	(03 hrs)

Techniques for better Time Management, Meditation and concentration techniques, Self- hypnotism, Self-acceptance, and self-growth, Goal setting: Wish List, SMART Goals, Blueprint for success, Short Term, Long Term, Lifetime Goals. Confidence Building: Case studies, Confidence building videos of motivational speakers.

<table>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO1, CO2</td></tr>
<tr><td>Unit III</td><td>LEADERSHIP SKILLS</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Working individually and in a team, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation, Introduction to Interpersonal Relations, Virtual Leadership: Introduction, Essential Skills for Managing Remote Teams and challenges of virtual leadership.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3, CO4</td></tr>
<tr><td>Unit IV</td><td>TEAM BUILDING</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Importance of groups in organization and Team Interactions in group, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts., How to build a good team? Teamwork & Team building Interpersonal skills, Virtual team dynamics: issues and resolutions</td></tr>
<tr><td>Mapping of Course Outcomesfor Unit IV</td><td colspan="2">CO2 ,CO4</td></tr>
</table>

Reference Books:

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; OxfordPublishers.2E, ISBN: 780199459742, ISBN: 0199459746.
2. SKILLS, 2015, Career Development Centre, Green Pearl Publications.
3. ShaliniVerma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company. ISBN: 9789325974203, ISBN: 9325974207.
4. John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc, ISBN: 9789350098714, ISBN: 9350098717.
5. Basic Managerial Skills for All by E. H. McGrath, S. J., PHI Personality Development and Soft Skill, Mitra, Barun, Oxford University Press, ISBN: 9788120343146, ISBN:812034314X.
6. Personality Development by Rajiv K. Mishra. Rupa& Co.
7. How to deal with Stress by Stephen Palmer & Cary Cooper, Kogan Page India Pvt. Ltd., South Asian Edition Successful Time Management by Patrick Forsyth, Kogan Page
8. Shiv Khera, "You Can Win", A&C Black, 2014, ISBN: 13: 9789350593783
9. Gajendra Singh Chauhan, Sangeeta Sharma: Soft Skills – An Integrated Approach to Maximize Personality, Wiley India, ISBN:13:9788126556397

E-Books/E-Learning References:

1. Developing Soft Skills and Personality: By Prof.T.Ravichandran, IIT Kanpur https://onlinecourses.nptel.ac.in/noc19_hs32/preview
2. Leadership:Prof KalyanChakravatti, IIT Kharagpur https://nptel.ac.in/courses/122/105/122105021/
3. Virtual leadership https://youtu.be/SNeTzgBE93o
4. Motivation and Confidence building videos of motivational speakers like Shiv Khera, Sandeep Maheshwari , Sonu Sharma , Vivek Bindra , B.K.Shivani

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Third Year Information Technology (2019 Course)
Mandatory Audit Course 6
314459 (C): Foreign Language-(Japanese Language- IV)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH) :1 hrs/week
Tutorial(TUT): 3 hrs/week
(Assignments and Self-study)</td><td>Non Credit</td><td>Audit Course</td></tr>
</table>

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Prerequisite Courses:

1. Students must have already studied can read/write Hiragana and Katakana script
2. Students must have studied Japanese for beginners that includes the syllabus of Audit course Module 1 to 3

Course Objectives:

1. Japan Market needs: To meet the needs of ever growing industry with respect to the Japanese language support.
2. Japanese Culture and Mindset: To get introduced to Japanese society and culture throughlanguage.
3. Career opportunities: To know more about Higher studies, Career opportunities in Japan /Japanese companies across the world.
4. Soft skills and self-development: To learn the manners, business culture and develop the confidence by gaining the knowledge of global perspective and cross-cultural studies.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Do Better Communication in Japanese language.

CO2: Demonstrate knowledge of Japanese Language Scripts (Reading, Writing, etc).

CO3: Demonstrate knowledge of Japanese culture, lifestyle, etc.

CO4: Pursue advanced Professional Japanese Language course.

COURSE CONTENTS

Unit I	JAPANESE GRAMMAR	(3 hrs Lecture + 3 hrs Self-study)

Receiving and Giving, Verb past tense, Negative, Make sentences using various adjectives, Culture/Others: Conversation/Essay about some place, Introduction to the tourism in Japan, Introduction to Business/Work culture in Japan, Kanjis: 41 to 50, Listening practice, Vocabulary and conversation practice

Reference:

a. Minna no Nihongo I : Lesson 7and 8 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 5

<table>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">INTERACTIVE JAPANESE</td></tr>
<tr><td colspan="3">Adverbs of degree, Stating like / dislike, Living and Non-living things, Stating wish/desire, Stating the present action (verb te form), Culture/Others: Introduction to Career Opportunities, Education and Higher studies in Japan, Kanjis: 51 to 60, Listening practice, Vocabulary and conversation practice
Reference:
a. Minna no Nihongo I : Lesson 9 and 10 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 6</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>FORMAL JAPANESE</td><td>(3 hrs Lecture + 3 hrs Self-study)</td></tr>
<tr><td colspan="3">Counters , Making comparisons, Past tense of verbs ,Past tense of adjectives, Combining adjectives (i + i, na+i …), Culture/Others: Information about career forums and Job Fairs Introduction about Japanese companies recruitment process, Kanjis: 61 to 70, Listening practice, Vocabulary and conversation practice
Reference:
c. Minna no Nihongo Lesson 11 and 12 (Text book + Audio and Video)
d. Nihongo Challenge Kanji - Lesson 7</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>LIFE IN JAPAN</td><td>(3 hrs Lecture + 3 hrs Self-study)</td></tr>
<tr><td colspan="3">Stating wish/desire (ga hoshi, verb tai form), Stating / combining multiple actions (verb te form), Stating the order of multiple actions (verb te kara form),Expressing "Permission" and "Prohibition" (te mo ii, te wa ikenai forms),Culture/Others: Preparation of a job interview for a Japanese company, Do’s and Don’tsin a Job Interview ,Kanjis: 71 to 80,Listening practice, Vocabulary and conversation practice
Reference:
a. Minna no NihongoI : Lesson 13 and 14 (Text book + Audio and Video)
b. Nihongo Challenge Kanji - Lesson 8</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td colspan="3">1. Minna no Nihongo I–MainText book with audio and video files(Books by Goyal Publishers – Available in shops / Online)
2. Minna no Nihongo - Translation and grammatical notes for self-study(Books by Goyal Publishers
3. Available in shops / Online)
4. Nihongo Challenge – Kanji(Available with Japanese Language schools/teachers)</td></tr>
</table>

Reference Books:
1. Nihongo Shoho: For better understanding and practice of Basic Japanese Grammar **2.** Marugoto : For scenario based Japanese conversation practice
E -Books / E- Learning References :
1. nihongo ichiban **a.** https://nihongoichiban.com/home/jlpt-n5-study-material/ **2.** jlpt sensei **a.** https://jlptsensei.com/how-to-pass-jlpt-n5-study-guide/

Faculty of Science & Technology
Savitribai Phule Pune University
Pune, Maharashtra, India

Curriculum for
Final Year of Information Technology
(2019 Course)
(With effect from AY 2022-23)

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Savitribai Phule Pune University
Final Year of Information Technology (2019 Course)
(With effect from Academic Year 2022-23)

Semester VII

Course Code	Course Name	Teaching Scheme(Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Termwork	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
414441	Information and Storage Retrieval	03	-	-	30	70	-	-	-	100	3	-	-	3
414442	Software Project Management	03	-	-	30	70	-	-	-	100	3	-	-	3
414443	Deep Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
414444	Elective III	03	-	-	30	70	-	-	-	100	3	-	-	3
414445	Elective IV	03	-	-	30	70	-	-	-	100	3	-	-	3
414446	Lab Practice III	-	04	-	-	-	25	-	25	50	-	2	-	2
414447	Lab Practice IV	-	02	-	-	-	25	25	-	50	-	1	-	1
414448	Project Stage-I	-	-	02	-	-	50	-	-	50	-	-	2	2
414449	Audit Course7													
										Total Credit	15	03	02	20
	Total	15	06	02	150	350	100	25	25	650	15	03	02	20

Elective III:

- Mobile Computing
- High Performance Computing
- Multimedia Technology
- Smart Computing

Elective IV:

- Bioinformatics
- Introduction to DevOps
- Computer Vision
- Wireless Communications

Lab Practice-III:

It is based on subjects:

- Information and Storage Retrieval

Lab Practice-IV:

It is based on subjects:

- Deep Learning

Audit Courses 7:

- 414449A: Copyrights and Patents
- 414449B: Stress Management by Yoga
- 414449C: English for Research Paper Writing

Savitribai Phule Pune University
Final Year of Information Technology (2019Course)
(With effect from Academic Year2022-23)

Semester VIII

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Teamwork	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
414450	Distributed Systems	03	-	-	30	70	-	-	-	100	03			03
414451	Elective V	03	-	-	30	70	-	-	-	100	03			03
414452	Elective VI	03	-	-	30	70	-	-	-	100	03			03
414453	Startup and Entrepreneurship	-	-	03	-	-	50	-	-	50	-	-	03	03
414454	Lab Practice V	-	04	-	-	-	50	25	-	75		02		02
414455	Lab Practice VI	-	02	-	-	-	25	-	50	75		01		01
414456	Project Stage II	-	10	-	-	-	100	-	50	150		05		05
414457	AuditCourse8													
Total Credit											09	08	03	20
Total		09	16	03	90	210	225	50	75	650	09	08	03	20

Elective V:

- Software Defined Networks
- Social Computing
- Natural Language Processing
- Soft Computing
- Game Engineering

Elective VI:

- Ethical Hacking and Security
- Augmented and Virtual Reality
- Business Analytics and Intelligence
- Blockchain Technology

Lab Practice V:

It is based on subjects:

- Distributed Systems

Lab Practice VI:

It is based on subjects:

- Elective VI

Audit Courses 8:

- 414457A: Functional Programming in Haskell
- 414457B: Cyber Laws and Use of Social Media
- 414457C: Constitution of India

Savitribai Phule Pune University, Pune Bachelor of Information Technology	
Program Educational Objectives	
PEO1	Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.
PEO2	Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.
PEO3	Possess an attitude and aptitude for research, entrepreneurship and higherstudies in the field of Computer Science and Information Technology.
PEO4	Have commitment ethical practices, societal contributions through communities and life-long learning.
PEO5	Possess better communication, presentation, time management and team work skills leading to responsible & competent professional sand will be able to address challenges in the field of IT at global level.

Program Outcomes		
Students are expected to know and be able to–		
PO1	Engineering knowledge	An ability to apply knowledge of mathematics, computing, science, engineering and technology.
PO2	Problem analysis	An ability to define a problem and provide a systematic solution with the help of conducting experiments, analyzing the problem and interpreting the data.
PO3	Design / Development of Solutions	An ability to design, implement, and evaluate software or a software /hardware system, component, or process to meet desired needs within realistic constraints.
PO4	Conduct Investigation of Complex Problems	An ability to identify, formulate, and provide essay schematic solutions to complex engineering /Technology problems.
PO5	Modern Tool Usage	An ability to use the techniques, skills, and modern engineering technology tools, standard processes necessary for practice as a IT professional.
PO6	The Engineer and Society	An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems with necessary constraints and assumptions.
PO7	Environment and Sustainability	An ability to analyze and provide solution for the local and global impact of information technology on individuals, organizations and society.
PO8	Ethics	An ability to understand professional, ethical, legal, security and social issues and responsibilities.
PO9	Individual and Team Work	An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).
PO10	Communication Skills	An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies /tools with the help of electives, profession along animations and extra-curricular activities.
PO11	Project Management and Finance	An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.
PO12	Life-long Learning	An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.

Program Specific Outcomes(PSO)	
A graduate of the Information Technology Program will demonstrate -	
PSO1	**An ability to apply the theoretical concepts and practical knowledge of Information Technology in analysis, design, development and management of information processing systems and applications in the interdisciplinary domain.**
PSO2	**An ability to analyze a problem, and identify and define the computing infrastructure and operations requirements appropriate to its solution. IT graduates should be able to work on large-scale computing systems.**
PSO3	**An understanding of professional, business and business processes, ethical, legal, security and social issues and responsibilities.**
PSO4	**Practice communication and decision-making skills through the use of appropriate technology and be ready for professional responsibilities.**

SEMESTER – VII

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414441: Information Storage and Retrieval

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 03 hrs/week	03 Credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses,
1. Data Structures and Files.
2. Database management systems.

Companion Course, if any: Lab Practice III

Course Objectives:
1. To understand the concepts of information retrieval.
2. To understand the role of clustering in information retrieval.
3. To learn different indexing structures and searching techniques.
4. To evaluate the performance of the IR system and understand user interfaces for searching.
5. To understand information sharing on the web.
6. To understand the various applications of information retrieval giving emphasis to multimedia and distributed IR, web Search.

Course Outcomes:
On completion of the course, students will be able to

CO1. Understand the concept of Information retrieval and to apply clustering in information retrieval.
CO2. Use an indexing approach for retrieval of text and multimedia data.
CO3. Evaluate performance of information retrieval systems.
CO4. Apply the concepts of multimedia and distributed information retrieval.
CO5. Use appropriate tools in analyzing the web information
CO6. Simulate the working of a search engine and recommender system.

COURSE CONTENTS

Unit I	Introduction to Information Retrieval	(06 hrs)
Basic Concepts of IR, Data Retrieval & Information Retrieval, Text mining and IR relation, IR system block diagram, **Automatic Text Analysis:** Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighting, Probabilistic Indexing, Automatic Classification. Measures of Association, Different Matching Coefficients, Cluster Hypothesis, **Clustering Techniques: Rocchio's** Algorithm, Single pass algorithm, Single Link algorithm.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Indexing and Searching Techniques**	**(06 hrs)**
Indexing: Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing. **Searching Techniques:** Boolean Search, sequential search, Serial search, cluster-based retrieval, Query languages, Types of queries, Patterns matching, structural queries. **IR Models:** Basic concepts, Boolean Model, Vector Model, Probabilistic Model.		
Mapping of Course Outcomes for Unit II	**CO2**	

Unit III	Evaluation and Visualization of Information Retrieval System	(06 hrs)
Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user-oriented measures. **Visualization in Information System:** Starting points, Query Specification, document context, User relevance judgment, Interface support for search process.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Distributed and Multimedia IR**	**(06 hrs)**
Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, **Multimedia IR:** Introduction, Data Modeling, Query Language, Background-Spatial Access Method, A Generic Multimedia Indexing Approach, One Dimensional Time Series, Two-Dimensionalcolor Images, Automatic Feature Extraction, Trends and Research Issue.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Web Searching**	**(06 hrs)**
Introduction, Challenges, Web Characteristics, **Search Engines:** Centralized Architecture, Distributed Architecture, User Interfaces, Ranking, Crawling the web, Indices, Browsing, Meta-searchers, Searching using Hyperlinks, Trends and Research Issues, **Introduction to Web Scraping:** Python for web scraping, Request, HTML parsing, Beautiful Soup.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Advanced Information Retrieval**	**(06hrs)**
XML Retrieval: Basic XML concepts, Challenges in XML retrieval, Vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. **Recommendation system:** Collaborative Filtering and Content Based Recommendation of Documents and Products. Introduction to Semantic Web.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Ricardo Baeza-Yates, Berthier Riberio–Neto, Modern Information Retrieval, Pearson Education, ISBN: 81-297-0274-6.
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk), Second Edition ISBN:978-408709293.
3. Ryan Mitchell, Web Scraping with Python, O'reilly, second Edition, ISBN: 9781491985571.
4. Ricci F, Rokach L, Shapira B, Kantor P, Recommender Systems Handbook, Springer, ISBN:978-0-387-85819-7.
5. Norbert Fuhr, MouniaLalmas, Saadia Malik, Gabriella Kazai, Advances in XML Information Retrieval and Evaluation, Springer New York Publisher.

Reference Books:

1. ChabaneDjeraba, Multimedia mining: A highway to intelligent multimedia documents, Kulwer Academic Publisher, ISBN: 1-4020-7247-3.
2. V. S. Subrahamanian, Satish K. Tripathi, Multimedia information System, Kulwer Academic Publisher.
3. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, An Introduction to Information Retrieval, Cambridge University Press, 2008.
4. Marek Kowalkiewicz, Maria E. Orlowska, Tomasz Kaczmarek, Witold Abramowicz, Web Information Extraction and Integration, Springer New York Publisher.
5. David Grossman, Ophir Frieder, Information Retrieval - Algorithms and Heuristics, Springer International Edition, ISBN: 978-1-4020-3004-8.
6. Hang Li, Learning to Rank forInformation Retrieval and Natural Language. 7. Processing, Morgan
7. & Claypool, ISBN: 9781608457076.
8. Robert Korfhage, Information Storage and Retrieval, John Wiley & Sons, First Edition,ISBN: 9788126507702.
9. Zhang, Jin, Visualization for Information Retrieval, Springer-Verlag Berlin Heidelberg,1st Edition, ISBN: 978-3-642-09442-2.

E Books / E Learning References:

1. https://web.stanford.edu/class/cs276/handouts/EvaluationNew-handout-1-per.pdf.
2. https://www.coursera.org/learn/text-retrieval

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414442: Software Project Management

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 3 hrs/week	03 Credits	Mid_Semester:30 Marks End_Semester:70 Marks

Prerequisite Courses: **Software Engineering**

Course Objectives:

1. To discuss the fundamentals of Software Project Management
2. To explain Project Design and Project Evaluation.
3. To acquire skill in Activity Planning and to deal with Risk Management
4. To provide platform to understand through different tools about Project Tracking, Monitoring & Control.
5. To discuss Staff Selection Process and the issues related to Staff Management.
6. To provide exposure to modern tools used for Software Project Management.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Apply the practices and methods for successful Software Project Management
CO2. Create Design and Evaluate Project
CO3. Analyze Project Schedule and calculate Risk Management with help of tools.
CO4. Demonstrate different tools used for Project Tracking, Monitoring & Control.
CO5. Identify Staff Selection Process and the issues related to Staff Management.
CO6. Discuss and use modern tools for Software Project Management.

COURSE CONTENTS

Unit I	Introduction to Software Project Management	(6hrs.)

Introduction to Software Project Management: Why is Software Project Management important? What is a Project? Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some Ways of Categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success, and Failure, what is Management? Management Control, Traditional versus Modern Project Management Practices.

Case study: Online Shopping System.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Project Design and Evaluation	(6 hrs.)

Project Design: Overview of UML diagrams: Use case, Class, Activity, State, Sequence, Deployment

Project Evaluation: What is Project Evaluation? Importance of Project Evaluation, Cost Benefit Evaluation Techniques

Process Evaluation and Improvement: The Process Improvement Process: The Process Improvement Cycle, Process Measurement: The GQM Paradigm, Process Analysis: Techniques of Process Analysis, Process change: The Process Change Process

Case study: Online Shopping System, Perform Cost-Benefit Analysis using Microsoft Excel

<table>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Activity Planning & Risk Management</td><td>(6 hrs.)</td></tr>
<tr><td colspan="3">Objectives of Activity planning – Project schedules – Activities – Sequencing and Scheduling, Network Planning Models – Formulating Network Model – Forward Pass & Backward Pass Techniques.
Risk Management- Introduction, Risk Management, Risk Assessment, Risk identification, Risk Prioritization, Risk Planning, Risk control, Risk Strategies, Evaluating Risk to the schedule
Study Risk Management Tools - SpiraPlan by Inflectra, Risk Management Studio, GRC Cloud
Case study: Online Shopping System</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>Project Tracking, Monitoring & Control</td><td>(6hrs.)</td></tr>
<tr><td colspan="3">Introduction: Project Tracking and Control, Monitoring and Control Processes, Collection of Project data, Partial Completion Reporting.
Data Collection Methods: Phone vs. Online vs. In-Person Interviews, Visualizing Progress, Visual Project Management, Kanban Boards, Project Calendars, Cost Monitoring, Four Steps in Project Cost Management, Earned Value Analysis, Project Tracking, Effective Approach to Track Projects,
Status Report: Four features of a Good Status Report, Change Control, Different factors of Change Control Process, Change Process Flow-Diagram, Software Configuration Management, Tasks in SCM Process, Participant of SCM Process.
Software Configuration Management Tools: Git, Team Foundation Server, Ansible, Managing Contracts, The Stages of Contract Management, Challenges of Contract Management, Benefits of Contract Management, Types of Contracts in Software Project Management
Case study: Online Shopping System, track different versions of a software using Git tool</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
<tr><td>Unit V</td><td>Managing People and Organizing Teams</td><td>(6 hrs.)</td></tr>
<tr><td colspan="3">Understanding Behavior-Organizational Behavior- Selecting the Right Person for the Job-Instruction in the Best Methods-Motivation-The Oldham-Hackman Job Characteristics Model- Stress-Health and Safety- Ethical and Professional Concerns-Becoming a team-Decision Making-Organization and Team Structures-Coordination Dependencies-Dispersed and Virtual Teams-Communication Genres and plans-Leadership.
Case study: Team Buildingin Project Management with reference to academic project work.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO5</td></tr>
<tr><td>Unit VI</td><td>Applications of Software Project Management in Industry</td><td>(6 hrs.)</td></tr>
</table>

Agile Project Management with Azure DevOps: An Overview of Application Lifecycle Management & Azure DevOps, Traceability, Visibility, Collaboration, and Extensibility. Difference between Microsoft TFS and Azure DevOps. **Metrics in Agile Practice:** Introduction to Metrics inAgile Practice, Metrics for Project Management, Agile Project Management in Azure DevOps and TFS. **Case study:** Online Shopping System.	
Mapping of Course Outcomes for Unit VI	**CO6**

Textbooks:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – FifthEdition, Tata McGraw Hill, New Delhi. - ***(for Unit 1, 3, 5)***
2. A Guide to the Project Management Book of Knowledge-Seventh Edition. ***(For Unit 4)***
3. Walker Royce, "Software Project Management" a unified approach. Addison Wesley ISBN 0-20130958-0. ***(For Unit 6)***

Reference Books:

1. JackMarchewka," Information Technology-Project Management", Wiley Student Version, 4th Edition, 2013.
2. Lan Somerville, Software Engineering, Fifth Edition, Addison Wesley Publications, 1996. *(For Unit 2)*
3. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN:9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527. *(For Unit 2)*
4. James P Lewis, "Project Planning, Scheduling & Control", McGraw Hill, 5th Edition, 2011.
5. PankajJalote," Software Project Management in Practice", Pearson Education, 2002.
6. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.
7. Joachim Rossberg "Agile Project Management with Azure DevOps" Apress. *(For Unit 6)*
8. Robert K. Wyzocki, Rudd McGary, Effective Project Management, WILEYDreamtech India Pvt. Ltd., 2000.

Books / E Learning References:

1. https://www.inflectra.com/SpiraPlan/(for Unit 3)
2. https://www.techtarget.com/searchsecurity/definition/governance-risk-management-and-compliance-GRC(for Unit 3)
3. https://www.softwaretestinghelp.com/risk-management-tools/#3_Risk_Management_Studio (For Unit 3)
4. NPTEL: https://nptel.ac.in/courses/106101061/29
5. https://onlinecourses.nptel.ac.in/noc17_mg01/preview
6. Coursera: https://www.coursera.org/learn/uva-darden-project-management
7. http://managementhelp.org/evaluation/program-evaluation-guide.htm.
8. https://nptel.ac.in/courses/106105218 (NPTEL)
9. Virtual Labs:- Software Engineering- **1) http://vlabs.iitkgp.ernet.in/se/3/** **2) http://vlabs.iitkgp.ernet.in/se/5/** **3) http://vlabs.iitkgp.ernet.in/se/6/** **4) http://vlabs.iitkgp.ernet.in/se/7/**

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414443: Deep Learning</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH): 3 hrs/week</td><td>03 Credits</td><td>Mid_Semester : 30 Marks
End_Semester : 70 Marks</td></tr>
<tr><td colspan="3">Prerequisite Courses:1. Machine Learning 2. Mathematics</td></tr>
<tr><td colspan="3">Companion Course: Artificial Intelligence Soft computing</td></tr>
<tr><td colspan="3">Course Objectives:
1. To introduce the theoretical foundations, algorithms, methodologies, and application of neural networks and deep learning.
2. To design and develop an application-specific deep learning model.
3. To provide the practical knowledge handling and analyzing real world applications.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able to–

CO1. Understand the theoretical foundations, algorithms, and methodologies of Deep Learning.
CO2. Apply the concepts of Convolution Neural Networks and use of popular CNN architectures.
CO3. Compare Feed Forward Neural Network and Recurrent Neural Network and learn modeling the time dimension using RNN and LSTM.
CO4. Elaborate unsupervised deep learning algorithms like Autoencoders.
CO5. Explore Representation Learning and Transfer Learning techniques using variants of CNN architecture.
CO6. Evaluate the performance of deep learning algorithms and to provide solution for various real-world applications.</td></tr>
<tr><td colspan="3" align="center">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>Fundamentals of Deep Learning</td><td>(06 hrs)</td></tr>
<tr><td colspan="3">What is Deep Learning?, Multilayer Perceptron ,Feed forward neural, Back propagation, Gradient descent, Vanishing gradient problem, Activation Functions: RELU, LRELU, ERELU, Optimization Algorithms, Hyper parameters: Layer size, Magnitude (momentum, learning rate),Regularization (dropout, drop connect, L1, L2)</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>Convolutional Neural Network:</td><td>(06 hrs)</td></tr>
<tr><td colspan="3">Introduction to CNN, Convolution Operation, Parameter Sharing, Equivariant Representation, Pooling, Variants of the Basic Convolution Function, The basic Architecture of CNN, Popular CNN Architecture – AlexNet.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Recurrent Neural Networks</td><td>(06 hrs)</td></tr>
</table>

Recurrent Neural Networks: Types of Recurrent Neural Networks, Feed-Forward Neural Networks vs Recurrent Neural Networks, Long Short-Term Memory Networks (LSTM), Encoder Decoder architectures, Recursive Neural Networks		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Autoencoders**	**(06 hrs)**
Undercomplete Autoencoders, Regulraized Autoencoders-Sparse Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Representation Learning**	**(06 hrs)**
Greedy Layerwise Pre-training, Transfer Learning and Domain Adaption, Distributed Representation, Variants of CNN: DenseNet.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Applications of Deep Learning**	**(06 hrs)**
Overview of Deep Learning Applications: Image Classification, Social N/w/ analysis, Speech Recognition, Recommender system, Natural Language Processing.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
3. Nikhil Buduma, "Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms" O'Reilly

Reference Books:

1. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding.
2. Deep Neural Networks” Apress, 2018.
3. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
4. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
5. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.
6. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.

E Books / E Learning References :

1. Michael Nielsen, “Neural Networks and Deep Learning”, Online book, 2016 (http://neuralnetworksanddeeplearning.com/)
2. Deep Learning for Visual Computing https://onlinecourses.nptel.ac.in/noc22_ee54
3. Deep Learning - IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs22
4. Deep Learning - IIT Ropar https://onlinecourses.nptel.ac.in/noc22_cs35/
5. Introduction to Deep Learning : https://www.coursera.org/learn/introduction-to-deep-learning-boulder
6. Deep Learning Specialization : https://www.coursera.org/specializations/deep-learning

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414444: Elective – III (Mobile Computing)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH):3 hrs/week	03 Credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses :

Companion Course:

Course Objectives:

1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system.
3. To understand the Generations of Mobile Communication Technologies.
4. To be familiar with the network layer protocols and Ad-Hoc networks.
5. To know the basis of transport and application layer protocols.
6. To gain knowledge about different mobile platforms and application development.

Course Outcomes:

On completion of the course, students will be able to–

CO1. understand the basic concepts of mobile computing, MAC and different multiplexing technics.
CO2. understand Protocols, Connection Establishment, Frequency Allocation, Routing of mobile telecommunication system like GSM, GPRS, UMTS.
CO3. understand the Generations of Mobile Communication Technologies
CO4. learn mobile IP , Adhoc – Network, Reactive Routing protocols, Multicast Routing.
CO5. obtaining knowledge of transport layer protocol TCP, File System, and different application layer protocols.
CO6. gain knowledge about different mobile platforms**,** operating Systems, Software Development Kit, Security Issues.

COURSE CONTENTS

Unit I	Introduction	(06 hrs)

Introduction to Mobile Computing: Applications of Mobile Computing, A short history of wireless communication,
Medium Access Control: Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals.
SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access.
CDMA: Spread Aloha multiple access.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**Mobile Telecommunication System**	**(06 hrs)**
Introduction to Cellular Systems, **GSM:** Services &Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, **GPRS, UMTS:** Architecture, Handover, Security.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Generations of Mobile Communication Technologies.**	**(06 hrs)**
First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Fourth Generation 4G wireless networks, Fifth Generation 5G wireless networks		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Mobile Network Layer**	**(06 hrs)**
Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunnelling and Encapsulation, Optimizations, Reverse tunnelling, **IPv6:**DHCP, **AdHoc networks:** Routing, Proactive protocol-DSDV, **Reactive Routing Protocols:** DSR, AODV, Hybrid routing –ZRP, **Multicast Routing:** ODMRP, Vehicular Ad Hoc networks (VANET) MANET Vs VANET Security.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Mobile Transport Layer**	**(06 hrs)**
Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction oriented TCP. **Support for Mobility:** File systems: Consistency, Examples. **World Wide Web:** Hypertext transfer protocol, Hypertext markup language, some approaches that might help wireless access, System architectures **Wireless application protocol:** Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Wireless markup language, WML script, Wireless telephony application, Examples Stacks with WAP, Mobile databases, Mobile agents.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Mobile Platforms and Applications**	**(06 hrs)**
Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems. **Software Development Kit:** Ios, Android, Blackberry, Windows Phone, M Commerce, Structure, Pros &Cons, Mobile Payment System, Security Issues.		

Mapping of Course Outcomes for Unit VI	**CO6**

Textbooks:

1. Yi Bang lin : "Wireless and mobile Network Architectures" Wiley publications
2. William c.y. Lee: "Mobile Communications and Design Fundamentals" Wiley publications

Reference Books:

1. Jochen Schiller, —Mobile Communications, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012
3. C.K.Toh, —AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.
4. Principles of Mobile Computing, 2nd Edition, Uwe Hansmann, LotharMerk, Martin Nicklous, Thomas Stober, Springer
5. Mobile Computing, Tomasz Imielinski, Springer

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414444: Elective – III (High Performance Computing)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 3 hrs/week	**03 Credits**	**Mid_Semester: 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses, if any:

Computer Organization, Processor Architecture, Operating Systems

Companion Course, if any:

Course Objectives:

1. To study parallel computing and Parallel Programming Platforms
2. To be conversant with performance of parallel algorithm design
3. To understand the Basic Communication Operations
4. To analyze parallel programming using analytical modeling
5. To understand CUDA architecture
6. To know parallel algorithms for high performance computing

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand concepts of parallel computing, its application areas and parallel computing platforms
CO2. Apply different Parallel programming paradigm and Decomposition Techniques.
CO3. Correlate various communication calls.
CO4. Analyze and Measure different Performance Metrics.
CO5. Perform CUDA Programming.
CO6. Build the logic to develop parallel algorithms for high performance computing.

COURSE CONTENTS

Unit I	Introduction to Parallel Computing	(6 hrs)
Introduction: What is parallel computing? Motivating Parallelism, Scope of Parallel Computing, Parallel Computing - Grand Challenges and Advantages, Dichotomy of Parallel Computing Platforms (Flynn's Classifications, Distributed Memory Architecture, Shared Memory Architecture, Hybrid Architecture), Communication Costs in Parallel Machines, Interconnection Networks and Routing Mechanisms. Impact of Process-Processor Mapping and Mapping Techniques.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Principles of Parallel Algorithm Design**	**(6 hrs)**
Parallel programming paradigm (Task forning, Pipelining, divide and conquer), Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Parallel Algorithm Models, Accelerator based computing (Introduction to CUDA and OpenACC)		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Basic Communication**	**(6 hrs)**

Message passing paradigm: Synchronous and asynchronous communication calls. Blocking Vs Nonblocking, Introduction to MPI: Point to point communication, Collecting Communication: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Shared memory programming and synchronisation.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Analytical Modeling of Parallel Programs**	**(6 hrs)**
Sequential execution time, parallel execution time and Sources of Overhead in Parallel Programs , Performance Metrics for Parallel Systems(Speedup, efficiency, Amdahl's law, Gustafson's law) , The effect of Granularity on performance , Scalability of parallel systems , Minimum execution time and minimum cost-optimal execution time, Asymptotic Analysis of parallel programs , other scalability metrics.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Shared Memory Programming**	**(6 hrs)**
CUDA Architecture, CUDA Programming (Kernels, synchronization, Memory Contention and Device to Host Communications), OpenMP Programming		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Parallel Algorithms and Applications**	**(6 hrs)**
Dense Matrix Algorithms (Canon's Algorithm): Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Monto Carlo Simulation (Calculation of PI), Parallel Sorting Algorithms(Bubble Sort and its Variants, Parallelizing Quick sort) Parallel graph (All-Pairs Shortest Paths, Algorithm for sparse graph) Parallel search algorithms (Depth-First Search, Best-First Search)		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0- 13-138768-3

Reference Books:

1. Kai Hwang," Scalable Parallel Computing", McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh," Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann,1999, ISBN 978-1-55860-343-1

E Books / E Learning References:
https://www.geeksforgeeks.org/introduction-to-cuda-programming/
http://cuda.ce.rit.edu/tutorials/tutorials.htm

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414444: Elective – III (Multimedia Technology)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 3hrs/week	**03 Credits**	**Mid_Semester: 30 Marks** **End_Semester : 70Marks**

Prerequisite Courses:

1.Data Structures and Files

2. Computer Graphics

Companion Course, if any: Not Applicable

Course Objectives:

1. To describe basic components of multimedia (text, image, audio, video, and animation).
2. To state text and image file formats and apply different compression techniques.
3. To classify different audio and video file formats.
4. To define animation techniques and use open-source authoring tools.
5. To express virtual reality and VR devices used in various applications.
6. To identify emerging trends and practice various tools.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand basic building block and applications of Multimedia.

CO2. Solve and analyze different algorithms for text and image compression.

CO3. Classify different audio and video file formats of Multimedia.

CO4. Apply open-source authoring tools of animation.

CO5. List various devices used in virtual reality and its use in daily life.

CO6. Recognize emerging trends in Multimedia.

COURSE CONTENTS

Unit I	Introduction to Multimedia	(6hrs)

Goals, objectives, and characteristics of multimedia, what is Multimedia, Multimedia and Hypermedia, **Multimedia building blocks:** text, image, audio, video, animation, Overview of Multimedia Software Tools, Multimedia Applications, Multimedia architecture, Evolving Technologies for Multimedia Systems, Some useful editing, and Authoring tools

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Text and Image Processing**	**(6hrs)**

Text: Text file formats: TXT, DOC; RTF, PDF, PS, EPS, OXPS **Text compression:** Huffman coding, LZ & LZW **Image:** Image Data Representation, Image File formats - BMP, TIFF, JPEG, GIF, PNG **Image processing:** Acquisition, Storage, Communication, Display, Enhancement **Types of Compression:** Lossless: RLE, Shannon - Fano algorithm, Arithmetic coding. **Lossy:** Vector quantization, Fractal Compression Technique, Transform coding and Hybrid: JPEG-DCT		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Audio and Video Processing**	**(6 hrs)**
Audio: Nature of sound waves, characteristics of sound waves, Use of audio in computer applications, psycho-acoustic, MIDI, Digital audio file formats: AIFF, VOC, AVI, WMA, OGG, PCM,MP3,AAC Audio compression techniques: DM, ADPCM and MPEG. **Video:** video signals formats, Video transmission standards: EDTV, CCIR, CIF, SIF, HDTV, Video file formats: AVI, MOV,RM,WAV,FLV,3GP,Video editing, Video Compression: H-261,H-263, MPEG		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Animation**	**(6hrs)**
Animation: Historical Background, Uses of Animation, Traditional Animation, Principal of Animation, Techniques of animation, Computer based Animation, Animation on the Web,3D Animation, Rendering Algorithms, Animation File formats, Animation **tools:** Autodesk Maya		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Virtual Reality**	**(6hrs)**
Architecture of VR, Concept and History of VR, Human Physiology and Perception, Forms of VR, VR applications, **VR devices:** Hand Gloves, Head mounted tracking system, VR chair, CCD, VCR, 3D Sound System, Head mounted display, Touchable Holograms, **Case Study:** Virtual Reality in education and health care		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Trends in Multimedia**	**(6hrs)**
Multimedia networking, Quality of data transmission, Multimedia over IP, Media on Demand, Multimedia in Android: Android Multimedia Framework Architecture, Multimedia Databases: storage, retrieval, organization, Multimedia application development: software life cycle overview, Features of Multimedia (text, Image, audio and video) processing software, **Gaming:** Facial Recognition, Voice Recognition,GestureControl,High-DefDisplays,Augmented Reality, Mobile Gaming, Cloud Gaming On-Demand Gaming. **VFX:** Visual Effect and Special Effect, why use Visual Effect, Blender VFX software.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:
1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications ",Pearson Education.
2. Ranjan Parekh,"Principlesof Multimedia",2/E, TataMcGraw-Hill,ISBN:1259006506
3. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
Reference Books:
1. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education. **2.** Prabhat K. Andleigh, KiranThakrar, “Multimedia Systems Design”, Pearson Education Unit I **3.** Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005. **4.** Foley, Dam, Feiner, Hughes," Computer Graphics Principles & Practice", 2nd Ed, Pearson Education **5.** Gonzalez,Woods,"DigitalImageProcessing" Addison Wesley. **6.** AlanH.Watt and Mark Watt,"Advanced Animation and Rendering Techniques :Theory and Practice",Addison-Wesley, ACMPress, ISBN:0201544121. **7.** Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig,Morgan Kaufmann Publishers, San Francisco, CA, 2002. **8.** J.R.Parker,“IntroductiontoGameDevelopmentUsingProcessing”,Mercury Learning & Information ;Pap/Comedition. **9.** Jeffrey A. Okun& Susan Zwerman, The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures, Publisher: Focal Press 2010.
E Books / E Learning References:
1. http://lavalle.pl/vr/book.html
2. https://nptel.ac.in/courses/106/106/106106138
3. https://www.coursera.org/learn/introduction-virtual-reality
4. https://wethegeek.com/technology-trends-in-future-gaming-industry
5. https://docs.blender.org/manual/en/latest/grease_pencil/visual_effects/index.html

SavitribaiPhule Pune University, Pune Final Year Information Technology (2019 Course) 414444: Elective – III (Smart Computing)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH) : 03 hrs/week	**03 Credits**	**Mid_Semester:30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any:

1. Human Computer Interaction.
2. Basics of Computer Network
3. Processor architecture and interfacing
4. Computer Network and Security

Companion Course, if any:

Course Objectives:

1. To describe smart computing, its properties applications and architectural design.
2. To explain various smart devices and services used in ubiquitous computing.
3. To be acquainted with interfacing of sensors and actuators with microprocessor.
4. To understand Internet of Things and its usefulness for society.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Demonstrate the knowledge of design of smart computing and its applications.
CO2. Describe different generations of mobile and mobile computing projects
CO3. Demonstrate the knowledge of design of Ubicomp and its applications.
CO4. Explain smart devices and services used Ubicomp.
CO5. Implement interfacing of various sensors, actuators to the development boards
CO6. Compare various IoT communication technologies and smart computing applications.

COURSE CONTENTS

Unit I	Introduction to Smart Computing	(06 hrs)
What is smart Computing? Bartel's definition of smart computing, The Five A's Of Smart Computing, Examples of smart computing, smartphone and mobile computing, Introduction to smartphones, tablet, PDA, or other digital mobile devices, Introduction to smartphone system architecture, Convergence of sensing Computing and Communication, Pervasive Computing or ubiquitous computing, Emerging Mobile Technologies and Applications.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Mobile Computing**	**(06hrs)**
Evolution of Cellular Networks and Cell Phones (1G,2G,3G,4G and 5G),Vision of mobile computing, Convergence of Mobile Access, Pervasiveness of Mobile Intelligence, Mobile Computing Challenges, study of notable mobile computing projects (oxygen, smart dust, AURA, Wireless GRID)		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Ubiquitous Computing**	**(06 hrs)**

Concept of Ubiquitous Computing and Advantages, Ubiquitous Computing Applications and Scope, Properties of Ubiquitous Computing, Modelling the Key Ubiquitous Computing Properties. Ubiquitous System Environment Interaction. Architectural Design for **UbiCom-Systems:** Smart DEI Model.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Smart Devices and Services**	**(06 hrs)**
Smart Devices and Service properties, Smart mobile devices and Users, Mobile code, Smart Card Devices and Networks, Service Architecture Models. Service Provision Lifecycle. Virtual Machines and Operating Systems, OS for Mobile Computers and Communicator Devices.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Sensors, Actuators and interfacing**	**(06 hrs)**
Sensors: Roles of Sensors & Actuators, Types of sensors, Working of Sensors: Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light camera etc. **Development boards:** Types of boards - Arduino, Raspberry pi, Beagle bone, ESP8266, Interfacing of sensors with development boards. Micro- Electro-Mechanical Systems (MEMS), Embedded Systems and Real-Time Systems. Programmable and PID type control system, Robots.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Applications of Smart Computing**	**(06 hrs)**
Introduction of IoT: Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT enabling technologies. **Case studies:** **Smart Home:** Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. **Smart Agricultural:** characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring)		
Mapping of Course Outcomes for Unit VI	**CO6**	
Textbooks:		
1. Smart Phone and Next Generation Mobile Computing (Morgan Kaufmann Series in Networking), PeiZheng, Lionel Ni **2.** Stefan Poslad, Ubiquitous Computing, Wiley, Student Edition, ISBN:9788126527335John Krumm, Ubiquitous Computing Fundamentals **3.** ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.		

Reference Books:
1. Principles Of Mobile Computing, Hansmann, LotharMerk, Martin Niclous, Stober **2.** Mobile Computing, Tomasz Imielinski, Springer **3.** Laurence T. Yeng, EviSyukur and Seng W. Loke, Handbook on Mobile and UbiquitousComputing, CRC, 2nd Edition, ISBN: 9781439848111 **4.** Lyla B. Das, "Embedded Systems: An Integrated Approach" Pearson, ISBN: 9332511675, 9789332511675 **5.** Smart Internet of things projects AgusKurniawanPackt - Sep 2016 978-1- 78646- 651-8 2 The Internet of Things Key Olivier Willy Publication 2nd Edition 978-
E Books / E Learning References
1. White Paper on Smart Computing Drives the New Era Of IT Growth by Andrew H. Bartels for Vendor Strategy Professionals.

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414445: Elective – IV (Bioinformatics)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH):3 hrs/week	**03 Credits**	**Mid_Semester:30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses:
Basics of biology, Design and Analysis of Algorithms Basic concepts of Data Mining and Machine Learning

Companion Course: biotechnology, drug designing and development, bio-analytics, proteomics

Course Objectives:

1. To introduce basic concepts and functions of bioinformatics and its applications
2. To study and Understand concept of biological databases, to study different Pattern Matching Techniques and algorithms for knowledge discovery in Bioinformatics databases through sequence alignment algorithms.
3. To analyze various simulation tools and algorithms in Bioinformatics for fast pairwise sequence alignment
4. To study Protein Structure Modeling and simulation and Drug discovery process and Anatomy of Proteins
5. To study Recent Trends in Bioinformatics such as Environmental Biotechnology, Application of nanotechnology, Genetic engineering etc.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Integrate biological concepts with information technologies to study the biological system.

CO2. Study Gene structure, various biological database, and methods to manage the different types of biological data.

CO3. Describe principles and algorithms of pairwise and multiple alignments.

CO4. Study various bioinformatics tools and Algorithm.

CO5. Understand modeling and simulation in bioinformatics, drug discovery process. and Protein Structure.

CO6. To Gain awareness in field of System Biology and Human Disease.

COURSE CONTENTS

Unit I	**Basic of Bioinformatics**	**(06 hrs)**
What is Bioinformatics and its relationship with molecular biology, Information Theory and Central Dogma of Molecular Biology, Bioinformatics Scope, Challenges and Bioinformatics Applications, Features and Major Databases in Bioinformatics, Interdisciplinary nature of Bioinformatics, Major Bioinformatics databases and tools.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Biological database and Gene Structure**	**(06hrs)**

Types of biological Database, Primary, Secondary and Structural data bases, tools for web search, data retrieval tools **Protein primary databases** - PIR, SWISS-PROT; Composite protein sequence database -NRDB, OWL, **Protein secondary databases** - PROSITE, Profiles; Database on protein structures – PDB, Genome databases - human (HGP) **What is a Gene?** Structural Genes, Genome Sequencing and Applications of Genetics Maps		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Sequence Alignment and Data Visualization**	**(06 hrs)**
Introduction to Sequence alignments and dynamic programming; Local alignment and Global Alignment. Methods of Sequence Alignments, Scoring Matrix: PAM and BLOSUM Sequence Visualization, Sequence maps, Structure Visualization and rendering tools, Statistical Concepts Microarray.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Bioinformatics Algorithm and Tools**	**(06 hrs)**
Biological algorithm vs. computer algorithms, Clustering, and classification algorithms FASTA Algorithm, BLAST Algorithm and its comparison, Hidden Markov Models, Graph and Genetics Algorithm.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Drug Discovery and Protein structure determination techniques**	**(06hrs)**
What is Drug and Drug discovery process? Modelling and Simulation Process, Applications of Bioinformatics in Drug Discovery Process. **Proteins:** Principles of protein structure; anatomy of proteins – Hierarchical organization of protein **structure –** Primary. Secondary, Super secondary, Tertiary and Quaternary structure.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Recent Trends in Bioinformatics**	**(6hrs)**
Environmental Biotechnology, Application of nanotechnology, Genetic engineering, and therapeutic application of stem cell. Future of medicine		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:
1. S.C.Rastogi, N.Mendiratta, P.Rastogi 'Bioinformatics-Methods & Application Genomics, Proteomics and Drug Discovery', Third Edition, Prentice Hall of India. **2.** Bryan Bergeron, 'Bioinformatics Computing', Pearson Education **3.** OrpitaBosumSimminder Kaur Thukral 'Bioinformatics: Databases, Tools and Algorithms', Oxford press. **4.** Neil C. Jones and Pavel A. Pevzner, "An Introduction to Bioinformatics Algorithms", MIT Press, First IndianReprint 2005
Reference Books:
1. SupratimChoudhuri , "BIOINFORMATICS FOR BEGINNERS Genes, Genomes, Molecular Evolution, Databases and Analytical Tools", Academic Press is an imprint of Elsevier **2.** Baxevanis, A. D. and Ouellette. B. F. F. 2004. Bioinformatics: A practical guide to theanalysis of genes and proteins. Wiley Inter-science. New York. 560 p.
E Books / E Learning References:
1. www.Bioinformatics.org **2.** www.bioinfo.mbb.yale.edu/mbb452a/intro/

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414445: Elective – IV (Introduction to DevOps)</td></tr>
<tr><td>Teaching Scheme</td><td>Credit Scheme</td><td>Examination Scheme</td></tr>
<tr><td>Theory (TH): 3 hrs/week</td><td>03 Credits</td><td>Mid_Semester: 30 Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="3">Prerequisite Courses: Software Engineering and Project Management, Cloud Computing</td></tr>
<tr><td colspan="3">Companion Course, if any:</td></tr>
<tr><td colspan="3">Course Objectives:
1. To understand the need of DevOps as a software engineering practice.
2. To understand the background of DevOps Evolution.
3. To know and understand the concept of Continuous Integration Continuous Delivery (CICD).
4. To learn the concept of continuous deployment and test strategies.
5. To learn the monitoring system and reliability engineering.
6. To explore the emerging tools used in the DevOps lifecycle.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able –
CO1. Understand the fundamental concepts of DevOps
CO2. Link the background of DevOps with other technologies
CO3. Comprehend the concept of continuous integration and continuous delivery
CO4. Compare various stages of continuous deployment and test strategies
CO5. Justify the importance of monitoring system and reliability engineering
CO6. Use the latest tools in DevOps</td></tr>
<tr><td colspan="3" align="center">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>Introduction to DevOps and the Culture</td><td>(6 hrs)</td></tr>
<tr><td colspan="3">What is DevOps? Role of DevOps Engineer, Developer responsibility, Introduction to Continuous Integration and Continuous Delivery Policies, DevOps Culture: Dilution of barriers in IT departments, Process automation, Agile Practices, Reason for adopting DevOps, What and Who Are Involved in DevOps? Changing the Coordination, Introduction to DevOps pipeline phases , Defining the Development Pipeline, Centralizing the Building Server, Monitoring Best Practices, Best Practices for Operations.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>Microservices Architecture and Cloud Native Development</td><td>(6 hrs)</td></tr>
<tr><td colspan="3">Monolithic applications, Introduction to microservice architecture, Implementing a microservices Architecture, Pros and Cons of a microservice Architecture, Characteristics of microservice architecture, Monolithic applications and microservices compared, microservices best practices, Deployment strategies, Introduction to cloud computing, cloud computing deployment models, service models, why to use cloud, Principle of container based application design, Introduction to Docker, Serverless computing, orchestration, Difference between orchestration and automation</td></tr>
</table>

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Continuous Integration and Test-Driven Development**	**(6 hrs)**
Introduction to continuous integration, time to market and quality, Build in a Continuous Integration Scenario, Code Repository Server, Continuous Integration Server, Introduction to Continuous Delivery and chain, Differentiate Continuous Integration and Continuous Delivery, Strategies for Continuous Delivery, Benefits of Continuous Integration and Continuous Delivery, Designing a CI and CD System, Building Continuous Integration and Continuous Delivery Pipelines, Continuous Database Integration, Preparing the Build for Release, Identifying the Code in the Repository, Creating Build Reports, Putting the Build in a Shared Location, Releasing the Build		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Continuous Deployment and Orchestration**	**(6 hrs)**
Implementing a testing Strategy: Types of Tests, Integration testing, managing defect backlogs, what is Continuous Deployment? Changes moving through the deployment pipeline, Trade-offs in the deployment pipeline, Basic Deployment pipeline, Deployment pipeline practices & Commit stage, Automated Acceptance Test Gate, Subsequent test stages, preparing to release, Implementing a deployment pipeline		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Continuous Monitoring and Site Reliability**	**(6 hrs)**
What is a monitoring system? Factors involved in monitoring systems, why monitoring is important, white-box and black-box monitoring, building a monitoring system, monitoring infrastructure and applications, collecting data, logging, creating dashboard, behavior driven monitoring, what is site reliability engineering? SRE and DevOps, roles, and responsibilities of SRE, common tools used by SREs		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**DevOps Tooling and Case Studies**	**(6 hrs)**
Continuous Development/ Version Control: Git, Serverless orchestration: Kubernetes, Container Technology: Docker, Continuous Integration: Jenkins, Continuous delivery: Jenkins, Continuous Deployment: Ansible, Continuous Testing: Selenium, Monitoring: Prometheus, Bug tracking tool: Jira, elk stack. Case study: Spotify: Using Docker, Bank of New Zealand, EtSy.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. PierluigiRiti, “Pro DevOps with Google Cloud Platform”, Apress, ISBN: 978-1-4842-3896-7.
2. Katrina Clokie, “A Practical Guide to Testing in DevOps”, Lean Publishing published on 2017-08-01
3. Jez Humble and David Farley, “Continuous Delivery”, Pearson Education, Inc, ISBN: 978–0–321–60191–9

Reference Books:
1. Viktor Farcic, “The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices” **2.** Jennifer Davis and Katherine Daniels, “Effective DevOps: Building a Culture of Collaboration, Anity, and Tooling at Scale”, O’Reilly Media, Inc., ISBN: 978-1-491-92630-7 **3.** Sanjeev Sharma and Bernie Coyne, “DevOps for Dummies”, John Wiley & Sons, Inc., 2nd IBM Limited Edition, ISBN: 978-1-119-04705-6
Web Links:
1. https://www.redhat.com/en/resources/cloud-native-container-design-whitepaper **2.** https://www.redhat.com/en/topics/cloud-native-apps/what-is-serverless **3.** https://www.redhat.com/en/topics/automation/what-is-orchestration **4.** https://www.atlassian.com/continuous-delivery/continuous-integration **5.** https://www.flagship.io/glossary/site-reliability-engineer/ **6.** https://docs.microsoft.com/en-us/learn/paths/intro-to-vc-git/ **7.** https://www.javatpoint.com/kubernetes **8.** https://www.javatpoint.com/docker-tutorial **9.** https://www.javatpoint.com/jenkins **10.** https://www.javatpoint.com/jenkinss **11.** https://www.javatpoint.com/ansible **12.** https://www.javatpoint.com/selenium-tutorial **13.** https://prometheus.io/docs/introduction/overview/ **14.** https://www.javatpoint.com/jira-tutorial **15.** https://www.geeksforgeeks.org/what-is-elastic-stack-and-elasticsearch/

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414445: Elective – IV (Computer Vision)</td></tr>
<tr><td>Teaching Scheme</td><td>Credit Scheme</td><td>Examination Scheme</td></tr>
<tr><td>Theory (TH): 3 hrs/week</td><td>03 Credits</td><td>Mid_Semester: 30 Marks
End_Semester: 70 Marks</td></tr>
</table>

Prerequisite Courses:

1. Students should know vectors, linear algebra (i.e., matrix operations, solution of linear equations).
2. Programming language (e.g., C, Matlab, Python etc).

Companion Course, if any:

Course Objectives:

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand three-dimensional image analysis techniques.
4. To understand Feature extraction techniques.
5. To study some applications of computer vision algorithms.

Course Outcomes:

By the end of the course, students should be able to

CO1. Implement fundamental image processing techniques required for computer vision.
CO2. Apply feature extraction techniques.
CO3. Apply Hough Transform for line, circle, and ellipse detections.
CO4. Understand three-dimensional analysis techniques.
CO5. Develop skills to develop applications using computer vision techniques.

COURSE CONTENTS

Unit I	**Fundamentals of Digital Image Processing**	**(6 hrs)**

Introduction to Computer Vision?, Fundamentals Of Image Formation, **Review of Digital image processing:** Introduction, Origin, Applications and Examples of Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between pixels, **image processing techniques:** classical filtering operations, Thresholding techniques, edge detection techniques, corner and interest point detection, texture Analysis

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	**Shapes and Regions**	**(6 hrs)**

Binary shape analysis, Connectedness, object labelling and counting, size filtering, distance functions and their uses, skeletons and thinning, Other Measures for Shape Recognition, Boundary pattern analysis: Boundary Tracking Procedures, Centroidal Profiles, Tackling the Problems of Occlusion, Accuracy of Boundary Length Measures, Object segmentation and shape models, Active Contours, Shape Models

Mapping of Course Outcomes for Unit II	**CO2**

Unit III	**Feature Detection and Matching**	**(6 hrs)**

Points and patches: Feature detectors, Feature descriptors, Feature matching, Feature tracking Application: Performance-driven animation, **Edges:** Edge detection, Edge linking, Application: Edge editing and enhancement, Vanishing points, **Application:** Rectangle detection		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Hough Transform**	**(6 hrs)**
Line detection – Hough Transform (HT) for line detection, the foot-of-normal method, Using RANSAC for Straight Line Detection, Hough-Based Schemes for Circular Object Detection, The Problem of Unknown Circle Radius, Overcoming the Speed Problem, Ellipse Detection, Applications, and case study: Human Iris Location, The Generalized Hough Transform (GHT), Use of the GHT for Ellipse Detection, A Graph-Theoretic Approach to Object Location, Possibilities for Saving Computation, Using the GHT for Feature Collation		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**3D Vision and Motion**	**(6 hrs)**
The three-dimensional world, Methods for 3D vision, projection schemes for 3D vision, Shape from X : shape from shading, Photometric Stereo, Shape from texture, Share from focus, The Assumption of Surface Smoothness, Shape from Texture, Use of Structured Lighting, 3D Reconstruction, active range finding, surface representations, point-based representation, volumetric representations, Structure from motion: triangulation, bundle adjustment, Dense motion estimation: translational alignment, parametric motion, spline based motion, Optical flow layered motion		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Computer Vision Applications**	**(6 hrs)**
Application: Photo album – Object detection, Face detection, Pedestrian detection, Face recognition: Eigen faces, Active appearance and 3D shape models, Application: Personal Photo Collections, Category Recognition, Intelligent Photo Editing, Image Search, **Application: Surveillance** – The basic geometry, foreground-background separation, particle filters, Chamfer Matching, Tracking, and Occlusion, combining views from multiple cameras, License Plate Location, Occlusion Classification for Tracking, Human Gait Analysis, In-vehicle vision system: Locating the Roadway, Location of Road Markings, Location of Road Signs, Location of Vehicles, Locating Pedestrians		
Mapping of Course Outcomes for Unit VI	**CO6**	
Textbooks:		
1. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012. **2.** Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, 3rd Edition, Pearson, ISBN: 978-81-317-2695-2		

Reference Books:
1. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012. **2.** R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011. **3.** Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012. **4.** D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012. **5.** Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012. **6.** Sudha Challa, "Fundamentals of Object Tracking", Cambridge University Press, 2011.
Online references:
1. http://kercd.free.fr/linksKCD.html **2.** http://www.cs.ubc.ca/spider/lowe/vision.html **3.** http://www.visionscience.com/ **4.** https://www.fritz.ai/object-detection/ **5.** https://viso.ai/deep-learning/object-tracking/ **6.** https://www.pearson.com/us/higher-education/program/Gonzalez-Digital-Image-Processing-4th-Edition/PGM241219.html?tab=resources

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414445: Elective – IV (Wireless Communication)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 3 hrs/week	03 credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses: Basic Computer Networks, Computer Networks and Security, Mobile Computing

Companion Course :NA

Course Objectives:

1.To learn fundamental knowledge of wireless communication and generation of cellular network.

2. To understand basic fundamentals of cellular system and LTE Technology.

3. To study various multiple access techniques to access the shared channel.

4.To learn various protocols and applications in wireless communication system.

5. To understand security issues, challenges and tools in wireless communication system.

6. To study recent trends and technologies in wireless communication.

Course Outcomes:

On completion of the course, students will be able to–

CO1: Articulate the fundamental concept of cellular system.

CO2: Analyse the fundamentals of cellular systems.

CO3: Illustrate multiple access technique for effective utilization of spectrum.

CO4: Design and analyse the WAP Programming Model in networking environment.

CO5: Learn and understand security issues, challenges and tools in wireless communication.

CO6: Explore the emerging trends and applications in wireless communication.

COURSE CONTENTS

Unit I	Introduction to Wireless Communication	(6hrs)

Evolution of mobile communications, Types of Wireless Communication: Satellite Communication, Microwave Communication, Infrared, Generation of Cellular network, 2G/3G/4G/5G/6G.

Unit II	Fundamentals of Cellular and LTE Technology	(6hrs)

Cellular system, hexagonal geometry cell and concept of frequency reuse, Need of LTE Long Term Evolution (LTE) Technology fundamentals: Architecture features. **4G:** LTE communication protocol: Protocol model, Air Interface Transport Protocols, Fixed Network Transport Protocols, User Plane Protocols , Signalling Protocols

Unit III	Multiple Access Techniques	(6hrs)

Overview of TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access), SDMA (Space Division Multiple Access), IDMA (Interleave Division Multiple Access).
Latest access technologies: MIMO (Multiple Input Multiple Output), OFDM (Orthogonal Frequency Division Multiplexing).

Unit IV	**Wireless Communication Protocols**	**(6 hrs)**

Wireless Application Protocol, The WAP Programming Model, WAP Architecture, Traditional WAP Networking Environment, Wi-Fi Direct, Li-Fi, NFC, SigFox, Z-Wave, LoRaWAN, Thread (based on IEEE 802.15.4), RT Wi-Fi, RTCP, RTSP, SPEED.

Unit V	**Security in Wireless Communication**	**(6 hrs)**

Security Issue and challenges in GSM, 1G, 2G, 3G, 4G.
Multimedia security in 5G and 6G, post-quantum cryptography, Molecular communication, visible light communication (VLC), and distributed ledger (DL). UMTS Security, Bluetooth Security, WEP, WPA2.
Wireless Security Tools: Kismet, URH (Universal Radio Hacker).

Unit VI	**Recent Trends and Applications in Wireless Technology**	**(6 hrs)**

5G NR (New Redio): Working, Benefits.
Holographic MIMO Surfaces for 6G Wireless Networks, Simultaneous Transmission and Reflection (STAR) for 360° Coverage, Quantum technology for 5G/6G Wireless Networks.
Applications of Wireless Technology.

Textbooks:

1. Wireless Communications, T.L. Singal, McGraw Hill Education.
2. Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers.
3. Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
4. Principles of Modern Wireless Communication Systems Theory and Practice, 1st Edition, Aditya Jagannatham.
5. 5G Outlook–Innovations and Applications,RamjeePrasad,River Publishers Series in Communications.
6. Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press

Reference Books:
1. Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley. **2.** Wireless Communications- Principles &Practice,Theodore S. Rappaport, Prentice Hall Series. **3.** Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall. **4.** Adhoc& Sensor Networks Theory and Applications, Carlos de MoraisCordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition. **5.** Wireless Networks, Nicopolitidia, M S Obaidat, GI Papadimitriou, Wiley India (Student Edition, 2010). **6.** Wireless Communications, Andrea Goldsmith, Cambridge University Press, 1st South Asian Edition 2009. **7.** https://pcefet.com/common/library/books/50/2784_[Christopher_Cox]_An_Introduction_to_LTE_LTE,_LTE(b-ok.org).pdf **8.** https://www.techtarget.com/whatis/definition/5G-New-Radio-NR.

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) **414446: Lab Practice III**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR): 04 hrs/week	**02 Credits**	**OR: 25 Marks** **TW: 25 Marks**

Prerequisites:

1. Data Structures and Files.
2. Database management systems.

Course Objectives:

1. To understand the concepts of information retrieval.
2. To understand the role of clustering in information retrieval.
3. To study indexing structures for information retrieval.
4. To evaluate the performance of the IR system and understand user interfaces for searching.
5. To understand information sharing on the web.
6. To understand the various applications of information retrieval giving emphasis to multimedia and distributed IR, web Search.

Course Outcomes:

On completion of the course, students will be able to

CO1. Understand the concept of Information retrieval and to apply clustering in information retrieval.

CO2. Use appropriate indexing approach for retrieval of text and multimedia data. Evaluate performance of information retrieval systems.

CO3. Apply appropriate tools in analyzing the web information.

CO4. Map the concepts of the subject on recent developments in the Information retrieval field.

Guidelines for Instructor's Manual
The faculty member should prepare the laboratory manual for all the laboratory assignments, and it should be made available to the students and laboratory instructor/Assistant.
Guidelines for Student's Lab Journal
1. Students should submit term work in the form of journals. The Journal consists of prologue, certificate, table of contents, handwritten write-up of each assignment (Title, Objectives, Problem Statement, Theory concept, Outcomes, Conclusion), and printouts of the code written using coding standards, sample test cases etc. To support Go-green, printouts should be asked to any 2 students from each batch. However, all students must submit the soft copy in the form CD/DVD and should be maintained by the batch teacher. **2.** Oral Examination will be based on the ISR theory and practical assignments. **3.** Students are expected to know the theory involved in the experiment. **4.** The oral examination should be conducted if and only if the journal of the candidate is complete in **5.** All respects and certified by concerned faculty and head of the department. **6.** All the assignments mentioned in the list must be conducted.
Guidelines for Lab /TW Assessment
1. Examiners will assess the term work based on performance of students considering the parameters such as timely completion of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc. **2.**Examiners will judge the understanding of the concept by asking the questions related to theory & laboratory assignments. **3.**Appropriate knowledge of usage of software and hardware related to respective laboratories should be as a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in a journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student programs should be attached to the journal by every student and the same to be maintained by the department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at laboratory.
Guidelines for Laboratory Conduction
All the assignments should be conducted on 64-bit open-source software. C/C++/Java programming language can be used for implementation of assignments if not mentioned. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in a journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student's programs should be attached to the journal by every student and the same to be maintained by the department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at laboratory.
Guidelines for Oral Examination
Both internal and external examiners should jointly conduct Oral examination. During assessment, the Examiners should give the maximum weightage to the satisfactory answer of the question asked. The supplementary and relevant questions may be asked at the time of evaluation to judge the student 's understanding of the fundamentals, effective and efficient implementation.
List of Laboratory Assignments

Group A: CO1, 2, 3

1. Implement Conflation algorithm to generate document representative of a text file.
2. Implement Single-pass Algorithm for clustering of files.(Consider 4 to 5 files)
3. Implement a program for retrieval of documents using inverted files.

Group B: CO3, 5

1. Implement a program to calculate precision and recall for sample input. (Answer set A, Query q_1, Relevant documents to query q_1- Rq_1)
2. Write a program to calculate harmonic mean (F-measure) and E-measure for above example.
3. Implement a program for feature extraction in 2D color images (any features like color, texture etc. and to extract features from input image and plot histogram for the features.

Group C: CO4, 5

1. Build the web crawler to pull product information and links from an e-commerce website. (Python)
2. Write a program to find the live weather report (temperature, wind speed, description, and weather) of a given city. (Python).
3. Case study on recommender system for a product / Doctor / Product price / Music.

Textbooks:

1. Ricardo Baeza-Yates, Berthier Riberio–Neto, Modern Information Retrieval, Pearson Education, ISBN: 81-297-0274-6.
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk), Second Edition ISBN:978-408709293.
3. Ryan Mitchell, Web Scraping with Python, O'reilly.
4. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook.

Reference Books:

1. ChabaneDjeraba, Multimedia mining: A highway to intelligent multimedia documents, Kulwer Academic Publisher, ISBN: 1-4020-7247-3.
2. V. S. Subrahamanian, Satish K. Tripathi, Multimedia information System, Kulwer AcademicPublisher.
3. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, An Introduction to Information Retrieval, Cambridge University Press, 2008.
4. Marek Kowalkiewicz, Maria E. Orlowska, Tomasz Kaczmarek, Witold Abramowicz, WebInformation Extraction and Integration, Springer New York Publisher.
5. David Grossman, Ophir Frieder, Information Retrieval - Algorithms and Heuristics, Springer,International Edition, ISBN: 978-1-4020-3004-8.
6. Hang Li, Learning to Rank for Information Retrieval and Natural Language. 7. Processing, Morgan& Claypool, ISBN: 9781608457076.
7. Robert Korfhage, Information Storage and Retrieval, John Wiley & Sons, First Edition,ISBN: 9788126507702.
8. https://web.stanford.edu/class/cs276/handouts/EvaluationNew-handout-1-per.pdf.

Virtual Laboratory:

1. http://nlp-iiith.vlabs.ac.in/

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414447: Lab Practice IV

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR):02 hrs/week	01 credits	PR: 25 Marks TW: 25 Marks

Prerequisites: Python programming language

Course Objectives:

The objective of the course is

1. To be able to formulate deep learning problems corresponding to different applications.
2. To be able to apply deep learning algorithms to solve problems of moderate complexity.
3. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Outcomes:

On completion of the course, students will be able to-

CO1. Learn and Use various Deep Learning tools and packages.
CO2. Build and train a deep Neural Network models for use in various applications.
CO3. Apply Deep Learning techniques like CNN, RNN Auto encoders to solve real word Problems.
CO4. Evaluate the performance of the model build using Deep Learning.

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/assistant

Guidelines for Student's Lab Journal

1. Students should submit term work in the form of a handwritten journal based on a specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all respects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to theory & implementation of experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to the respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers of the program in a journal may be avoided. There must be hand-written write-ups for every assignment in the journal. The DVD/CD containing student's programs should be attached to the journal by every student and the same to be maintained by the department/lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at
Laboratory.

Guidelines for Practical Examination

1. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement.
2. Student's understanding of the fundamentals, effective and efficient implementation can be evaluated by asking relevant questions based on implementation of experiments he/she has carried out.

List of Laboratory Assignments

Mapping of course outcomes for Group A assignments: CO1, CO2,CO3,CO4

1. Study of Deep learning Packages: Tensorflow, Keras, Theano and PyTorch. Document the distinct features and functionality of the packages.

Note: Use a suitable dataset for the implementation of following assignments.

2. Implementing Feedforward neural networks with Keras and TensorFlow
    a. Import the necessary packages
    b. Load the training and testing data (MNIST/CIFAR10)
    c. Define the network architecture using Keras
    d. Train the model using SGD
    e. Evaluate the network
    f. Plot the training loss and accuracy

3. Build the Image classification model by dividing the model into following 4 stages:
    a. Loading and preprocessing the image data
    b. Defining the model's architecture
    c. Training the model
    d. Estimating the model's performance

4. Use Autoencoder to implement anomaly detection. Build the model by using:
    a. Import required libraries
    b. Upload / access the dataset
    c. Encoder converts it into latent representation
    d. Decoder networks convert it back to the original input
    e. Compile the models with Optimizer, Loss, and Evaluation Metrics

5. Implement the Continuous Bag of Words (CBOW) Model. Stages can be:
    a. Data preparation
    b. Generate training data
    c. Train model
    d. Output

6. Object detection using Transfer Learning of CNN architectures

- **a.** Load in a pre-trained CNN model trained on a large dataset
- **b.** Freeze parameters (weights) in model's lower convolutional layers
- **c.** Add custom classifier with several layers of trainable parameters to model
- **d.** Train classifier layers on training data available for task
- **e.** Fine-tune hyper parameters and unfreeze more layers as needed

Reference Books:

1. Hands-On Deep Learning Algorithms with Python: Master Deep Learning Algorithms with Extensive Math by Implementing Them Using TensorFlow
2. Python Deep Learning, 2nd Edition by Ivan Vasilev , Daniel Slater , GianmarioSpacagna,, Peter Roelants, Valentino Zocca
3. Natural Language Processing with Python Quick Start Guide by Mirant Kasliwal

Virtual Laboratory:

SPIT's Virtual Labs for AI and Deep Learning: https://vlab.spit.ac.in/ai/

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414448: Project Stage I

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Tutorial (TUT): 02 hrs/week	02 Credits	Term Work: 50 Marks

Prerequisite Courses, if any: PBL, Seminar, Basic Knowledge of Latest Technologies in IT.

Companion Course, if any: NOT APPLICABLE

Course Objectives:

1. To build up their practical experience with implementation and hence develops self-confidence.
2. To generate the opportunities to experience practically the facts learned in various fields together.
3. To improve overall communication skill, Teamwork and Leadership Qualities, professionalism.
4. To apply the knowledge for solving realistic problems.
5. To evaluate alternative approaches and justify the use of selected tools and methods.

Course Outcomes:

On completion of the course, students will be able to–

CO1. To apply knowledge of mathematics, science, and engineering to formulate the Problem statement.
CO2. To design and conduct experiments, as well as to analyze and interpret data.
CO3. Understand the professional and ethical responsibility.
CO4. To communicate effectively.
CO5. Get broad education which is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
CO6. Recognition of the need for, and an ability to engage in life-long learning.
CO7. To use the techniques, skills, and modern engineering tools necessary for engineering practices.
CO8. To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Introductory Information:

BE Project can be application oriented and/or will be based on some innovative work in recent technologies like IoT, Cloud Computing, Web Technologies, Bio-inspired Algorithms, Artificial Intelligence, Machine Learning, Natural Language Processing, Theoretical Computer Science fundamentals. In Project Phase-I the student will undertake project over the academic year, which will involve the analysis, design of a system or sub system in the area identified earlier in the field of Information Technology and Computer Science and Engineering. The project will be undertaken preferably by a group of 3-4 students who will jointly work and implement the project. The group will select a project based on their internship or Guide can suggest based on recent technologies / Industrial Applications.

Guidelines to Faculty and Students:

1) The Head of the department / Project coordinator shall constitute a review committee (preferably same committee needs to carry throughout the year) for project group; project guide would be one member of that committee by default.
2) For sponsored projects, an employee of the sponsoring organization may be one of the member of review committee.
3) There shall be **TWO** reviews in Project phase –I (in semester-I) by the review committee.
4) The Project Review committee will be responsible for evaluating the timely progress of the projects. It is suggested to evaluate the skills learned by the students in their PBL (in their previous years).
5) Student should identify project of enough complexity, which has at least 4-5 major functionalities.
6) Student should adopt skills learned in Software Engineering / Software Architecture to identify stakeholders, actors, Architectural Styles etc... and write detail problem statement for the system.
7) Review committee should finalize the scope of the project.
8) If change in project topic is unavoidable then the students should complete the process of Project approval by submitting synopsis along with the review of important papers which should be approved by review committee.
9) Every student of the project group shall make presentation on the progress made by them before the committee during each review. Each student/group is required to give presentation as part of review for 10 to 15 minutes followed by a detailed discussion and query session.
10) Students need to note down the queries raised during review(s) and comply the same in the next review session.
11) The record of the remarks/suggestions of the review committee (project dairy) should be properly maintained and should be made available at the time of university examination.
12) Project group needs to present / publish TWO papers (One in each semester, at least one paper should be in **UGC – Care journal**).
    a) Paper must be checked for Plagiarism by any open software.
    b) One paper during first semester which includes Literature Survey and Detailed design components of the Project Statement.
    c) One paper during second semester which includes Methodologies / Algorithms implemented, Results obtained, Analysis of results and conclusion.
13) Project report must also be checked for Plagiarism.
14) The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers, and report.

Review 1: Synopsis –

Points to be covered:

1) The precise problem statement/title based on literature survey and feasibility study.
2) Motivation, objectives, and scope of the project.
3) List of required hardware, software, or other equipment for executing the project, test Environment/tools, cost and software measurement/human efforts in hours.
4) System overview- proposed system and expected outcomes.
5) Architecture and initial phase of design (DFD).

Review 2: Requirement and Design Specification

Points to be covered:

1) User and System Requirements.
2) Functional and Non-functional Requirements.
3) SRS Document, Writing structures SRS as per Problem Statement.
4) Requirement Analysis / Models.
5) UML/ER Diagrams.
6) Detail architecture / System design/ Algorithms with analysis / Methods / Techniques.
7) Need to discuss Design models and Component level designs.
8) Detailed Design (DFD levels as per the problem statement).
9) At least 30-40% coding documentation with at least 3 to 4 working modules.
10) Identification of test to be essential and appropriate (to be implement later).
11) Project plan.

Evaluation Criteria:

Following criteria and weightage is suggested for evaluation of Project-Phase I Term Work.

1) Originality of Problem Statement: 10% (05 Marks)
2) Depth of Understanding the Problem Statement: 10% (05 Marks)
3) Concreate Literature Survey with identified gaps in all referred papers: 10% (05 Marks)
4) Design and Analysis of Algorithm / Model / Architecture / System: 40% (20 Marks)
5) Representation of results using suitable tools like tabulation, graph etc: 10% (05 Marks)
6) Presentation Skill: 10% (05 Marks)
7) Report preparation and Paper publication: 10% (05 Marks)

Project report contains the details as Follows:

Project report must have:

- **i.** Certificate from the institute
- **ii.** Certificate sponsoring organization (If any)
- **iii.** Acknowledgement
- **iv.** Abstract
- **v.** Contents
- **vi.** List of Abbreviations (As applicable)
- **vii.** List of Figures (As applicable)
- **viii.** List of Graphs (As applicable)
- **ix.** List of Tables (As applicable)
  1. Introduction and aims/motivation and objectives.
  2. Literature Survey (with proper citation).
  3. Problem Statement/definition.
  4. Software Requirement Specification (In SRS Documentation only).
  5. Flowchart
  6. Project Requirement specification.
  7. Proposed system Architecture.
  8. High level design of the project (DFD,UML, ER Diagrams).
  9. System implementation-code documentation: Algorithm style, Description of detailed methodologies, protocols used etc..as applicable.
  10. Test cases.
  11. Proposed GUI/Working modules/Experimental Results (Module wise if available) in suitable format.
  12. Project Plan.
  13. Conclusions.
  14. Bibliography in IEEE format.

Appendices:

- **A.** Plagiarism Report of Paper and Project report from any open-source tool.
- **B.** Base Paper(s) [If any].
- **C.** Tools used / Hardware Components specifications [If any].
- **D.** Published Papers and Certificates.

Use appropriate plagiarism tools, reference managers, Latex for efficient and effective project writing.

Reference Books:

1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011
2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education
3. UML 2 and the Unified Process, Second Edition, JIM Arlow, Ila Neustadt, Pearson
4. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Pearson
5. Design Patterns in Java Second Edition by Steven John Metsker, Pearson

All the assignments should be conducted on Latest version of Open-Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading

<table>
<tr><td colspan="3">Savitribai Phule Pune University, Pune
B.E Information Technology (2019 Course)
414449A: Audit Course 7
Copyrights and Patents</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH): 01 hrs/week</td><td>Non-Credit</td><td>Audit Course</td></tr>
<tr><td colspan="3">Prerequisite Courses, if any:</td></tr>
<tr><td colspan="3">Course Objectives:
1. To introduce fundamental aspects of Intellectual Property Rights (IPR)
2. To study the awareness about Copyrights, Trademark and Trade Secrets.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able to–
CO1. Understand the concepts of Intellectual Property Rights.
CO2. Understand the knowledge about Copyrights and Trademark.
CO3. Understand the knowledge how to protect trade secrets.</td></tr>
<tr><td colspan="3">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>Introduction to Intellectual Property Law</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law.
Introduction to Cyber Law – Innovations and Inventions Trade related Intellectual Property Right</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>Trademark</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Trademark Registration Process – Post registration Procedures – Trade mark maintenance - Transfer of Rights - Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark – Likelihood of confusion - Trademarks claims – Trademarks Litigations – International Trademark Laws.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Copyrights</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Principles of Copyright Principles -The Subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer, and duration – Right to prepare Derivative works – Rights of Distribution – Rights of Perform the work Publicity Copyright Formalities and Registrations - Limitations - Copyright disputes and International Copyright Law – Semiconductor Chip Protection Act</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>Introduction to Trade Secret</td><td>(03 hrs)</td></tr>
</table>

Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement - Trade Secret Law - Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law	
Mapping of Course Outcomes for Unit IV	**CO4**

Textbooks:

1) DebiragE.Bouchoux: "Intellectual Property". Cengage learning, New Delhi
2) M.Ashok Kumar and Mohd.Iqbal Ali: "Intellectual Property Right" Serials Pub.
3) Cyber Law. Texts & Cases, South-Western's Special Topics Collections
4) Prabhuddha Ganguli: 'Intellectual Property Rights" Tata Mc-Graw –Hill, New Delhi
5) https://nptel.ac.in/courses/109105112

Evaluation

Students should select any one of the topics in a group of 3 to 5. Students should submit a written Report. Make a presentation on the topic. Report will be evaluated by the faculty as per rubrics defined by them at start of course.

<table>
<tr><td colspan="4">Savitribai Phule Pune University, Pune
B.E Information Technology (2019 Course)
414449B: Audit Course 7
Stress Management By Yoga</td></tr>
<tr><td>Teaching Scheme:</td><td colspan="2">Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH): 01 hrs/week</td><td colspan="2">Non-Credit</td><td>Audit Course</td></tr>
<tr><td colspan="4">Prerequisite Courses, if any:</td></tr>
<tr><td colspan="4">Course Objectives:
To achieve overall health of body and mind</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of the course, students will be able to–
CO1. Understand the reasons for Stress.
CO2. Understand the role of Yoga.
CO3. Develop healthy mind in a healthy body.
CO4. Develop overall efficiency.</td></tr>
<tr><td colspan="4">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td colspan="2">Introduction to Stress</td><td>(03 hrs)</td></tr>
<tr><td colspan="4">Meaning and Definition of Stress. Types: Eutress, Distress, Anticipatory Anxiety, Intense Anxiety and Depression. Meaning of Management – Stress Management. Physiology of Stress on: Autonomic Nervous System.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="3">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">Introduction to Yoga</td><td>(03 hrs)</td></tr>
<tr><td colspan="4">Meaning and definition of Yoga – aims & objectives of yoga, Definitions of Eight parts of yog. (Ashtanga), Concept of Stress according to Yoga.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="3">CO2</td></tr>
<tr><td>Unit III</td><td colspan="2">Asan and Pranayam</td><td>(03 hrs)</td></tr>
<tr><td colspan="4">Asan - Various yog poses and their benefits for mind & body.
Pranayam - Regularization of breathing techniques and its effects-Types of pranayam.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="3">CO3</td></tr>
<tr><td>Unit IV</td><td colspan="2">Effect of Yoga</td><td>(03 hrs)</td></tr>
<tr><td colspan="4">Impact of Yoga on Muscular system, Respiratory System, Circulatory system,Nervous system, Digestive system and Endocrine system</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="3">CO4</td></tr>
</table>

1. **Textbooks:**
2. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur **3.** "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (PublicationDepartment), Kolkata **4.** Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers. **5.** Ravishankar.N.S., (2001). Yoga for Health. New Delhi: Pustak Mahal. **6.** https://nptel.ac.in/courses/121105009 **7.** https://onlinecourses.swayam2.ac.in/aic19_ed29/
Evaluation
Students should select any one of the topics in a group of 3 to 5. Students should submit a written Report. Make a presentation on the topic. Report will be evaluated by the faculty as per rubrics defined by them at start of course.

Savitribai Phule Pune University, Pune B.E Information Technology (2019 Course) 414449C: Audit Course 7 English for Research Paper Writing		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory(TH): 01 hrs/week	**Non-Credit**	**Audit Course**

Prerequisite Courses, if any:

Course Objectives:

1. To improve writing skills and level of readability.
2. Learn about what to write in each section.
3. Summarize the skills needed when writing a research paper.
4. To study the good quality of paper at very first-time submission.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand that how to improve writing skills and level of readability.

CO2. Identify and categorize about what to write in each section.

CO3. Ensure the good quality of paper at very first-time submission.

COURSE CONTENTS

Unit I	Introduction to Research Paper Writing	(03hrs)
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.		
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Presentation Skills**	**(03 hrs)**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Writing Problem Solution - Texts**	**(03 hrs)**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.		
Mapping of Course Outcomes for Unit III	CO2, C03	
Unit IV	**VERIFICATION SKILLS**	**(03 hrs)**
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.		

Mapping of Course Outcomes for Unit IV	**CO3**

Textbooks:

1) Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press Model Curriculum of Engineering & Technology PG Courses [Volume -II]
2) Goldbort R (2006) Writing for Science, Yale University Press
3) Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4) Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht HeidelbergLondon, 2011
5) https://nptel.ac.in/courses/110105091

Evaluation

Students should select any one of the topics in a group of 3 to 5. Students should submit a written research Report /paper or make a presentation on the topic. Report/Presentation will be evaluated by the faculty as per rubrics defined by them at start of course.

SEMESTER – VIII

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)

414450: Distributed Systems

Teaching Scheme: 03 Hrs/Week	Credit Scheme:	Examination Scheme:
Theory (TH): 03 hrs/week	03 Credits	Mid_Semester:30 Marks End_Semester: 70 Marks

Prerequisite Courses:
Operating System, Computer Network, Data Structure and Algorithm

Companion Course, if any:
NA

Course Objectives:

1. To learn the principles, architectures and programming models used in distributed systems.
2. To understand the fundamentals and knowledge of the Middleware of distributed systems
3. To gain knowledge of working components and fault tolerance of distributed systems.
4. To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
5. To make students aware about distributed and multimedia file systems and web systems.
6. Create an awareness of Emerging trends in distributed computing.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Demonstrate the core concepts of distributed systems.
CO2. Understand the concept of middleware of distributed systems.
CO3. Understand Inter-process communication methods and analyze different coordination algorithms.
CO4. Comprehend the importance of replication to achieve fault tolerance in distributed systems.
CO5. Analyze the design and functioning of existing distributed file systems, distributed multimedia, and distributed web-based systems.
CO6. Understand various Recent Trends in distributed systems.

COURSE CONTENTS

Unit I	Introduction to Distributed Systems	(6 hrs)

Introduction: Network operating System VS Distributed operating systems, Characteristics, Design goals, challenges of Distributed Systems, Examples of Distributed Systems, Trends in Distributed systems: Pervasive networking and the modern Internet, Mobile and ubiquitous computing, Focus on resource sharing
Distributed Computing Models: Physical, Architecture and Fundamental models
• **Case Study:** WWW 1.0,2.0, 3.0

Mapping of Course Outcomes for Unit I	**CO1**

Unit II	Middleware	(6 hrs)

Introduction to middleware, middleware Framework, Role of middleware, Examples of Middleware, Origins of middleware, Architecture vs Middleware, RMI, CORBA, General Approaches to adaptive software, Types of middleware-messages oriented middleware, intelligent middleware, content centric middleware, middleware protocol, middleware Services, Distributed computing Environment (DCE), middleware Issues, middleware Analyst **Case Study: -** XML Based middleware		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Inter-Process Communication**	**(6 hrs)**
IPC: Introduction, Layered protocols, API for internet protocols, IPC through shared memory, external data representation and marshaling, Types of communication, inter process communication, multicast communication, message-oriented communication, MPI, network virtualization, overlay networks **Coordination:** Clock synchronization, logical clocks, mutual exclusion, election algorithms, Gossip based coordination **Case Study:** IBM WebSphere Message Queuing		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Replication and Fault Tolerance**	**(6 hrs)**
Replication: Reasons for replication, Replica management – Finding the best server location, Content replication and placement, Content distribution, Managing replicated objects Consistency protocols: Primary based protocols, replicated write protocols **Fault Tolerance:** Introduction to fault tolerance, Reliable client server communication, Reliable group communication, distributed commit, Recovery – Check pointing, Message logging **Case Study:** Caching and replication in web		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Distributed Files, Multimedia and Web Based System**	**(6 hrs)**
Distributed Files: Introduction, File System Architecture, Sun Network File System and HDFS. **Distributed Multimedia Systems:** Characteristics of Multimedia Data, Quality of Service Management, Resource Management **Distributed Web Based Systems:** Architecture of Traditional Web-Based Systems, Apache Web Server, Web Server Clusters, Communication by Hypertext Transfer Protocol, Synchronization, Web Proxy Caching **Case Study:** The Global Name Service, The X.500 Directory Service, BitTorrent		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Recent Trends in Distributed Systems**	**(6 hrs)**

Recent Trends: Introduction, Portable and handheld Devices, Wearable devices, Devices embedded in appliances, Parallel Virtual Machine (PVM), Jini, Service Oriented Architecture, The Future of Recent Trends.

Tools for Distributed System Monitoring: Prometheus, Zabbix, Nagios

• **Case Studies:** Mach, Chorus

Mapping of Course Outcomes for Unit VI	**CO6**

Textbooks:

1. Distributed Systems: Concepts and Design by George Coulouris, J Dollimore and Tim Kindberg,
2. Pearson Education, ISBN: 9789332575226, 5th Edition, 2017.
3. Distributed Systems, Maarten van Steen, Andrew S. T,ThirdeditionVersion.
4. Andrew S. Tanenbaum, Maarten van Steen, PHI ,2nd Edition, ISBN: 978-0130888938
5. Distributed Operating Systems: Concepts and Design by P. K. Sinha, PHI, ISBN: 978-0780311190

Reference Books:

1. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University
2. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition,
3. HagitAttiya and Jennifer Welch, Wiley India
4. Tool for Distributed Systems Monitoring, Łukasz KUFEL, Foundation of Computing and Decision Sciences, Vol 41(4), 2016, e-ISSN 2300-3405, DOI:10.1515/fcdc-2016-0014

E Books / E Learning References:

1. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/distributed-systems-survey.pdf
2. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/DisSysUbiCompReport.html

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414451: Elective-V (Software Defined Network)		
Teaching Scheme:	**Credit:**	**Examination Scheme:**
Theory (TH):03 hrs/week	**03 Credits**	**Mid_Sem : 30 Marks** **End_Sem : 70 Marks**

Prerequisite Courses:

Prior knowledge of fundamentals of Computer Network and Cloud Computing.

Course Objectives:

1. To understand the Need, History of SDN and Methods of API in SDN.
2. To understand role of Open Flow protocol and SDN Controllers and Use cases.
3. Acquire knowledge of Virtualization and its basic principles and understand role of Cloud Computing using SDN
4. To learn concept of data centre in SDN
5. To learn about security issues and challenges in SDN.
6. To learn applications and future of SDN.

Course Outcomes:

On completion of the course, student will be able to–

CO1. Acquire fundamental knowledge of SDN exploring the need, characteristics, and architecture of SDN and methods of API's in SDN.

CO2. Recognize Open Flow protocols and its forwarding, pipeline model and use cases of SDN controller.

CO3. Demonstrate virtualization and Cloud computing services of SDN.

CO4. Comprehend IT Infrastructure and understand the data center in SDN.

CO5. Analyse various security issues and challenges in SDN.

CO6. Comprehend SDN application areas and future.

COURSE CONTENTS

Unit I	Introduction to Software Defined Networking (SDN)	(6hrs)

Introduction of SDN -Definition, Need of SDN, History of Software Defined Networking (SDN), Fundamental characteristics of SDN, Advantages and Disadvantages of SDN, Distributed control planes, Load Balancing, Centralized control planes, The Evolution of Networking Technology.

Alternate SDN Methods- SDN via Existing APIs, SDN via Hypervisor-Based Overlay Networks. Traditional Switch Architecture-Roles and Separation of data, control and management Planes, SDN API's (Northbound API's, Southbound API's), SDN Devices.

Unit II	Open Flow & SDN Controllers	(6hrs)

Definition, OpenFlow architecture, Flow & Group Table types, Hybrid Approaches, The OpenFlow forwarding and pipeline model, OpenFlow Advantages and Limitations, OpenFlow Protocol.

SDN Controllers -SDN OpenFlow Controllers: Open-Source Controllers - NOX, POX, Use Case: FloodLight, Mininet, Implementing software-defined network (SDN) based firewall.

Unit III	Virtualization and Cloud Computing	(6hrs)

Virtualized Network Functions -Background and Motivation for NFV, Virtual Machines, NFV Concepts - NFV Reference architecture, NFV Infrastructure, Virtualized Network Functions (NFV) - Management and Orchestration, Comparison between SDN and NFV, NFV Use Cases - SDN and NFV.
Cloud Computing -Cloud Computing and Resource Virtualization, SDN Applications in Network Virtualization, Cloud Network Virtualization using SDN- Synergy between SDNs and clouds, Integration Architectures, Network as a Service (NaaS) supported by SDN, Security as a Service (SecaaS) using SDN.

Unit IV	SDN in Data Center	(6hrs)

Data Center- Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path technologies in data centers, Ethernet fabrics in Data centers, SDN Use Cases in the Data Center, Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network

Unit V	SDNsecurity	(6hrs)

Security Characteristics of SDN, Security Analysis and Potential attacks in SDN,Security Principles of SDN, Solutions to the security issues in SDN, Network Security enhancement using the SDN Framework – Issues and Challenges, Threats to SDN -Networks, Controllers, Applications.

Unit VI	SDN Applications and SDN Future	(6hrs)

SDN applications-Reactive versus Proactive Applications, Analysing Simple SDN Applications, A Simple Reactive Java Application, Using the Floodlight Controller, Using the Open Daylight Controller, Access Control for the Campus, Traffic Engineering for Service Providers.
SDN Future -Potential Novel Applications of Open SDN-Managing Non-traditional Physical Layer Links, Applying Programming Techniques to Networks, Security Applications, Roaming in Mobile Networks, Traffic Engineering in Mobile Networks.

Textbooks:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
2. SiamakAzodolmolky, "Software Defined Networking with Open Flow, Packt Publishing, 2013, ISBN: 9781849698726.
3. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", 2013, ISBN : 10:1-4493-4230-2, 978-1-4493-4230-2.

Reference Books:

1. Vivek Tiwari, "SDN and OpenFlow for Beginners", Digital Services, 2013, ISBN: 10: 1-940686-00-8, 13: 978-1-940686-00-4.
2. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", CRC Press, 2014, ISBN: 10: 1466572094.
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.

E Books / E Learning References:

1. https://www.sdxcentral.com/sdn/definitions/software-defined-networking-tutorial/
2. http://sbrc2015.ufes.br/wp-content/uploads/Ch1.pdf
3. http://pure.qub.ac.uk/files/16066743/SDN_Security_Survey_FinalFile.pdf

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414451: Elective- V (Social Computing)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 3 hrs/week	03 Credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses:

- Basic Knowledge of Graphs
- Networking
- Data Mining and Analytics

Course Objectives:

1) To understand foundations of Social Media Analytics.
2) To understand network measures for social data.
3) To Visualize and understand the data mining aspects in social networks.
4) To understand social similarities in social groups
5) To understand behavioral part of web applications for Analysis.
6) To analyze the data available on any social media applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand basics of Social Media Analytics
CO2. Correlate Network Measures for Social Media Data
CO3. Visualize mining in social media data
CO4. Discuss the Social Similarities
CO5. Interpret social media behavior
CO6. Apply Social Media Computations for Google+

COURSE CONTENTS

Unit I	Introduction to social media	(6 hrs)
The foundation for analytics, social media data sources, defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics.		
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Network Measures**	**(6hrs)**
Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Betweenness Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence Information Diffusion in social media: Herd Behaviour, Information Cascades, Diffusions in Cascades, Epidemics		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Mining in social media**	**(6 hrs)**

Data Mining in Social Media: Motivations for Datamining in Social Media, Data mining Methods for Social Media, Data Representation, Data mining- A Process, Examples- Social Networking Sites, The Blogosphere
Text mining in Social Networks: Keyword Search, Query Semantics and Answer Ranking, Keyword search over XML and relational data, Keyword search over graph data, Classification Algorithms, Clustering Algorithms, Transfer Learning in Heterogenous Networks

Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Influence and Homophily**	**(6 hrs)**
Influence and Homophily: Measuring Assortativity, Influence, Homophily, Distinguishing Influence and Homophily: Shuffle test, Edge-Reversal Test, Randomization Test		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Social Media Behavior**	**(6 hrs)**
Recommendation in social media: Challenges, Classical Recommendation Algorithms, Recommendation using Social Context, Evaluating Recommendations, Behaviour Analytics: Individual Behaviour, Collective Behaviour		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Case Study**	**(6 hrs)**
Mining Google+: Overview, Exploring Google+ API, A Whiz bang Introduction to TF-IDF, Query human Language Data with TF-IDF Mining Web pages: Scraping, Parsing, and crawling Web, Discovering Semantics by Decoding syntax, Entity-Centric Analysis, Quality of Analysis for Processing Human Language Data		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Alex Gonçalves: Social Media Analytics Strategy, Using Data to Optimize Business Performance, Apress
2. Raza Zafarani, Mohammad Ali Abbasi, Huan Liu: Social Media Mining, Cambridge University Press April 2014
3. Mathew A Russell, Mining the Social Web, Data Mining, Facebook, Twitter, LinkedIn, Google+, GITHUB and More, 2nd Edition, OReilly.

Reference Books:
1. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6. 2. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0. 3. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615. 4. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6. 5. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents and Usage Data, Springer, 2 nd Edition, ISBN: 978-3-642-19459-7.
E Books / E Learning References:
https://emplifi.io/resources/blog/social-media-analytics-the-complete-guide

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414451: Elective V (Natural Language Processing)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH):03hrs/week	03 Credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses, if any: Theory of Computer Science

Companion Course, if any:

Course Objectives:

This course will enable students to

1. Learn the techniques in natural language processing.
2. Be familiar with the natural language generation.
3. Be exposed to Text Mining.
4. Understand the information retrieval techniques

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand and analyze the natural language text and model.

CO2. Analyze the natural language syntactically.

CO3. Analyze and study natural language logically.

CO4. Process the natural language text based on relations and knowledge.

CO5. Evaluate the natural language text using models and apply modeling techniques for automatic document separation and text mining.

CO6. Apply information retrieval techniques.

COURSE CONTENTS

Unit I	Introduction to NLP	(6hrs)

Overview and language modelling: Overview: Origins and challenges of NLP- Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modelling: Various Grammar- based Language. Models-Statistical Language Model.

Mapping of Course Outcomes for Unit I	CO1

Unit II	Word Level Analysis and Syntactic Analysis	(6 hrs)

Word Level Analysis: Regular Expressions- Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging.

Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing,

Mapping of Course Outcomes for Unit II	CO2

Unit III	Semantic Analysis	(6hrs)

<table>
<tr><td colspan="3">Introduction, Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation
Discourse Processing: Introduction, Cohesion, Reference Resolution, Discourse Coherence and Structure</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>Text Processing: Relations and Knowledge</td><td>(6hrs)</td></tr>
<tr><td colspan="3">Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.
Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations.
A Case Study in Natural Language Based Web Search: In Fact System Overview, The GlobalSecurity.org Experience.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO4</td></tr>
<tr><td>Unit V</td><td>Document Processing and Text Mining</td><td>(6hrs)</td></tr>
<tr><td colspan="3">Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.
Evolving Explanatory Novel Patterns for Semantically Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining</td></tr>
<tr><td>Mapping of Course Outcomes for Unit V</td><td colspan="2">CO5</td></tr>
<tr><td>Unit VI</td><td>Information retrieval and lexical resources</td><td>(6hrs)</td></tr>
<tr><td colspan="3">Information Retrieval: Design features of Information Retrieval Systems-Classical, non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net-Stemmers-POS Tagger- Research Corpora.
Model: Introduction to iSTART</td></tr>
<tr><td>Mapping of Course Outcomes for Unit VI</td><td colspan="2">CO6</td></tr>
<tr><td colspan="3">Textbooks:</td></tr>
<tr><td colspan="3">1. U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), “Natural LanguageProcessing and Text Mining”, Springer-Verlag London Limited 2007.</td></tr>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td colspan="3">1. Allen James, Natural Language Understanding, Pearson India, 2nd Edition ISBN: 9788131708958, 8131708950
2. James H. Martin, Daniel Jurafsky, Speech and Language Processing Pearson 1stAddition, ISBN 9789332518414
3. Hobson Lane, Cole Howard, Hannes Hapke. 2019. Natural Language Processing in Action. Live Book</td></tr>
</table>

E Books / E Learning References:
1. https://onlinecourses.nptel.ac.in/noc20_cs87/preview 2. https://onlinecourses.nptel.ac.in/noc19_cs56/preview 3. Virtual Lab :- (Natural Language Processing Lab) http://nlp-iiith.vlabs.ac.in/

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414451: Elective-V (Soft Computing)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH):3 hrs/week	**03 credits**	**Mid_Semester:30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any: Linear Algebra and Calculus, Probability Theory

Companion Course, if any: -

Course Objectives:

The objective of this course is to

1. Get familiarize with soft computing concepts
2. Understand use of Neural networks, fuzzy logic, GA, Hybrid Systems for problem solving

Course Outcomes:

On completion of the course, students will be able to–

CO1. Learn soft computing techniques and their roles in problem solving.
CO2. Understand and Analyze various Artificial neural network techniques
CO3. Understand and define the fuzzy systems for problem solving.
CO4. Understand and apply the concepts of genetic algorithms for problem solving.
CO5. Identify and select a suitable Soft Computing method to solve the problem
CO6. Identify and understand the role of soft computing models in various applications

COURSE CONTENTS

Unit I	Introduction	(6 hrs)
Basic concept of Soft Computing, Historical Development, Definitions, Soft Computing characteristics, advantages and disadvantages, Constitutes of Soft Computing : Fuzzy Logic and Computing, Neural Computing, Evolutionary Computing, Genetic Algorithms, Probabilistic Reasoning.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Artificial Neural Networks**	**(8 hrs)**
Fundamentals: Biological Neurons and Artificial neural network, model of artificial neuron. Neural Network Architectures, Neural Network models: Perceptron, Adaline, and Madaline networks; single layer network; Back propagation and multi-layer networks. **Learning Methods:** Hebbian, competitive, Boltzman etc., Competitive learning networks: Kohonenself-organizing networks, Hebbian learning; Hopfield Networks.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Fuzzy Logic and Fuzzy Systems**	**(6hrs)**

Fuzzy logic, fuzzy sets and operations, fuzzy relations, Fuzzy arithmetic, and fuzzy measures. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. Fuzzy rules and reasoning, Fuzzy inference systems- Mamdani Fuzzy Models– Sugeno Fuzzy Models, Fuzzy modeling and decision making, Neuro-fuzzy modeling.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Genetic Algorithms**	**(6 hrs)**
Introduction, Encoding, Operators of Genetic Algorithm, Basic Genetic Algorithm, Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA) Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Hybrid Systems**	**(6 hrs)**
Introduction, Neuro-Fuzzy modeling: Genetic Algorithm based Back-propagation Network, Fuzzy – Backpropagation, Fuzzy Logic Controlled Genetic Algorithms, Simplified Fuzzy ARTMAP, Case studies.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Applications Of Soft Computing Techniques**	**(6 hrs)**
Applications of fuzzy in pattern recognition-character recognition. Applications of evolutionary computing in Image processing and computer vision, soft computing in mobile ad-hoc networks, soft computing in Information Retrieval and Semantic web, Soft Computing in Software Engineering, Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley publications, 2nd Edition.
2. J. S. R. Jang, C. T. Sun, E. Mizutani, 'Neuro-Fuzzy and Soft Computing- A computational approach to Learning and Machine Intelligence' PHI

Reference Books:

1. David E. Goldberg, Genetic Algorithms - Pearson Education, 2006
2. Satish Kumar, "Neural Networks - A Classroom Approach", Tata McGraw,Hill
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd ed. Wiley India.
4. Samir Roy, Udit Chakroborthy, —Introduction to soft computing - neuro-fuzzy and genetic algorithm, Pearson Education, 2013

E-Resources

1. Introduction to Soft Computing: NPTEL- https://onlinecourses.nptel.ac.in/noc20_cs17/preview
2. Virtual Lab (Soft Computing Tools in Engineering lab) :- http://vlabs.iitkgp.ac.in/scte/

<table>
<tr><td colspan="3">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414451: Elective V (Game Engineering)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH):3 hrs/week</td><td>03 credits</td><td>Mid_Semester:30 Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="3">Prerequisite Courses: Discrete Structures.</td></tr>
<tr><td colspan="3">Companion Course, if any:</td></tr>
<tr><td colspan="3">Course Objectives:
1. To develop strong conceptual underpinnings of games.
2. To understand complete structure of a computer game and the major components of a game engine.
3. To develop creativity and individuality in problem solving and performing tasks.
4. To learn how to design challenges, rules and feedbacks when implementing and aligning the game activities with goals.
5. To develop competences necessary for graduate students to be employed in the game development industry.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able to–
CO1. Describe fundamentals of game engineering and the social- ethical issues in game development.
CO2. Develop creative and critical thinking skills for designing compelling games.
CO3. Apply game mechanics to make game more enjoyable.
CO4. Analyze Games over Networks and Peer Effects.
CO5. Demonstrate an understanding of various tools that are used in game development.
CO6. Apply mathematical and game programming knowledge and skills to solve development tasks.</td></tr>
<tr><td colspan="3">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>An Introduction to Games and Gaming</td><td>(6 hrs)</td></tr>
<tr><td colspan="3">Introduction: Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behaviour, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1, CO2, CO6</td></tr>
<tr><td>Unit II</td><td>Developing Thinking</td><td>(7 hrs)</td></tr>
<tr><td colspan="3">Re-framing Context: Communicology, Apparatus, and Post-history, Concepts Applied to Video games and Gamification, Rethinking 'playing the game' with Jacques Henriot, To Play Against: Describing Competition in Gamification, Player Motivation: Powerful Human Motivators, Why People Play, Player types, Social Games, Intrinsic verses Extrinsic Motivation, Progression to Mastery.
Case Study: Wordle</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO1, CO2,CO6</td></tr>
</table>

Unit III	Game Mechanism	(6 hrs)
Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen-and App-Based Digital Futures, Remodelling design, Game Mechanics: Designing for Engagement, Game Mechanics and dynamic. Case Study: Cricket League		
Mapping of Course Outcomes for Unit III	**CO1, CO2, CO3,CO6**	
Unit IV	**Rules of Play - Game Design Fundamentals**	**(6 hrs)**
Rules of Play: Defining Rules, Rules on Three Levels, The Rules of Digital Games Network effects and games over networks: Positive and negative externalities, Utility-based resource allocation, Selfish routing, Wardrop and Nash equilibrium, partially optimal routing, Network pricing, Competition and implications on network performance, Strategic network formation, Price of anarchy.		
Mapping of Course Outcomes for Unit IV	**CO1, CO2, CO3, CO4,CO6**	
Unit V	**Game Designing: Tools and Techniques**	**(6hrs)**
Godot 3.2, Construct 2, Unity: Game Engine, LOVE 2D: Framework, GameMaker: Studio, Clickteam Fusion 2.5,GameFroot ,Sploder, Stencyl, Flowlab, GameSalad, Scratch,Instant Gamification Platforms: Mambo.io, Installation and use of BigDoor, ngageoint/gamification-server.		
Mapping of Course Outcomes for Unit V	**CO1, CO2, CO3, CO4, CO5,CO6**	
Unit VI	**Applications and Case Studies**	**(6 hrs)**
Applications:esports, Ads, healthcare, teaching-learning. **Case studies:**Counter-Strike, PUBG New State, Minecraft, Nike Plus: Making Fitness Fun,Yahoo! Gamifies Questions,Axie Infinity: blockchain-based game, An Interactive Museum Touch-Screen Game		
Mapping of Course Outcomes for Unit VI	**CO1, CO2, CO3, CO4, CO5,CO6**	

Textbooks:

1. Gabe Zechermann, Christopher Cunningham, Gamification by Design, Oreilly media, First, ISBN: 978-1-449-39767-8.
2. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, NiklasSchrape, Rethinking Gamification
3. Katie SalenTekinbas , Eric Zimmerman, “Rules of PlayGame Design Fundamentals”, The MIT Press
4. Martin Osborne, An Introduction to Game Theory, Oxford University Press, 2003
5. http://meson.press/books/rethinking-gamification, Meson Press, First Edition,ISBN:978-3-95796-001-6.

Reference Books:

1. Susan Jacobs, Getting Gamification Right, The eLearning Guild, First.

E Books / E Learning References :

1) https://godotengine.org/, 2) https://mambo.io/, 3) https://unity.com/, 4) https://gamemaker.io/

<table>
<tr><td colspan="4" align="center">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414452: ElectiveVI (Ethical Hacking and Security)</td></tr>
<tr><td>Teaching Scheme:</td><td colspan="2">Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH): 03hrs/week</td><td colspan="2">03 Credits</td><td>Mid_Semester:30Marks
End_Semester: 70 Marks</td></tr>
<tr><td colspan="4">Prerequisite Courses: Computer Network: OSI Model, TCP/IP Protocol Suite, Fundamentals of Cyber Security, Fundamentals of Windows, and Linux Operating System</td></tr>
<tr><td colspan="4">Companion Course: Certified Ethical Hacking (EC Council), Ethical Hacking NPTEL</td></tr>
<tr><td colspan="4">Course Objectives:
1. Understand Importance of Ethical Hacking and legalities of penetration Testing
2. Apply Foot printing techniques with realistic approach
3. Analyze Meta sploit tool with Kali Linux for penetration testing
4. Analyze Privilege Escalation techniques in Windows and Linux
5. Create awareness about web application security and Hacking
6. Apply WiFi Hacking and security Techniques</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of the course, students will be able to–
CO1. Identify Ethical hacking processes and become acquainted with Penetration testing.
CO2. Recognize Foot printing techniques and apply in real time applications
CO3. Build knowledge about Meta sploit tool with Kali Linux
CO4. Differentiate Privilege Escalation in Windows and Linux
CO5. Construct Secure Web Applications to understand Hacking Techniques.
CO6. Recognize Wifi Hacking and Security techniques.</td></tr>
<tr><td colspan="4" align="center">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td colspan="2">Introduction to Basics of Ethical Hacking and Penetration Testing</td><td>(6 hrs)</td></tr>
<tr><td colspan="4">Introduction to basic Terminologies of Ethical Hacking, CIA(confidentiality, Integrity Availability , Types of Hackers , Ethical Hacking Process, Different tools for Ethical Hacking, Introduction to Kali Linux, What Is a Penetration Test, Vulnerability Assessments versus Penetration Test,Types of Penetration Testing:Network Penetration Test, Web Application Penetration Test,Mobile Application Penetration Test, Social Engineering Penetration Test, Physical Penetration Test</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="3">CO1</td></tr>
<tr><td>Unit II</td><td colspan="2">Foot printing & Port Scanning</td><td>(6 hrs)</td></tr>
<tr><td colspan="4">Foot printing: Introduction to foot printing, Understanding the information gathering methodology Introduction to fingerprinting in Ethical Hacking, Introduction to Reconnaissance, Reconnaissance types, Tools used for the reconnaissance phase, Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting, Enumeration-Introduction, Enumerating windows OS & Linux OS.</td></tr>
</table>

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**System Security and Hacking**	**(6hrs)**
Introduction to Metasploit ,Reconnaissance with Metasploit , Port Scanning with Metasploit , Compromising a Windows Host with Metasploit ,Client Side Exploitation Methods , E– Mails with Malicious Attachments ,Creating a Custom Executable , Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post– Exploitation Introduction :Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Countermeasures – Escalating Privileges –Executing Applications – Keyloggers and Spyware		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Privilege Escalation in Windows and Linux**	**(6hrs)**
Introduction Windows Privileges, Horizontal vs. Vertical Privilege Escalation, Windows Privilege Escalation Techniques- Windows Authentication Bypass, Windows Privacy Policy Settings, Access Token Manipulation, DLL Search Order Hijacking, Privilege Escalation Attack Vectors- Credential Exploitation, Vulnerabilities and Exploits, Misconfigurations, Malware, Social Engineering. Linux Privilege Escalation- Introduction, Linux File Permission, Sudo Bypass, NFS, Passwords on Files, Kernel Exploits, LXD Linux Container.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Web Application Hacking and Security**	**(6hrs)**
Introduction to Hacking Web Applications, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), XML External Entity (XXE), Injections: SQL Injection& Code Injection, Denial of Service (DoS), Exploiting Third-Party Dependencies Web Application Security: Securing Modern Web Applications, Secure Application Architecture, OWASP Top 10 Web Application Security Risks and tools		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Wi-Fi Hacking and Security**	**(6 hrs)**
Wi-Fi Security: Introduction to Wireless Security, Working, Types of Security, Protocols- WEP, WPA, WPA2 cracking, Threats to Wi-Fi Security, Secure Home and Business Wi-Fi Network, Stronger Wi-Fi Security, Updating WiFi Security Settings for Home WiFi Networks. Wi-Fi Hacking: Essential Tools for Hacking Wireless Networks, Evil Twin attack, Network Sniffing and social engineering		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:
1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2014**.** **2.** Andrew Hoffman, Web Application Security-Exploitation and Countermeasures for Modern Web Applications, O'Reilly publication **3.** Marcus Pinto, DafyddStuttard, The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws, Wiley Publication **4.** Alexis Ahmed, "Privilege Escalation Techniques, O'Reilly Media Company. Packt publishing. 2021
Reference Books:
1. Hacking: The Art of Exploitation by Jon Erickson **2.** Basics of Hacking and Penetration testing: Made Easy by Patrick Engebreston **3.** Penetration Testing: A Hands-on Introduction to Hacking by Georgia Weidman
E Books / E Learning References:
1. https://assets.ctfassets.net/kvf8rpi09wgk/5Yy2CMOxlE7eLlsTzFZ333/e656ff09a94ff0b63106de8d300903ac/CEH_Notes.pdf **2.** https://resources.infosecinstitute.com/topic/process-scanning-and-enumeration/ **3.** https://owasp.org/Top10 **4.** https://medium.com/techloop/reconnaissance-the-key-to-ethical-hacking-3b853510d977 **5.** Don Matthews, Unintended Consequences, Ethical Hacking ... **6.** www.coursera.org › lecture › industrial-iot-markets-security **7.** https://www.coursera.org/lecture/cybersecurity-for-data-science/hacking-white-grey-and-black-hackers-DzVHT **8.** https://www.coursera.org/lecture/cybersecurity-for-data-science/social-engineering-CD9QT **9.** https://www.coursera.org/lecture/hacking-patching/penetration-testing-with-kali-linux-z06ZJ **10.** https://medium.com/javarevisited/10-free-courses-to-learn-ethical-hacking-and-penetration-testing-for-beginners-84e40104aa6c.

<table>
<tr><td colspan="3">Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414452: Elective-VI (Augmented and Virtual Reality)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory (TH): 03 hrs/week</td><td>03 Credits</td><td>Mid_Semester :30 Marks
End_Semester :70 Marks</td></tr>
<tr><td colspan="3">Prerequisite Courses, if any:</td></tr>
<tr><td colspan="3">Companion Course, if any:</td></tr>
</table>

Course Objectives:

1. To study modern overviews on virtual reality and list the applications of VR.
2. To know the representation of Virtual world in VR.
3. To Study the fundamentals of visual perception, motion and tracking in real and virtual world.
4. To study modern overviews and perspectives on Augmented reality and list the applications of AR
5. To study the working of various state of the art AR devices.
6. To study computer vision concepts for AR and describe AR techniques.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Analyze how Virtual Reality systems work.
CO2. Understand the representation of Virtual world.
CO3. Describe the importance of motion and tracking in VR systems.
CO4. Analyze how AR systems work and list the applications of AR.
CO5. Identify the working of various AR components and AR devices.
CO6. Make use of computer vision concepts for AR.

<table>
<tr><td colspan="3">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>Introduction to Virtual Reality</td><td>(6 hrs)</td></tr>
<tr><td colspan="3">Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>Representing the Virtual World in VR</td><td>(6 hrs)</td></tr>
<tr><td colspan="3">Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR, Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Visual Perception, Motion and Tracking in VR</td><td>(6 hrs)</td></tr>
</table>

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models. Motion in Real and Virtual Worlds, Tracking- Tracking 2D & 3D Orientation.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Introduction to Augmented Reality**	**(6 hrs)**
What Is Augmented Reality - Defining Augmented Reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, Augmented Reality Concepts- How Does Augmented Reality Work? Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience, Applications of Augmented Reality		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Augmented Reality Components and Devices**	**(6 hrs)**
Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking &Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion. Types of AR devices.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Computer Vision for Augmented Reality & AR Software**	**(6hrs)**
Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Textbooks:		
1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016 **2.** Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002 **3.** Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494		

Reference Books:
1. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009. 2. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003. 3. SanniSiltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
E Books / E Learning References:
1. http://lavalle.pl/vr/book.html 2. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf 3. https://nptel.ac.in/courses/106/106/106106138/ 4. https://www.coursera.org/learn/ar

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414452: Elective VI (Business Analytics and Intelligence)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 03 hrs/week	03 Credits	Mid_Semester: 30 Marks End_Semester: 70 Marks

Prerequisite Courses: DBMS, ADBMS, DSBDA

Companion Course: -

Course Objectives:

1. Apply conceptual knowledge on how Business Intelligence is used within organizations.
2. Explore various systems and software for Business Intelligence
3. Understand several business scenarios where business analytics and intelligence can be useful
4. Understand the mathematical and analytical models behind Business Intelligence

Course Outcomes:

On completion of the course, students will be able to–

CO1. Apply conceptual knowledge on how Business Intelligence is used in decision making process
CO2. Use modelling concepts in Business Intelligence
CO3. Understand and apply the concepts of business reports and analytics with the help of visualization for business performance management
CO4. Comprehend the model-based decision making using prescriptive analytics
CO5. Analyze the role of analytics and intelligence in Business
CO6. Comprehend different Business Intelligence trends and its future impacts

COURSE CONTENTS

Unit I	Introduction to Decision Making and Business Intelligence	(6hrs)

Changing Business Environments, Decision Making & Simon's Decision-Making Process, Managerial roles in Decision Making, Information Systems Support for Decision Making, framework for Computerized Decision Support: The Gorry and Scott-Morton Classical Framework, Decision support systems (DSS). Capabilities of DSS, DSS Classification, DSS Components.

Business Intelligence (BI), Framework for BI, BI architecture, DSS - BI Connection, Goals of Business Intelligence, Business Intelligence: Tasks and Analysis Formats, BI use cases: Application in Patient Treatment, Application in Higher Education, Application in Logistics

Mapping of Course Outcomes for Unit I	CO1

Unit II	Modeling in BI	(6hrs)

Models and Modeling in BI, Model Presentation, Model Building, Model Assessment and Quality of Models, Modeling using Logical Structures: Ontologies &Frames, Modeling using Graph Structures: Business Process Model and Notation (BPMN) & Petri Nets, Modeling using Probabilistic Structures, Modeling Using Analytical Structures. Models and Data: Data Generation, The Role of Time, Data Quality

Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Business reporting, Visual analytics, and Performance management**	**(6 hrs)**
What Is a Business Report, Components of Business Reporting Systems, Data and Information Visualization, Types of Charts and Graphs, Visual Analytics, Performance Dashboards, Business Performance Management, Closed Loop BPM Cycle, Performance Measurement, Key Performance Indicators, Balanced Scorecards, The Four Perspectives of BSC? **BI Tools:** Tableau, Qlik, power BI, Dundas BI, Sisense, Webfocus, Oracle BI		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Prescriptive Analytics & Model-Based Decision Making**	**(6hrs)**
What are Descriptive analytics, predictive analytics, and prescriptive analytics, Decision Support Systems Modeling, Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Decision Modeling with Spreadsheets, Mathematical Programming Optimization, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking, Decision Analysis with Decision Tables and Decision Trees, Multi-criteria Decision Making with Pairwise Comparisons		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Role of Analytics and Intelligence inBusiness**	**(6 hrs)**
The role of visual and business analytics (BA) in BI and how various forms of BA are supported in practice. ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI Applications in Fraud Detection, BI Applications in Retail Industry		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Business Analytics: Emerging Trends and Future Impacts**	**(6 hrs)**
Emerging Technologies, the critical success factors for implementing a BI strategy, Predicting the Future with the help of Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, cloud computing and BI, Future beyond Technology. Impacts of Analytics in Organizations, Issues of Legality, Privacy, and Ethics, Location-Based Analytics for Organizations, Analytics Applications for Consumers.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Wilfried Grossmann & Stefanie Rinderle-Ma “Fundamentals of Business Intelligence”, Springer, ISBN 978-3-662-46531-8 (eBook)
2. 2. Business Intelligence and Analytics: Systems for Decision Support, 10th edition, ISBN 978-0-133-05090-5, by Ramesh Sharda, DursunDelen, and Efraim Turban, published by Pearson Education © 2014.

Reference Books:

1. Sabherwal, R. and Becerra-Fernandez, I. (2011). Business Intelligence: Practices, Technologies, and Management. John Wiley.
2. Turban,E. and Volonino, L.(2011). Information Technology for Management: Improving Strategic and Operational Performance. 8th edn.Wiley.

E Books / E Learning References:

1. https://www2.deloitte.com/us/en/pages/deloitte-analytics/articles/business-analytics-case-studies.html
2. https://www.blastanalytics.com/analytics-case-studies
3. BI Foundations with SQL, ETL and Data Warehousing Specialization (Coursera)

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414452: Elective-VI (Blockchain Technology)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 3hrs/week	**03 Credits**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses, if any:

Computer Network & security, distributed systems

Course Objectives:

1. To understand and explore cryptography in the blockchain.
2. To understand the working of blockchain technology.
3. To explore a blockchain platform: Ethereum and understand the concept of Tokenization
4. To understand the working of Hyper ledger.
5. To understand consensus mechanism.
6. To understand the applications & risks involved in blockchain.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand the concept of cryptography and decentralization.

CO2. Acquire fundamental knowledge of blockchain with issues associated with it.

CO3. Acquire knowledge of Ethereum blockchain platform.

CO4. Understand hyper ledger fabric platform.

CO5. Acquire the knowledge regarding working of tokenization.

CO6. Describe the applications and risk involved

COURSE CONTENTS

Unit I	Role of Cryptography in Blockchain	(6hrs)
Introduction to cryptography, Use of Cryptography in Blockchain, Cryptographic algorithm, cryptographic elements, cryptocurrency and its Benefits, introduction to decentralized system Security, Integrity, and Privacy Issues of a Decentralized System.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Introduction to Blockchain Technology**	**(6 hrs)**
What is bitcoin, Mechanics of Bitcoin, bitcoin transaction, Introduction of Block chain, History of Blockchain, Block chain Technology Definition, Types of Block Chain, Peer to Peer Network, platform for decentralization, Transactional blocks, why use blockchain technology.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Blockchain Platforms: Ethereum**	**(6hrs)**

Blockchain Platform introduction, what is **Ethereum**, Ethereum feature,Components of Ethereum Ecosystem, Ethereum Programming Languages, Runtime Byte Code, Blocks and Blockchain, How Smart Contracts Work. **Introduction to Tokenization:** What is token, technology behind tokenization, how blockchain tokenization can help in enterprise systems, Tokenizing Shares and Fund Raising, challenges to tokenization		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Blockchain Platforms: Hyper ledger**	**(6 hrs)**
What is Hyper ledger, features of a Hyper ledger blockchain, How Does Hyper Ledger Fabric Work, The Architecture of Hyper ledger Fabric System, Benefits of Hyper ledger Fabric, Differences Between Ethereum And Hyper ledger		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Introduction to Tokenization**	**(6hrs)**
Introduction to Tokenization: What is token, technology behind tokenization, how blockchain tokenization can help in enterprise systems, Tokenizing Shares and Fund Raising, challenges to tokenization, Consensus Mechanism.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Merits and Demerits of Blockchain and Applications**	**(6hrs)**
Selection Criteria for Blockchain platform for Applications, Blockchain and Enterprise – A Technology of Coordination, Risks and Limitations of Blockchain: Privacy, Security Risks of Blockchain, The “Evil Sides” of Blockchain and Legal Regulations for Blockchain: Ransomware, Money Laundering. Benefits of Blockchain in various scenarios. 1. Use Case: Blockchain for Supply Chain Financing 2. Use Case: Blockchain for Health Insurance.		
Mapping of Course Outcomes for Unit VI	**CO6**	

Textbooks:

1. Imran Bashir,” Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks”, Packt Publishing Limited, **ISBN-13:** 978-1787125445
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies”, Princeton University Press, ISBN: hardcover9780691171692 ebook: 9781400884155

Reference Books:

1. Kumar Saurabh, Ashutosh Saxena, “Blockchain Technology: Concepts and Applications”, Wiley publication, First Edition, ISBN: 978-8126557660.
2. Melanie Swan,” Blockchain Blueprint for a New Economy”, O'Reilly Media, Print ISBN: 9781491920497, 1491920491eText ISBN: 9781491920459, 1491920459

E Books / E Learning References:
1. BLOCKCHAIN, Cybrosys Limited Edition, E-book https://www.studocu.com/co/document/universidad-eia/calculo-integral/cybrosys-limited-edition-e-book-criptomonedas/14736261 2. Online Course by NPTEL https://nptel.ac.in/courses/106104220 https://drive.google.com/file/d/1PtYaDmWYaqPVGjKDnMYGWO5eoI5wMPtJ/view

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414453: Startup and Entrepreneurship		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Tutorial (TUT) : 03 hrs/week	**03 Credits**	**TW: 50 Marks**

Prerequisite Courses, if any:

Course Objectives:

1. To encourage students to build new technology, knowledge system based on innovations and can address local challenges.
2. Creating environment to innovate and build products towards sustainable development goals.
3. To provide platform for speedy communication and market reach of technology/ product developed by students.
4. To have start up ecosystem by bridging the gap between academia, industries and financial institutions, government support

Course Outcomes:

On Completion of Course students will be be able to:-

1. able to understand key concepts and framework of innovation and start-up ecosystem.
2. gain knowledge of how to develop start up ecosystem, its key components and how to influence and manage dynamics between them and increase the productivity of ecosystem.
3. understand the role of different stakeholders in ecosystem in building and supporting growth of start-ups.
4. have insight into global trend in start-up ecosystem and product development.
5. mapping different start-up ecosystems and developing performance indicators.

COURSE CONTENTS		
Unit I	**Start-up Opportunity**	**(3 hrs)**
Identify business opportunity with problem identification, market size, existing pains for customers, existing alternatives, customer psychology, willingness to pay, customer segments.		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Product/ Service Proposal**	**(3 hrs)**
Value Proposition Canvas, problem-solution fit, brainstorming, competition analysis, creating competitive advantage, sustainable differentiation.		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Business model**	**(3 hrs)**
Types, Lean canvas, Risky assumptions related to product, market, business, and execution capabilities		
Mapping of Course Outcomes for Unit III	**CO3**	

Unit IV	Minimum Viable Product (MVP)	(3 hrs)
Create and iterate, testing of MVP, customer feedback, validate risky assumptions, solution-market fit		
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Financial Plan	(3 hrs)
Manpower, Sales, Expenses, profitability projections, reality check, Funding plan, Pitch deck		
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Marketing strategy	(3 hrs)
Importance of brand and branding strategy, positioning, market penetration strategy/ plan, digital marketing, use of social media, customer acquisition Use of technology: for business scalability, effective execution, growth plan		
Mapping of Course Outcomes for Unit VI	CO6	

E Books / E Learning References:

- https://www.forbes.com/sites/palomacanterogomez/2019/04/10/how-to-frame-a-problem-to-find-the-right-solution/?sh=13af54355993
- https://hbswk.hbs.edu/item/how-entrepreneurs-can-find-the-right-problem-to-solve
- https://www.youtube.com/watch?v=6y3WIrgp_NY
- https://hbr.org/2014/07/what-you-need-to-know-about-segmentation
- https://www.youtube.com/watch?v=ReM1uqmVfP0
- https://www.youtube.com/watch?v=w62zW30PKms
- https://www.youtube.com/watch?v=FULiFueLGzE
- https://www.youtube.com/watch?v=7o8uYdUaFR4
- https://steveblank.com/2021/04/20/the-secret-to-the-minimum-viable-product/
- https://www.youtube.com/watch?v=1hHMwLxN6EM
- https://www.youtube.com/watch?v=4uGx14UVWPc
- https://www.youtube.com/watch?v=OVnN4S52F3k
- https://www.entrepreneur.com/article/251687
- https://www.forbes.com/sites/forbesbusinessdevelopmentcouncil/2020/09/14/13-key-steps-to-developing-a-go-to-market-strategy/?sh=53023c476fc1
- https://www.garyfox.co/business-model/business-model-channels/
- https://www.forbes.com/sites/allbusiness/2019/05/25/small-business-website-tips/?sh=2c551a0421ad

- https://www.forbes.com/sites/forbesagencycouncil/2020/10/08/digital-marketing-best-practices-for-startups/?sh=2e55af9e3ded

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414454: Lab Practice - V

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR): 4 hrs/week	02 Credits	PR: 25 Marks TW: 50 Marks

Prerequisites:

1. Operating Systems
2. Computer Network Technology
3. Web Application Development

Course Objectives:

1. The course aims to provide an understanding of the principles on which the distributed systems are based, their architecture, algorithms and how they meet the demands of Distributed applications.
2. The course covers the building blocks for a study related to the design and the implementation of distributed systems and applications.

Course Outcomes:

Upon successful completion of this course student will be able to:

1. Demonstrate knowledge of the core concepts and techniques in distributed systems.
2. Learn how to apply principles of state-of-the-Art Distributed systems in practical application.
3. Design, build and test application programs on distributed systems

Guidelines for Instructor's Manual

The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/Assistant.
The instructor's manual should include prologue, university syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, algorithm written in pseudo language, sample test cases and references.

Guidelines for Student's Lab Journal

1. The laboratory assignments are to be submitted by students in the form of journals. The Journal consists of prologue, Certificate, table of contents, and handwritten/printed write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.)
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.

Guidelines for Lab /TW Assessment

Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten/printed write-up along with results of implemented assignment, attendance etc.
Examiners will judge the understanding of the practical performed in the examination by asking some

questions related to theory & implementation of experiments he/she has carried out.

Guidelines for Laboratory Conduction

Staff in-charge will suitably frame the assignments and flexibility may be incorporated. All the assignments should be conducted on the latest version of Open-Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements for practical examination. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to judge the student 's understanding of the fundamentals, effective and efficient implementation. The evaluation should be done by both external and internal examiners.

List of Laboratory Assignments

1. Implement multi-threaded client/server Process communication using RMI.
2. Develop any distributed application using CORBA to demonstrate object brokering. (Calculator or String operations).
3. Develop a distributed system, to find sum of N elements in an array by distributing N/n elements to n number of processors MPI or OpenMP. Demonstrate by displaying the intermediate sums calculated at different processors.
4. Implement Berkeley algorithm for clock synchronization.
5. Implement token ring based mutual exclusion algorithm.
6. Implement Bully and Ring algorithm for leader election.
7. Create a simple web service and write any distributed application to consume the web service.
8. **Mini Project (In group):** A Distributed Application for Interactive Multiplayer Games

Reference Books:

1. Distributed Systems –Concept and Design, George Coulouris, Jean Dollimore, Tim Kindberg& Gordon Blair,Pearson,5th Edition,ISBN:978-13-214301-1.
2. Distributed Algorithms,Nancy Ann Lynch, Morgan Kaufmann Publishers, illustrated, reprint, ISBN: 9781558603486.
3. Java Network Programming & Distributed Computing by David Reilly, Michael Reilly
4. Distributed Systems - An Algorithmic approach by Sukumar Ghosh (good book for distributed algorithms)
5. Distributed Algorithms: Principles, Algorithms, and Systems by A. D. Kshemkalyani and M. Singhal (Good for algorithms, but very detailed, has lots of algorithms; good reference)
6. Design and Analysis of Distributed Algorithms by Nicola Santoro (good, distributed algorithms book)

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414455: Lab Practice VI (Ethical Hacking and Security)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical (PR): 02hrs/week	01 Credits	OR: 50 Marks TW: 25 Marks

Prerequisites: Computer Network, Cyber Security, Kali Linux

Course Objectives:

1. To obtain practical knowledge of finding vulnerabilities in network and web applications.
2. To understand legal usage of industry standard security tools in an isolated environment.
3. To gain hands-on practical on current security threats and its approach.
4. To grasp the understanding of breaching different operating systems.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Perform internal and external vulnerability analysis on web application and network.
CO2. Comprehend the hacker's mindset while conducting reconnaissance and system hacking.
CO3. Implement industry standard security protocols to prevent cyber-attacks.
CO4. Carry-out the same tactics, techniques, and procedures as actual hackers.

Guidelines for Instructor's Manual

1. The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

1. There must be hand-written write-ups for every assignment in the journal. Student should work on real time ethical hacking tools and find vulnerabilities, Kali linux software must be installed on system with different commands.

Guidelines for Practical Examination

Practical should be conducted on Kali Linux.
Google dorking should be experienced with real time website finding vulnerabilities.

List of Laboratory Assignments

1. **Assignment No 1: Reconnaissance (2 Hrs)**
   To perform reconnaissance on a website using google dorking technique on a tryhackme room.
   Perform Google Dorking: https://tryhackme.com/room/googledorking
2. **Assignment No.2(2 Hrs)**
   To perform reconnaissance on a website using web OSINT technique on a tryhackme room.
   Perform Web OSINT: https://tryhackme.com/room/webosint
3. **Assignment No 3: Scanning, enumeration, and analysis (2 Hrs)**
   To perform scanning using nmap(a powerful network scanning tool) in a tryhackme room.
   Perform scanning using Nmap tools: https://tryhackme.com/room/furthernmap
   Perform vulnerability analysis using Nessus tool:
   https://tryhackme.com/room/rpnessusredux
4. **Assignment 4 - POST-EXPLOITATION (2Hrs)**
   Perform Windows Privilege Escalation:
   https://tryhackme.com/room/windowsprivescarena
   Perform Post-Exploitation: https://tryhackme.com/room/postexploit
   Perform Linux Privilege Escalation: https://tryhackme.com/room/linuxprivesc

Reference Books:

1. Hacking: The Art of Exploitation, 2nd Edition 2nd Edition, Kindle Editionby Jon Erickson
2. javascript:void(0)The Basics of Hacking and Penetration Testing, Patrick Engebretson, 2nd edition
3. he Hacker Playbook 2, Peter Kim, 1st edition
4. Penetration Testing, Georgia Weidman, 1st edition

Virtual Laboratory

Penetration Testing Lab | Virtual Hacking Labs
Kali Linux | Penetration Testing and Ethical Hacking Linux ...
https://www.kali.org

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414455: Lab Practice VI (Augmented and Virtual Reality)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR):2 hrs/week	**01 Credit**	**OR: 50 Marks** **TW: 25 Marks**

Prerequisites:

Course Objectives:

Course Outcomes:

Guidelines for Instructor's Manual

1. The faculty member should prepare the laboratory manual for all the experiments, and it should be made available to students and laboratory instructor/Assistant.

Guidelines for Student's Lab Journal

1. Student should submit term work in the form of handwritten journal based on specified list of assignments.
2. Practical Examination will be based on the term work.
3. Candidate is expected to know the theory involved in the experiment.
4. The practical examination should be conducted if and only if the journal of the candidate is complete in all aspects.

Guidelines for Lab /TW Assessment

1. Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten write-up along with results of implemented assignment, attendance etc.
2. Examiners will judge the understanding of the practical performed in the examination by asking some questions related to the theory & implementation of the experiments he/she has carried out.
3. Appropriate knowledge of usage of software and hardware related to respective laboratory should be checked by the concerned faculty member.

Guidelines for Laboratory Conduction

1. There must be hand-written write-ups for every assignment in the journal.
2. Appropriate tools must be made available to students to perform assignments. Prefer open source if available.

Guidelines for Practical Examination

The exam will be based on all assignments .

List of Laboratory Assignments

1. **Assignment No.1**
   Study of various AR VR Development tools.
2. **Assignment No.2**
   Case study of an any single application using both VR and AR technologies.
3. **Assignment No.3**
   Installation and understanding of UNITY 3D IDE.
4. **Assignment No.4**

Create a C# script which plays a video when an image is scanned using AR App (use ARCore& Unity).
Text Books
1. Steve Aukstakalnis- Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Addison-Wesley Professional, September 2016, ISBN: 9780134094328 2. Allan Fowler- Beginning iOS AR Game Development Developing Augmented Reality Apps with Unity and C#, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
Reference Books
1. Learning C# by Developing Games with Unity 3D Beginner's Guide Terry Norton Pack Publication Packt publishing, 9th October 2017. ISBN-13: 978-1787286436 2. Jonathan Linowes, KrystianBabilinski – Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia.
Online links
Manual:https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.1/manual/index.html

Savitribai Phule Pune University, Pune Final Year Information Technology (2019 Course) 414455: Lab Practice VI (Business Analytics and Intelligence)		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR): 02hrs/week	**01 Credits**	**OR: 50 Marks** **TW: 25 Marks**

Prerequisites: DSBDA Lab

Course Objectives:

1. To apply conceptual knowledge on various Business Analytics aspects.
2. To explore various tools for Data Analysis and visualization
3. To understand different practical techniques used by businesses for analytics
4. To understand the mathematical and analytical models behind Business Intelligence

Course Outcomes:

On completion of the course, students will be able to–

CO1. Compare and analyze different analytical tools used by businesses

CO2. Understand the application of critical notion of KPI using real time case studies

CO3. Design and implement the analytical models using suitable tools

CO4. Create visualizations using suitable tools

Guidelines for Instructor's Manual

Lab Assignments: Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective courses at their level. For each laboratory assignment, it is essential for students to draw/write/generate visualizations, mathematical model, Test data set and comparative/complexity analysis (as applicable).

Guidelines for Student's Lab Journal

Program codes / analysis with sample output of all performed assignments are to be submitted as softcopy. Use of Google Classroom / Drive /DVD or similar media containing student's programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Guidelines for Lab /TW Assessment

Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct an internal monthly practical examination as part of continuous assessment.

Guidelines for Laboratory Conduction

Following is a list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for respective courses at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate visualizations, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorials may be as per guidelines of authority

Guidelines for Practical Examination

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria

List of Laboratory Assignments

Group A

1. Comparative Study of Open-Source Data Analysis tools
2. Identify Key Performance Indicators (KPI) for any real time case study and present analysis for the same

Group B

1. Create, model, and analyze Petri nets with a standards-compliant Petri net tool for Producer / Consumer OR Dining Philosophers problem
2. Perform a what-if-analysis on Book Store Scenario using Excel
3. Create a decision tree for predicting the loan eligibility process using Python

Group C

1. Create following visualizations using Excel
    a. Combo charts
    b. Band Chart
    c. Thermometer Chart
    d. Gantt Chart
    e. Waterfall Chart
    f. Sparklines
    g. PivotCharts
2. Create interactive visualizations using any open-source tool. (Eg. KNIME, D3.js, Grafana, etc.)
3. Create a dashboard / report using Google Data Studio on YouTube Channel Data / Google Ads Data / Search Console Data

Reference Books:

1. Wilfried Grossmann & Stefanie Rinderle-Ma "Fundamentals of Business Intelligence", Springer, ISBN 978-3-662-46531-8 (eBook)
2. https://datastudio.google.com/
3. http://pipe2.sourceforge.net/
4. https://www.knime.com/

Savitribai Phule Pune University, Pune **Final Year Information Technology (2019 Course)** **414455: Lab Practice VI (Blockchain Technology)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical (PR): 02 hrs/week	**01 credit**	**OR: 50 Marks** **TW: 25 Marks**

Prerequisites: Programming skills: javascript, react.js

Course Objectives:

1. To acquaint students with the basic skills required for adopting to crypto currency & block chain
2. To acquire knowledge about consensus algorithms and its working.

Course Outcomes:

On completion of the course, students will be able to–

1.To implement small blockchain experimentations.

2. Identify Consensus mechanism for Blockchain Application.

Guidelines for Instructor's Manual

The instructor’s manual is to be developed as hands - on resource and reference. The instructor's manual need to include prologue (about university/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration - concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.

Guidelines for Lab /TW Assessment

Faculty member should frame Practical Assignments based on given list of assignments. Students will submit term work in the form of journal containing handwritten write-ups/ source code and output. Staff incharge should maintain a record of continuous assessment and produced at the time of examination

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. Use of open-source software is to be encouraged. All the assignments should be conducted on Latest version of open-Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.

List of Laboratory Assignments

1. **Assignment No.1**

   To setup a crypto wallet

   a) i) hosted wallets ii) self-custody wallet iii) hardware wallets (optional) and evaluate each of these.

b) Understand the basic operations in the wallet on bitcoin such as 1) buy 2) sell 3) send 4) receive 5) exchange 6) mining.

2. **Assignment No.2**
   1) Create a local Ethereum network using Hardhat or any other tool, build a smart contract that lets you send a 👋 (wave) to your contract and keep track of the total # of waves. Compile it to run locally.
   2) Connect to any Ethereum walleteg.Metamask. Deploy the contract with testnet. Connect wallet with your webapp. Call the deployed contract through your web app. Then store the wave messages from users in arrays using structs
3. **Assignment no.3**
   Prepare your build system and Building Bitcoin Core.
   a. Write Hello World smart contract in a higher programming language (Solidity).
   b. Solidity example using arrays and functions
4. **Assignment no.4**
   Deploy a simple contract to the Ethereum blockchain.
5. **Assignment no.5**
   Polling / voting system using Solidity, Ethereum and a data structure hashmap(optional)

Online References

- https://buildspace.so/p/build-solidity-web3-app/lessons/welcome
- https://www.theinsaneapp.com/2022/05/best-web3-projects.html
- https://www.coinbase.com/learn/tips-and-tutorials/how-to-set-up-a-crypto-wallet

Savitribai Phule Pune University, Pune

Final Year Information Technology (2019 Course)

414456 : Project-II

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 10 hrs/week	05 Credits	Term Work : 100 Marks Oral : 50 Marks

Prerequisite Courses, if any: Project Phase-I (B.E. (IT) Final Year Semester-I)

Companion Course, if any: NA

Course Objectives:

1. To enable the student to extend further the investigative study taken up under Project stage-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory / Industry.
2. To build up exposure of implementation and hence develops analysis of results by considering performance measures.
3. To expose students to product development environment using industrial experience, use of state of art technologies.
4. To encourage and expose students with funding agency for sponsored projects.
5. To generate the opportunities to experience practically the facts learned in various fields together.
6. To improve overall communication skill, Teamwork and Leadership Qualities, professionalism.
7. Evaluate the various validation and verification methods.
8. Analyzing professional issues, including ethical, legal and security issues, related to computing projects.
9. To evaluate alternative approaches, and justify the results obtained.

Course Outcomes:

On completion of the course, students will be able to–

1. To apply engineering and mathematical knowledge to investigate / select proper technology / Algorithm suitable to solve the problem in hand.
2. To apply knowledge of statistics for analysis of results and express conclusion and justification for the same.
3. To design and conduct experiments, as well as to analyze and interpret data or develop prototype model of the application.
4. To communicate effectively.
5. Get broad education which is necessary to understand the impact of engineering solutions in a global, economic, environmental, ethically and societal context.
6. Recognition of the need for, and an ability to engage in life-long learning.

Introductory Information:

BE Project Phase-II is the continuation of Project Phase-I for implementation, and analysis of results to arrive a valid conclusion with justification.

Guidelines to Faculty and Students:

1. Preferably same review committee needs to continue for Project Phase-II.
2. There shall be **TWO** reviews in Project phase –II (in semester-II) by the review committee.
3. The Project Review committee will be responsible for evaluating the timely progress of the projects. It is suggested to evaluate the skills learned by the students in their PBL (in their previous years).
4. Student needs to justify the Algorithm / Model used for implementation.
5. Every student of the project group shall make presentation on the progress made by them before the committee during each reviews. Each student/group is required to give presentation as part of review for 10 to 15 minutes followed by a detailed discussion and query session.
6. Students need to note down the queries raised during review(s) and comply the same in the next review session.
7. The record of the remarks/suggestions of the review committee (project dairy) should be properly maintained in continuation of Project Phase-II and should be made available at the time of university examination.
8. Project group needs to present / publish **TWO** papers (One in each semester, at least one paper should be in **UGC – Care journal**).
   a. Paper must be checked for Plagiarism by any open software.
   b. One paper during second semester which includes Methodologies / Algorithms implemented, Results obtained, Analysis of results and conclusion.
9. Project report must also be checked for Plagiarism.
10. The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Review 3: Implementation –

Points to be covered:

1. Detailed study of Algorithm(s) / Model / Hardware specification (As applicable).
2. Confirmation of Data set used (As applicable)
3. Detailed ER Diagram / DFD diagrams.
4. Detailed UML Diagrams.
5. Sample results (module based).

Review 4: Testing and Result Analysis.

Points to be covered:

1. Appropriate test cases and results of test cases.
2. Representation of results with analysis.
3. Conclusion over performance parameters (as applicable)
4. Conclusion and future work suggested.
5. Knowledge of references utilized.

Evaluation Criteria:

Following criteria and weightage is suggested for evaluation of Project-Phase II Term Work.

1. Availability of standard Data set / Input parameters: 10%
2. Depth of Understanding of implemented Technology / Algorithm / Domain / Model: 40%
3. Test cases / Validation and Verification process: 10%
4. Justification of Algorithm / Model / Architecture / System: 10%
5. Analysis of results and conclusion: 10%
6. Presentation Skill: 10%
7. Report preparation and Paper publication: 10%

Project report contains the details as Follows:

It is suggested to have only one Project report which includes work carried at Project Phase-I as well. Project report must have:

- **i.** Certificate from the institute.
- **ii.** Certificate sponsoring organization (If any).
- **iii.** Acknowledgement.
- **iv.** Abstract.
- **v.** Contents.
- **vi.** List of Abbreviations (As applicable).
- **vii.** List of Figures (As applicable).
- **viii.** List of Graphs (As applicable).
- **ix.** List of Tables (As applicable).
    1) Introduction and aims/motivation and objectives.
    2) Literature Survey (with proper citation).
    3) Problem Statement/definition.
    4) Software Requirement Specification (In SRS Documentation only).
    5) Flowchart
    6) Project Requirement specification.
    7) Proposed system Architecture.
    8) High level design of the project (DFD , UML , ER Diagrams).
    9) System implementation-code documentation: Algorithm style, Description of detailed methodologies, protocols used etc..as applicable.
    10) Test cases.
    11) GUI/Working modules and Experimental Results in suitable format.
    12) Project Plan.
    13) Analysis and Conclusions with future work.
    14) Bibliography in IEEE format.

Appendices

- **a)** Plagiarism Report of Paper and Project report from any open source tool.
- **b)** Base Paper(s) [If any].
- **c)** Tools used / Hardware Components specifications [If any].
- **d)** Published Papers and Certificates (Both Papers).

Use appropriate plagiarism tools, reference managers, Latex for efficient and effective project writing.

Savitribai Phule Pune University, Pune B.E Information Technology (2019 Course) 414457A: Audit Course8 Functional Programming in Haskell		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 01 hrs/week	**Non-Credit**	**Audit Course**

Prerequisite Courses: Programming using any high-level language.

Course Objectives:

1. To understand the paradigm of programming.
2. To develop insight about 'lazy' execution.
3. To learn the syntax and semantics of the Haskell programming language.
4. To learn 'idioms' of Haskell programming

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand the correctness of programs.

CO2. Make use of higher-order functions.

CO3. Make use of the data encapsulation and parametric polymorphism for functional programming.

CO4. Understand the importance of the 'type checking' of values/functions to develop programs relatively faster.

COURSE CONTENTS

Unit I	**Introduction**	**(3 hrs)**
Types and Values, Running Haskell Programs, Lists, Strings, Tuples. Introduction to ghci interpreter		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Functions**	**(3 hrs)**
Functions, Type Inference, Recursion, Higher-order Functions, Polymorphic Types, Lambda Functions. Computation as rewriting, lazy evaluation and infinite data structures		
Mapping of Course Outcomes for Unit II	**CO2, CO3**	
Unit III	**Data Types**	**(3 hrs)**
User defined Data Types, Abstract data types, Recursive Data Types-Binary search trees		
Mapping of Course Outcomes for Unit III	**CO4**	
Unit IV	**Arrays and IO**	**(3hrs)**
Arrays, Input / Output		
Mapping of Course Outcomes for Unit IV	**CO4**	

Textbooks:
1. Brian O'Sullivan, John Goerzen and Don Stewart, 'Real World Haskell', O'reilly. **2.** MiranLipovača, 'Learn You a Haskell for Great Good!', No Starch Press. **3.** Graham Hutton, "Programming in Haskell", Cambridge University Press. **4.** https://nptel.ac.in/courses/106106137
Evaluation
Students should select any one of the topic in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

Savitribai Phule Pune University, Pune B.E Information Technology (2019 Course) 414457B: Audit Course 8 Cyber Laws And Use Of Social Media		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 01 hrs/week	**Non-Credit**	**Audit Course**

Prerequisite Courses: Programming using any high-level language.

Course Objectives:

To understand and aware Cyber laws which are focusing on protecting the privacy of users from organizations and other users.
To know the cyber threats happening around them and to help them stay secure in the daily use of Cyberspace.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand the importance of IT Act.

CO2. Understand the significance of cyber laws and its practices.

CO3. Identify and Analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

CO4. To study various privacy and security concerns of Online social media.

COURSE CONTENTS

Unit I	Introduction to IT Act	(03 hrs)
Evolution of the IT Act, Genesis and Necessity Various authorities under IT Act and their powers: Penalties & Offences, amendments. Traditional Principals of Jurisdiction, Extra-terrestrial Jurisdiction, Case Laws on Cyber Space Jurisdiction		
Mapping of Course Outcomes for Unit I	**CO1**	
Unit II	**Cyber Law: International Perspective**	**(03 hrs)**
EDI: Concept and legal Issues, UNCITRAL Model Law, Electronic Signature Laws of Major Countries, Cryptography Laws, Cyber Laws of Major Countries, EU Convention on Cyber Crime		
Mapping of Course Outcomes for Unit II	**CO2**	
Unit III	**Cyber Forensic and Computer Crimes**	**(03 hrs)**
Types, Crimes targeting Computers: Definition of Cyber Crime & Computer related crimes. Classification & Differentiation between traditional crime and cyber-crimes. Cyber-crimes and cyber terrorism: - a) Cyber-crimes and the categories of crime i) Cyber frauds ii) Cyber thefts iii) Cyber stacking b) Cyber Terrorism. c) Hacking, Virus, Trojan, worms etc.		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Use of Social Media**	**(03 hrs)**

Elements of Social Networks, Social Media Outlets. (Facebook, Twitter, etc.): How the differences impact, how to use them.
Videos: Broadcasting to peers, many to many, friends and followers, apps, pages, pseudonyms of good and evil Focused Networks (Flickr, Linked In, YouTube, etc.) networks that focus on specific topics or activities

Mapping of Course Outcomes for Unit IV	**CO4**

Textbooks:

1. The Information Technology act, 2000, Bare Act-Professional Book Publishers, New Delhi.
2. Aparna Viswanathan, "Cyber Law- Indian and International Perspectives On Key Topics Including Data Security, E-Commerce, Cloud Computing and Cyber Crimes".
3. First Responder's Guide to Computer Forensics by Richard Nolan etal; Carnegi Mellon, 2005.
4. https://nptel.ac.in/courses/106106146

Evaluation

Students should select any one of the topics in a group of 3 to 5. Students should submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics defined by him/her/them at start of course.

<table>
<tr><td colspan="3">Savitribai Phule Pune University, Pune
B.E Information Technology (2019 Course)
414457C: Audit Course 8
Constitution Of India</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit Scheme:</td><td>Examination Scheme:</td></tr>
<tr><td>Theory(TH): 01 hrs/week</td><td>Non-Credit</td><td>Audit Course</td></tr>
<tr><td colspan="3">Prerequisite Courses, if any:</td></tr>
<tr><td colspan="3">Course Objectives:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights.
3. To address the role and functions of local administration.</td></tr>
<tr><td colspan="3">Course Outcomes:
On completion of the course, students will be able to–
CO1. Understand the Principles of the Indian Constitution.
CO2. Understand and identify the growth of the demand for civil rights in India.
CO3. Understand the organizations of governance.
CO4. Understand the role and functions of local administration.</td></tr>
<tr><td colspan="3">COURSE CONTENTS</td></tr>
<tr><td>Unit I</td><td>History of Making of the Indian Constitution</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">History Drafting Committee, (Composition & Working), Philosophy of the Indian Constitution: Preamble, Salient Features</td></tr>
<tr><td>Mapping of Course Outcomes for Unit I</td><td colspan="2">CO1</td></tr>
<tr><td>Unit II</td><td>Contours of Constitutional Rights & Duties</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Fundamental Rights, Right to Equality, Right to Freedom, right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.</td></tr>
<tr><td>Mapping of Course Outcomes for Unit II</td><td colspan="2">CO2</td></tr>
<tr><td>Unit III</td><td>Organs of Governance:</td><td>(03 hrs)</td></tr>
<tr><td colspan="3">Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary</td></tr>
<tr><td>Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>Local Administration and Election Commission</td><td>(03 hrs)</td></tr>
</table>

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected representative, CEO of Municipal Corporation.
Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role.
Block level: Organizational Hierarchy (Different departments),
Village level: Role of Elected and Appointed officials, Importance of grass root democracy.
Election Commission: Role and Functioning

Mapping of Course Outcomes for Unit IV	**CO4**

Textbooks:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. https://nptel.ac.in/courses/129106003

Evaluation:

Students should select any one of the topics in a group of 3 to 5. Students should submit a written Report. Make a presentation on the topic. Report will be evaluated by the faculty as per rubrics defined by them at start of course.

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Academic Year – 2023-24

CRITERION 1 - CURRICULAR ASPECTS

1.2
Academic Flexibility

1.2.1

Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

S.E (Electronics / Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2020)

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
207005	Engineering Mathematics III	04	-	01	30	70	25	-	-	125	04	-	01	05
204181	Electronic Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204182	Digital Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204183	Electrical Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204184	Data structures	03	-	-	30	70	-	-	-	100	03	-	-	03
204185	Electronic Circuit Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204186	Digital circuits Lab		02					50		50		01		01
204187	Electrical Circuit Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
204188	Data Structures Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
204189	Electronic Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
204190	Mandatory Audit Course 3 [&]	-	-	-					-	-	-	-	-	-
Total		**16**	**10**	**01**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**05**	**01**	**22**

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
204191	Signals & Systems	03	-	01	30	70	25	-	-	125	03	-	01	04
204192	Control Systems	03	-		30	70		-	-	100	03	-	-	03
204193	Principles of Communication Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
204194	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
204195	Signals & Control System Lab		02				50			50		01		01
204196	Principle of Communication Systems Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204197	Object Oriented Programming Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
204198	Data Analytics Lab		02				-		25	25		01		01
204199	Employability Skill Development	02	02	-	-	-	50	-	-	50	02	01	-	03
204200	Project Based Learning [η]	-	04				50		-	50		02		02
204201	Mandatory Audit Course 4[&]	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**14**	**14**	**01**	**120**	**280**	**175**	**50**	**75**	**700**	**14**	**07**	**01**	**22**

Abbreviations:

In-Sem: In semester | End-sem: End semester | TH : Theory | TW : Term Work
PR : Practical | OR : Oral | TUT : Tutorial

Note: Interested students of S.E. (Electronics/E&TC) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204190: Mandatory Audit Course - 3		
Teaching Scheme:	**Credit**	**Examination Scheme:**
--	--	--

List of Courses to be opted (Any one) under Mandatory Audit Course 3

- Technical English For Engineers
- Ecology and Environment
- Ecology and Society
- German I
- Science, Technology and Society
- Introduction to Japanese Language and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University Second Year of Electronics/E & Tc Engineering (2019 Course) 204201: Mandatory Audit Course - 4		
Teaching Scheme:	**Credit**	**Examination Scheme:**
--	--	--

List of Courses to be opted (Any one) under Mandatory Audit Course 4

- Enhancing Soft Skills and Personality
- Language & Mind
- Emotional Intelligence
- German II
- Human Behaviour
- Speaking Effectively

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

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the guidelines on the NPTEL portal.

- After clearing the examination successfully; student will be awarded with certificate.

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- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

T.E (Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2021)

Savitribai Phule Pune University, Pune

T.E. (Electronics& Telecommunication Engineering) 2019 Course

(With effect from Academic Year 2021-22)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304181	Digital Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
304182	Electromagnetic Field Theory	03	-	01	30	70	25	-	-	125	03	-	01	04
304183	Database Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304184	Microcontrollers	03	-	-	30	70	-	-	-	100	03	-	-	03
304185	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304186	Digital Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304187	Database Management Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
304188	Microcontroller Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304189	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304191A	Mandatory Audit Course 5 &	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**01**	**150**	**350**	**50**	**125**	**25**	**700**	**-**		**-**	**-**
						Total Credit					**15**	**05**	**01**	**21**

Elective -I

1) Digital Signal Processing
2) Electronic Measurements
3) Fundamentals of JAVA Programming
4) Computer Networks

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019 Course
(With effect from Academic Year 2021-22)

Semester-VI														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**			
		Theory	**Practical**	**Tutorial**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
304192	Cellular Networks	03	-	-	30	70	-	-	-	100	03	-	-	03
304193	Project Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304194	Power Devices & Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
304195	Elective-II	03	-	-	30	70	-	-	-	100	03	-	-	03
304196	Cellular Networks Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
304197	Power Devices & Circuits Lab	-	02	-	-	-	-	50	-	50		01		01
304198	Elective-II Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304199	Internship**	-	-	-	-	-	100	-	-	100	-	-	04	04
304200	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304191 B	Mandatory Audit Course 6 [&]	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**10**	**00**	**120**	**280**	**125**	**75**	**100**	**700**				
								Total Credit			**12**	**05**	**04**	**21**

Abbreviations:

In-Sem: In semester　End-Sem: End semester　TH: Theory　TW : Term Work

PR: Practical　OR: Oral　TUT: Tutorial

Note: Students of T.E. (Electronics & Telecommunications) have to opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Elective -II

1) Digital Image Processing
2) Sensors in Automation
3) Advanced JAVA Programming
4) Embedded Processors
5) Network Security

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304185 (C): Fundamentals of JAVA Programming (Elective - I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

1. Data Structures
2. Object Oriented Programming concept

Companion Course, if any: Fundamentals of JAVA Programming Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in Java.
- Develop an ability to write various programs in Java for problem solving.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Understand the basic principles of Java programming language

CO2: Apply the concepts of classes and objects to write programs in Java

CO3: Demonstrate the concepts of methods & Inheritance

CO4: Use the concepts of interfaces & packages for program implementation

CO5: Understand multithreading and Exception handling in Java to develop robust programs

CO6: Use Graphics class, AWT packages and manage input and output files in Java

Course Contents

Unit I	JAVA Fundamentals	(08 Hrs.)

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java.

Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.

Mapping of Course Outcomes for Unit I	CO1: Understand the basic principles of Java programming language.

Unit II	Classes and Objects	(06 Hrs.)
Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class.		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of classes and objects to write programs in Java**	
Unit III	**Methods & Inheritance in JAVA**	**(06 Hrs.)**
Abstract Methods and classes, Strings ,One dimensional and two dimensional arrays , wrapper classes, enumerated types, Command line arguments **Inheritance:** Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch.		
Mapping of Course Outcomes for Unit III	**CO3: Demonstrate the concepts of methods & Inheritance.**	
Unit IV	**Interfaces & Packages**	**(06 Hrs.)**
Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface **Packages:** Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.		
Mapping of Course Outcomes for Unit IV	**CO4: Use the concept of interfaces & packages for program implementation.**	
Unit V	**Multithreading & Exception Handling**	**(06 Hrs.)**
Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.		
Mapping of Course Outcomes for Unit V	**CO5: Understand multithreading and Exception handling in Java to develop robust programs**	

Unit VI	Graphics Programming and File Handling	(06 Hrs.)
Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. **Managing input/output files**: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files.		
Mapping of Course Outcomes for Unit VI	**CO6: Use Graphics class, AWT packages and manage input and output files in Java**	

Learning Resources

Text Books:

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition.
2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.

Reference Books:

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7th Edition.
3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in Java"**

Link of the Course: https://nptel.ac.in/courses/106/105/106105191/

<table>
<tr><td colspan="3">Savitribai Phule Pune University
Third Year of E & Tc Engineering (2019 Course)
304185 (D): Computer Networks (Elective - I)</td></tr>
<tr><td>Teaching Scheme:</td><td>Credit</td><td>Examination Scheme:</td></tr>
<tr><td>Theory: 03 hrs. / week</td><td>03</td><td>In-Sem (Theory): 30 Marks
End Sem (Theory): 70 Marks</td></tr>
</table>

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Digital Communication

Companion Course, if any: Computer Networks Lab

Course Objectives:

- To understand the concepts of networking, its standards and protocols.
- To learn controlling techniques in networking at different layers.
- To learn protocols at different layers of reference model.
- To understand routing and networking in inter and intra domain.
- To learn network programming.
- To understand applications, protocols and its implication in networks.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.

CO2: Understand the working of controlling techniques for flawless data communication using data link layer protocols.

CO3: Learn the functions of network layer, various switching techniques and internet protocol addressing.

CO4: Explore various interior and exterior, unicasting and multicasting protocols.

CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.

CO6: Illustrate the use of protocols at application layer.

Course Contents

Unit I	Basics of Network & Physical Layer	(07 Hrs.)

Types of networks, Network topologies, Design issues for Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing.

Mapping of Course Outcomes for Unit I	**CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.**

Unit II	Data Link Layer	(06 Hrs.)
Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelization protocols.		
Mapping of Course Outcomes for Unit II	**CO2: Understand the working of controlling techniques for flawless data communication using data link layer protocols**	
Unit III	**Network Layer -I**	**(07 Hrs.)**
Introduction to Network Layer: Network-Layer Services, Circuit switching, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6.		
Mapping of Course Outcomes for Unit III	**CO3: Learn the functions of network layer, various switching techniques and internet protocol addressing.**	
Unit IV	**Network Layer - II**	**(07 Hrs.)**
Unicast & Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP.		
Mapping of Course Outcomes for Unit IV	**CO4: Explore various interior and exterior, unicasting and multicasting protocols.**	
Unit V	**Transport Layer**	**(06 Hrs.)**
Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS, socket programing .		
Mapping of Course Outcomes for Unit V	**CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.**	
Unit VI	**Application Layer**	**(05 Hrs.)**
Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP.		
Mapping of Course Outcomes for Unit VI	**CO6: Illustrate the use of protocols at application layer.**	

Learning Resources

Text Books:

1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, 5th Edition.
2. Achyut S Godbole, “Data Communication and Networking”, Tata McGraw-Hill, 1st Edition.

Reference Books:

1. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education,4th Edition, 2003
2. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 1st Edition.
3. Greg Tomsho, Ed Tittel, David Johnson. “Guide to Networking Essentials”, Thomson India Learning, 5th Edition, 2007.
4. William Stallings, “Data and Computer Communication”, Pearson Education, 8th Edition, 2000
5. James F. Kurouse & W. Rouse, “Computer Networking: A Top down Approach”, Pearson Education, 6th Edition.

MOOC / NPTEL Courses:

1. Computer Networks - Course (swayam2.ac.in)
2. Introduction to Computer Networks & Internet Protocols - Course (swayam2.ac.in)
3. Computer Networks and Internet Protocol - Course (nptel.ac.in)
4. NPTEL Course **“Computer Networks”**

Link of the Course: **https://nptel.ac.in/courses/106/105/106105183/**

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189 (C): Fundamentals of JAVA Programming Lab (Elective - I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical : 25 Marks**
Prerequisite Courses, if any: - Knowledge of Object Oriented Programming		
Companion Course, if any: Fundamentals of JAVA Programming		

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write some simple programs in Java such as: i) To find factorial of number. ii) To display first 50 prime numbers. iii) To find sum and average of N numbers
2.	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.
3.	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display " Matching Rectangles", otherwise display " Non-matching Rectangle"
4.	Write a program in JAVA to demonstrate the method and constructor overloading

Group B (Any Four)

5	Write Programs in Java to sort i) List of integers ii) List of names. The objective of this assignment is to learn Arrays and Strings in Java
6.	Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java
7.	Write a program in Java to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.
8.	Write a Java program which imports user defined package and uses members of the classes contained in the package.
9.	Write a Java program which implements interface.

10	Write a program to create multiple threads and demonstrate how two threads communicate with each other.
Group C (Any Three)	
11.	Write a java program which use try and catch for exception handling.
12.	Write a Java program to draw oval, rectangle, line , text using graphics class
13.	Write a java program in which data is read from one file and should be written in another file line by line.
14.	A Mini project in Java: A group of 4 students can develop a small application in Java

Virtual LAB Links:

Link of the Virtual Lab: https://java-iitd.vlabs.ac.in/

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189 (D): Computer Networks Lab (Elective – I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral : 25 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Computer Networks		

List of Laboratory Experiments

NOTE: All experiments should be implemented using Open-Source Tools: Wireshark, Packet Tracer and C / C++

Group A (Any Four)

1.	Implementation of LAN using suitable multiuser Windows operating System and demonstrating client-server and peer to peer mode of configuration.
2.	Simulating various Networks (LAN, WAN) using relevant network devices on Simulator a) Ping b) ipconfig / ifconfig c) Host name d) Whois e) Netstat f) Route g) Tracert/Traceroute/ Tracepath h) NSlookup i) ARP j) Finger k) Port Scan / nmap
3.	Observe and note the details of the live type of traffic (ARP, Frame analysis, ethernet) from interface using packet capture and analysis tool
4.	Using a Network Simulator (e.g., packet tracer) Configure router using RIP
5.	Capture and note the packet of HTTP /FTP /Telnet / DHCP Protocol using TCP-stream learn sequence of packets being sent and received.

Group B (Any Four)

1.	Socket Programming in C/C++ on TCP Client, TCP Server.
2.	Write a program to simulate leaky bucket/token bucket.
3.	Observe and note the working of protocols using PING / TRACEROUTE / PATHPING and capture packets in LAN using packet capture and analysis tool.
4.	Configure servers like HTTP / FTP and understand packet sequence and data flowing between client-server using packet analysis tools.
5.	Executing Proxy, web Server using simulator.
6.	Executing Telnet, DHCP Server using simulator.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304191 (A): Mandatory Audit Course - 5		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 5

- Developing Soft skills and Personality
- Entrepreneurship and IP Strategy
- Urbanization and Environment
- Environmental & Resource Economics
- Environment and Development
- Globalization and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

SEMESTER - VI

Savitribai Phule Pune University

Third Year of E & TC Engineering (2019 Course)

304195 (C): Advanced JAVA Programming (Elective - II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming Lab

Course Objectives: Make the learner to:

- Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
- Design and develop Web applications
- Designing Enterprise based applications by encapsulating an application's business logic.
- Designing applications using pre-built frameworks.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Design and develop GUI applications using Applets.

CO2: Apply relevant AWT/ swing components to handle the given event.

CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.

CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC)

CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)

CO6: Develop program for client /server communication using Java Networking classes.

Course Contents

Unit I	Applet	(06 Hrs.)

Applet Basics – Introduction, limitations of AWT, Applet architecture – HTML APPLET tag – Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables

Mapping of Course Outcomes for Unit I	CO1: Design and develop GUI applications using Applets.

Unit II	Event Handling using AWT/Swing components	(08 Hrs.)

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface

components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.		
Mapping of Course Outcomes for Unit II	**CO2: Apply relevant AWT/ swing components to handle the given event.**	
Unit III	**GUI Programming**	**(06 Hrs.)**
Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.		
Mapping of Course Outcomes for Unit III	**CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.**	
Unit IV	**Database Programming using JDBC**	**(06 Hrs.)**
The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries		
Mapping of Course Outcomes for Unit IV	**CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC).**	
Unit V	**Remote Method Invocation (RMI)**	**(06 Hrs.)**
Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.		
Mapping of Course Outcomes for Unit V	**CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)**	

Unit VI	**Networking**	**(08 Hrs.)**
The java.net package, Connection oriented transmission – Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example. InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example.		

Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview – the Java web server – The Life Cycle of a Servlet, your first servlet.	
Mapping of Course Outcomes for Unit VI	**CO6: Develop program for client /server communication using Java Networking classes.**

Learning Resources
Text Books: 1. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition 2. Jim Keogh, "Complete Reference J2EE" , Enterpr 3. E. Balaguruswamy, "Programming with JAVA: A Primer" McGraw Hill Education, India, 5th Edition.
Reference Books: 1. "Java 6 Programming", Black Book, Dreamtech 2. "Java Server Programming, Java EE6 (J2EE 1.6)", Black Book, Dreamtech 3. M.T. Savaliya,"Advanced Java Technology", Dreamtech
MOOC / NPTEL Courses: **1.** NPTEL Course **"Programming in Java"** **Link of the Course: https://nptel.ac.in/courses/106/105/106105191/** **2.** Udemy course **"Advanced Java Programming"** **Link of the Course: https://www.udemy.com/course/advanced-java-programming**

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304195 (E): Network Security (Elective-II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives: To introduce various network models, security threats and attacks and fundamentals of network security.

- To imbibe good foundation of network security in students for implementation of new network security algorithms.
- To understand different network models and the protocols used in each layer.
- To acquire detailed approach of encryption decryption for the data to transmit.
- To understand the role of network security as a tool for protection of different network entities.
- To be able to accurately apply security algorithms to real world security issues.
- To ensure windows and web browser security through implementation of various encryption standards.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Analyze attacks on computers and computer security.

CO2: Demonstrate knowledge of cryptography techniques.

CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers

CO4: Evaluate different Message Authentication Algorithms and Hash Functions

CO5: Get acquainted with various aspects of E-Mail Security

CO6: Assimilate various aspects of Web Security

Course Contents

Unit I	Attacks on Computers and Computer Security	(06 Hrs.)

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Mapping of Course Outcomes for Unit I	CO1: Analyze attacks on computers and computer security.

Unit II	Cryptography-Concepts and Techniques	(06 Hrs.)

Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Mapping of Course Outcomes for Unit II	**CO2: Demonstrate knowledge of cryptography techniques.**	
Unit III	**Symmetric and Asymmetric key for Ciphers**	**(08 Hrs.)**
Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution, Asymmetric key Ciphers, Principles of public key crypto systems, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.		
Mapping of Course Outcomes for Unit III	**CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers.**	
Unit IV	**Message Authentication Algorithms and Hash Functions**	**(07 Hrs.)**
Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, HMAC, CMAC, Digital signatures, knapsack algorithm, Authentication Applications such as Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.		
Mapping of Course Outcomes for Unit IV	**CO4: Evaluate different Message Authentication Algorithms and Hash Functions.**	
Unit V	**E-Mail Security**	**(06 Hrs.)**
Pretty Good Privacy, S/MIME, IP security overview, IP Security architecture, Authentication Header, Encapsulating , Security payload, Combining security associations, Key management		
Mapping of Course Outcomes for Unit V	**CO5: Get acquainted with various aspects of E-Mail Security**	
Unit VI	**Web Security**	**(07 Hrs.)**
Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual E lections.		
Mapping of Course Outcomes for Unit VI	**CO6**: Assimilate various aspects of Web Security	

Learning Resources

Text Books:

1. William Stallings , "Cryptography and Network Security" ,Pearson Education, 4th Edition
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 3rd Edition.
3. C K Shymala, N Harini, Dr. T R Padmanabhan, "Cryptography and Network Security", Wiley India,1st Edition.

Reference Books: 1. Forouzan Mukhopadhyay, “Cryptography and Network Security”, Mc Graw Hill, 2nd Edition. 2. Mark Stamp, “Information Security, Principles and Practice”, Wiley India, 2nd Edition. 3. W.M. Arthur Conklin, Greg White, “Principles of Computer Security”, TMH, 4th Edition. 4. Neal Krawetz, “Introduction to Network Security”, CENGAGE Learning Distributor, 1st Edition. 5. Bernard Menezes, “Network Security and Cryptography”, CENGAGE Learning Distributor, 1st Edition.
MOOC / NPTEL Courses: **1.** NPTEL Course **“Introduction to Cyber Security ”** **Link of the Course:** https://onlinecourses.swayam2.ac.in/nou19_cs08/preview 2. NPTEL Course “**Information Security – 5 – Secure Systems Engineering**” **Link of the Course:** https://nptel.ac.in/courses/106/106/106106199/

Savitribai Phule Pune University

Third Year of E & TC Engineering (2019 Course)

304198 (C): Advanced JAVA Programming Lab (Elective – II)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	01	Practical: 25 Marks

Prerequisite Courses, if any:
1.Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write a program to demonstrate status of key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown.
2.	Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. Frame should become visible when the mouse enters it.
3.	Develop a GUI which accepts the information regarding the marks for all the subjects of a student in the examination. Display the result for a student in a separate window.
4.	Write a program to insert and retrieve the data from the database using JDBC.
5.	Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not.
6.	Write a program to demonstrate the use of InetAddress class and its factory methods.

Group B (Any Two)

7.	A. Write Servlet (procedure for client side) to display the username and password accepted from the client. B. Write Servlet (procedure for server side) to display the username and password accepted from the client.
8.	Write program with suitable example to develop your remote interface, implement your RMI server, implement application that create your server, also develop security policy file.
9.	Write a database application that uses any JDBC driver.

Group C (Any Two)

10.	Write a simple JSP page to display a simple message (It may be a simple html page).
11.	Create login form and perform state management using Cookies, HttpSession and URL Rewriting.
12.	Create a simple calculator application using servlet.
13.	Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store the registration details in the database.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304198 (E): Network Security Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Network Security		

Group A (Any Three)	
1.	Design and implement for the insecurity of default passwords, printed passwords and password transmitted in plain text.
2.	Write a program for Encryption and Decryption.
3.	Write a program to perform encryption and decryption using the following algorithms: Ceaser Cipher, Substitution Cipher http://vlabs.iitb.ac.in/bootcamp/labs/dbms/exp13/
4.	Write a program to implement digital Signature http://cse29-iiith.vlabs.ac.in/
Group B (Any Two)	
6.	Isolating WLAN traffic using separate firewall for VPN connection
7.	Study of different wireless network components and features of any one of the Mobile Security Apps
8.	Implementation of Symmetric and Asymmetric cryptography
9.	Implementation of Steganography
Group C (Any Three)	
10.	Implementation of DES http://cse29-iiith.vlabs.ac.in/
11.	Implementation of AES http://cse29-iiith.vlabs.ac.in/
12.	Implementation of Windows security using firewall and other tools
13.	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
14.	Implementation of Hash functions http://cse29-iiith.vlabs.ac.in/

Virtual LAB Links:

Links of the Virtual Lab:

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Byte_Karma/index.html

Note: Additional 2 experiments to be performed using the virtual lab

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304191 (B): Mandatory Audit Course - 6		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 6

- Patent Law for Engineers and Scientists
- English language for competitive exams
- Energy Resources, Economics and Environment
- Principles of Human Resource Management
- Six Sigma
- Non-Conventional Energy Resources

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

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- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

B.E (Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2022)

Savitribai Phule Pune University, Pune
B.E. (Electronics & Telecommunication) 2019 Course
(With effect from Academic Year 2022-23)

Semester-VII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
404181	Radiation & Microwave Theory	03	-	-	30	70	-	-	-	100	03	-	-	03
404182	VLSI Design and Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
404183	Cloud Computing	03	-	-	30	70	-	-	-	100	03	-	-	03
404184	Elective - 3	03	-	-	30	70	-	-	-	100	03	-	-	03
404185	Elective - 4	03	-	-	30	70	-	-	-	100	03	-	-	03
404186	Lab Practice - 1 (RMT & Cloud Computing)	-	04	-	-	-	25	-	50	75	-	02	-	02
404187	Lab Practice - 2 (VLSI Design & Elective -3)	-	04	-	-	-	25	50	-	75	-	02	-	02
404188	Project Stage - I	-	02	-	-	-	50	-	-	50	-	01	-	01
404189	Mandatory Audit Course 7	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**-**	**150**	**350**	**100**	**50**	**50**	**700**	**-**	**-**	**-**	**-**
	Total Credits										**15**	**05**	**-**	**20**

Elective - 3	**Elective - 4**
1. Speech Processing	1. Data Mining
2. PLC SCADA & Automation	2. Electronic Product Development
3. JAVA Script	3. Deep Learning
4. Embedded & RTOS	4. Low Power CMOS
5. Modernized IoT	5. Smart Antennas

Mandatory Audit Course - 7
1. Management Information System
2. Patent Search & Analysis
3. Knowledge Management
4. Energy Economics & Policy
5. Educational Leadership
6. Human Resource Development

Savitribai Phule Pune University, Pune
B.E. (Electronics & Telecommunication) 2019 Course
(With effect from Academic Year 2022-23)

Semester-VIII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
404190	Fiber Optic Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
404191	Elective - 5	03	-	-	30	70	-	-	-	100	03	-	-	03
404192	Elective - 6	03	-	-	30	70	-	-	-	100	03	-	-	03
404193	Innovation & Entrepreneurship	-	-	02	-	-	50	-	-	50	-	-	02	02
404194	Digital Business Management	-	-	02	-	-	50	-	-	50	-	-	02	02
404195	Fiber Optic Lab	-	02	-	-	-	25	-	50	75	-	01	-	01
404196	Lab Practice - 3 (Elective - 5)	-	02	-	-	-	25	50	-	75	-	01	-	01
404197	Project Stage - II	-	10	-	-	-	100	-	50	150	-	05	-	05
	Total	**09**	**14**	**04**	**90**	**210**	**250**	**50**	**100**	**700**	**-**	**-**	**-**	**-**
									Total Credits		**09**	**07**	**04**	**20**

Elective - 5	Elective - 6
1. Biomedical Signal Processing	1. System on Chip
2. Industrial Drives & Automation	2. Nano Electronics
3. Android Development	3. Remote Sensing
4. Embedded System Design	4. Digital Marketing
5. Mobile Computing	5. Open Elective

SEMESTER - VII

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404184 (B): PLC SCADA and Automation (Elective - III)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 Hrs. / Week	**03**	**In-Sem (Theory): 30Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

1. Control Systems
2. Sensor's in Automation
3. Power Devices and Circuits

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. Understanding and Recognize Industrial control problems.
2. Concept of PLC's and Its Importance in Industrial Automation.
3. Development of Ladder Programming in PLC and PLC Interface in real time applications.
4. Overview of technology of advanced automation Systems such as SCADA, DCS Systems.
5. Learning of CNC fundamentals and Important Protocols in Industrial Automation

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand and Recognize Industrial Control Problems.

CO2: **Analyze** & explain different hardware functions of PLC.

CO3: Develop Ladder Programming in PLC and PLC Interface in real time applications.

CO4: Explore and interpret functionality of SCADA.

CO5: Identify and interpret the functionality of DCS.

CO6: Define and explain CNC machines and Applications of Industrial Protocols.

Course Contents

Unit I	Elements of Process Control Automation	7 Hrs.
Process control principles, Control System Evaluation, Analog control, Digital control, Architecture of Industrial Automation Systems (Automation Pyramid), Advantages and limitations of Automation, Concept and Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Concept of VFD, Energy conservation schemes through VFD.		
Mapping of Course Outcomes for Unit I	**CO1: Understand and Recognize Industrial Control Problems**	
Unit II	**Fundamentals of PLC**	**7 Hrs.**
Architecture of PLC- Types of PLC's, Applications of PLC's, PC v/s PLC, Different Modules, Power Supply Unit etc. Need of PLC, Different Types of Sensors- Sinking, Sourcing. Operation and function. Monitoring of Process through Sensors- Connection Details. Analog Addressing, continuous Process Monitoring and Control.		
Mapping of Course Outcomes for Unit II	**CO2: Analyze & explain different hardware functions of PLC.**	

Unit III	Programming of Programmable Logic Controllers	7 Hrs.
PLC programming, NO/ NC Concept, Ladder diagram: of logic gates, arithmetic instructions, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter. PLC Programming of Branded PLCs. Concept of P,PI,PD,PID w.r.t. PLC, Data File Handling- Forcing I/O.		
Mapping of Course Outcomes for Unit III	**CO3: Develop Ladder Programming in PLC and PLC Interface in real time applications.**	
Unit IV	**Supervisory Control and Data Acquisition Systems (SCADA)**	**6 Hrs.**
Concept of SCADA, Architecture of SCADA, Components of SCADA Systems, MTU- functions of MTU, RTU- Functions of RTU, Directly interact with devices such as sensors, valves, pumps, motors, and more through human-machine interface (HMI) software. Working of SCADA, Applications of SCADA in Industrial Automation like Oil and gas, Power etc.		
Mapping of Course Outcomes for Unit IV	**CO4: Explore and interpret functionality of SCADA.**	
Unit V	**Distributed Control Systems (DCS)**	**6 Hrs.**
Basic Concept of DCS, History and Hierarchy of DCS, Basic Componenents of DCS as Operator Station, Control Module, and I/O module , Types of DCS, Need of DCS, Functions of each level, Advantages and Disadvantages, Applications of DCS such as Water Treatment Plant, Comparison of PLC, DCS and SCADA		
Mapping of Course Outcomes for Unit V	**CO5: Identify and interpret the functionality of DCS.**	
Unit VI	**CNC Machines and Industrial Protocols**	**7 Hrs.**
Introduction of CNC Machines, Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication: Devicenet, Foundation Fieldbus, PROFIBUS, MODBUS, Ethernet, TCP/IP, Concept of Industry 4.0.		
Mapping of Course Outcomes for Unit VI	**CO6: Define and explain CNC machines and Applications of Industrial Protocols.**	
Learning Resources		

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology", 8^{th} Edition, Pearson Education.
2. Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation", 2^{nd} Edition, Penram International Publishing India Pvt. Ltd.

Reference Books:

1. Stuart A. Boyer, "SCADA Supervisory Control and Data Acquisition", 4th Edition, ISA Publication.
2. John W. Webb, Ronold A Reis," Programmable Logic Controllers, Principles and Applications", 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Kilian, "Modern control technology: components & systems", 2nd Edition, Delmar.
4. Bela G Liptak "Process Software and Digital Networks", 4th Edition, CRC Press
5. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall.
6. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers.
7. R.G. Jamkar, "Industrial Automation Using PLC SCADA & DCS" Global Education Limited

MOOC / NPTEL Courses:

1. NPTEL Course on "**Industrial Automation and Control**", by Prof. S. Mukhopadhyay, IIT Kharagpur.

Link: https://nptel.ac.in/courses/108105088

Savitribai Phule Pune University Fourth Year of E & TC Engineering (2019 Course) 404184 (C): Java Script (Elective - III)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 Hrs. / Week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

1. Fundamentals of Java Programming
2. Advanced Java Programming

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. To learn the syntax and semantics of Java script.
2. To understand the data types and variables in Java script.
3. To learn how functions and objects are used in Java script.
4. To learn how to use regular expressions in java script for handling various string operations.
5. To understand the concept of object models and event handling in java script programs.
6. To learn the use of java script for controlling Windows and form handling

Course Outcomes: On completion of the course, learner will be able to -

CO1: Use basic features of java script.

CO2: Use relevant data types for developing application in java script.

CO3: Use the function and objects as self-contained, with data passing in and out through well-defined interfaces in development of small systems.

CO4: Apply the regular expression for Text matching and manipulation.

CO5: Explore use of the various aspects of JavaScript object models that are fundamental to the proper use of the language.

CO6: Develop the application using windows controlling and form handling.

Course Contents

Unit I	Introduction to Java Scripts	6 Hrs.

Introduction – First Look at JavaScript, Adding JavaScript to XHTML Documents- The <script> Element, Using the <script> Element, Event Handlers, Linked Scripts, History and Use of JavaScript, JavaScript Core Features- Overview-Basic Definitions, Language Characteristics, Variables, Basic Data Types, Composite Types, Flow Control Statements, Loops, Functions, Input and Output in JavaScript, Regular Expressions.

Mapping of Course Outcomes for Unit I	CO1: Use basic features of java script.

Unit II	Data Types and Variables	8 Hrs.
JavaScript's Primitive Types- Numbers, Hexadecimal Literals, Octal Literals, Special Values, Data Representation Issues, Data Representation Issues, Strings, Undefined and Null; Composite Types- Objects, The typeof Operator, Type Conversion, Variables. Operators, Expressions, and Statements- Statement Basics, Whitespace, Termination: Semicolons and Returns, Blocks. **Operators**- Assignment Operator, Arithmetic Operators, Bitwise Operators, Bitwise Shift Operators, Increment/Decrement, Logical Operators, void Operator, Object Operators **Core JavaScript Statements**- if Statements, switch, while Loops, do-while Loops, for Loops, for Loops, Object-Related Statements, Object Loops Using for in		
Mapping of Course Outcomes for Unit II	**CO2: Use relevant data types for developing application in java script.**	
Unit III	**Functions and Objects**	**6 Hrs.**
Function Basics- Parameter-Passing Basics, return Statements, Parameter Passing: In and Out. Global and Local Variables- Mask Out, Local functions **Functions as Objects-** Function Literals and Anonymous Functions, Static Variables, Advanced Parameter Passing, Recursive Functions, Using Functions **Objects-** Objects in JavaScript, Object Fundamentals Enumerating Properties, Objects Are Reference Types, Passing Objects to Functions, Common Properties and Methods, Array, Date, Math, Number, String, Object Types and Primitive Types		
Mapping of Course Outcomes for Unit III	**CO3: Use the function and objects as self-contained, with data passing in and out through well-defined interfaces in development of small systems.**	
Unit IV	**Regular Expressions**	**6 Hrs.**
The Need for Regular Expressions, Introduction to JavaScript Regular Expressions, Creating Patterns, Repetition Quantifiers, Grouping, Common Character Classes, RegExp Object, exec(). **String Methods for Regular Expressions:** search(), split(),replace(),replace() with Sub expressions **Advanced Regular Expressions:** Multiline Matching, Non-capturing Parentheses, Lookahead, Greedy Matching, Limitations of Regular Expressions.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the regular expression for Text matching and manipulation.**	
Unit V	**Fundamental Client-Side JavaScript and Event Handling**	**6 Hrs**
JavaScript Object Models: Object Model Overview, The Initial JavaScript Object Model, The Object Models **The Standard Document Object Model**: DOM Flavors, Document Trees, Accessing Elements, Creating Nodes, Inserting and Appending Nodes, Deleting and Replacing Nodes, The DOM and HTML Elements, The DOM and CSS, The DOM Versus DHTML Object Models. Overview of Events and Event Handling, The Basic Event Model, Netscape 4 Event Model, Internet Explorer 4+ Event Model, DOM2 Event Model, Event Model Issues.		
Mapping of Course Outcomes for Unit V	**CO5: Explore use of the various aspects of JavaScript object models that are fundamental to the proper use of the language.**	

Unit VI	Using Java scripts	8 Hrs.
Controlling Windows and Frames: Introduction to Window, Dialogs, Opening and Closing Generic Windows, Window Features, Writing to Windows, Controlling Windows, Window Events, Frames: A Special Case of Windows, Frames: A Special Case of Windows. **Form Handling:** Form Basics, Form Fields, Select Menus Option Groups, Other Form Elements: Label, Fieldset, and Legend, Form Validation, Form Usability and JavaScript, Dynamic Forms.		
Mapping of Course Outcomes for Unit VI	**CO6: Develop the application using windows controlling and for handling.**	
Learning Resources		

Text Books:

1. Thomas Powell and Fritz Schneider, "JavaScript 2.0: The Complete Reference", 2nd Edition, McGraw Hill
2. Kogent Learning Solutions, "HTML, JavaScript, PHP, Java, JSP, XML and AJAX" Black Book, Dreamtech Press.

Reference Books:

1. Jon Duckett, "JavaScript & J Query: Interactive Front-End Web Development", John Wiley & Sons.
2. David Flanagan, "JavaScript: The Definitive Guide", 7th Edition, O'Reilly Media.
3. Mike Mackgrath, "Javascripts in Easy Steps" Dreamtech Press

MOOC / NPTEL Courses:

1. NPTEL Course on "**Internet Technology**", by Prof. Indranil Sengupta, IIT Kharagpur
   Link: https://nptel.ac.in/courses/106105084

2. Udemy course on **"JavaScript: Understanding the Weird Parts**"
   Link: **https://www.udemy.com/course/understand-javascript/**

Savitribai Phule Pune University Fourth Year of E & TC Engineering (2019 Course) 404184 (E): Modernized IoT (Elective - III)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 Hrs. / Week	**03**	**In-Sem (Theory): 30 Marks** **End-Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

1. Basics of sensors and hardware components
2. Basic networking concepts
3. Knowledge of Microcontroller and embedded systems

Companion Course, if any:

1. Lab Practice- 2

Course Objectives:

1. To introduce the fundamentals of sensors and actuators along with the basic concepts of an IoT & IoE.
2. To give Insights into the Architecture and M2M technology for an IoT.
3. To Exposing students to the usage of Protocol Standardization for IoT with IoT Edge and Gateway Network with Communication protocols.
4. To develop design skills in industrial IoT.
5. To provide IoT Solutions with sensor-based application through embedded system platform.

Course Outcomes: On completion of the course, learner will be able to

CO1: Comprehend and analyze concepts of sensors, actuators, IoT and IoE.
CO2: Interpret IoT Architecture Design Aspects.
CO3: Comprehend the operation of IoT protocols.
CO4: Describe various IoT boards, interfacing, and programming for IoT.
CO5: Illustrate the technologies, Catalysts, and precursors of IIoT using suitable use cases.
CO6: **Provide** suitable solution for domain specific applications of IoT.

Course Contents

Unit I	Sensors, Actuators, IoT & IoE	6 Hrs.

Definitions, Types of sensors, Types of Actuators, Example and Working, Networking Basics, RFID Principals and components, Wireless Sensor Networks, Definition, and characteristics of an IoT, Physical Design of an IoT, Logical design of IoT, Communication Models, Communication API's, What is the IoE? Difference between IoT and IoE, Pillars of the IoE, Connecting the Unconnected, Transitioning to the IoE, Bringing It All Together.

Mapping of Course Outcomes for Unit I	**CO1: Comprehend and analyze concepts of sensors, actuators, IoT and IoE.**

Unit II	IoT Architecture Design Aspects	6 Hrs.

IoT-An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals-Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management

Mapping of Course Outcomes for Unit II	**CO2: Interpret IoT Architecture Design Aspects.**

Unit III	IoT Protocols	6 Hrs.
PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP, Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT		
Mapping of Course Outcomes for Unit III	**CO3: Comprehend the operation of IoT protocols.**	
Unit IV	**Interfacing Boards and Programming**	**6 Hrs.**
Introduction to IoT Boards, Interfacing with IoT Boards, IoT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.		
Mapping of Course Outcomes for Unit IV	**CO4: Describe various IoT boards, interfacing, and programming for IoT.**	
Unit V	**Industrial IoT**	**6 Hrs.**
Introduction, Key IIOT technologies, Catalysts, and precursors of IIoT, Innovation and the IIoT, Applications of IIoT Examples: Healthcare, Oil and Gas Industry, Logistics and the Industrial Internet, Retail applications, IoT innovations and design methodologies, Industrial Internet Architecture Framework (IIAF): Control domain, operational domain and application domain, Three tier topology, Design of low power device network, legacy industrial protocols, Bluetooth, Zigbee IP, Z-wave, Wi-Fi backscatter in IIoT design.		
Mapping of Course Outcomes for Unit V	**CO5: Illustrate the technologies, Catalysts, and precursors of IIoT using suitable use cases.**	
Unit VI	**Applications of IoT**	**6 Hrs.**
Smart Environment: Forest Fire Detection, Air Pollution, Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Metering: Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation, Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation		
Mapping of Course Outcomes for Unit VI	**CO6**: **Provide** suitable solution for domain specific applications of IoT.	
Learning Resources		

Text Books:

1. Ovidiu Vermesan, Peter Fresiss, "Internet of Things" From research and innovation to market Deployment", River Publishers series in Communication, USA.
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley Publications.

Reference Books:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication
2. “Internet of Things: Case Studies”, Libelium Inc, White papers, Spain
   http://www.libelium.com/resources/case-studies

MOOC / NPTEL Courses:

1. NPTEL Course on “**Introduction to IoT**”, by Prof. Sudip Misra, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105166

2. NPTEL Course on “**Introduction to Industry 4.0 and Industrial Internet of Things**”, by Prof. Sudip Misra, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105195

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404185 (B): Deep Learning (Elective - IV)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To comprehend the theoretical foundations, algorithms and methodologies of Neural Network.
2. To design and develop an application using specific deep learning models and know complexity of Deep Learning algorithms and their limitations
3. To examine the case studies of deep learning techniques

Course Outcomes: On completion of the course, learner will be able to:

CO1: Classify machine learning algorithms and its types.

CO2: Discuss the concepts of deep learning and its Frameworks.

CO3: Identify the deep learning architectures with respect to the applications.

CO4: Demonstrate different architectures of Convolutional neural networks.

CO5: Discuss natural language processing architectures.

CO6: Make use of various case studies and deep learning applications.

Course Contents

Unit I	Machine Learning	6 Hrs.

Introduction to Machine Learning, Types of Machines Learning, Linear Regression, Classification and Logistic Regression, Decision Tree and Random Forest, Naïve Bayes and Support Vector Machine. Applications of machine learning

Mapping of Course Outcomes for Unit I	**CO1: Classify machine learning algorithms and its types.**

Unit II	Introduction to Deep Learning and Frameworks	6 Hrs.

Deep Learning Basics: Intro, History, capabilities, the perceptron, Multi Layer Perceptron, ANN architecture. Tensor Flow, Creating and Manipulating Tensor Flow Variables, Tensor Flow Operations, Placeholder Tensors, Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in Tensor Flow, Logging and Training the Logistic Regression, Introduction to Keras, PyTorch.

Mapping of Course Outcomes for Unit II	**CO2: Discuss the concepts of deep learning and its Frameworks.**

Unit III	Deep Learning Architecture	6 Hrs.
Width and Depth of Neural Networks, Different Activation Functions, Batch-normalization, Overfitting and generalization., Dropout, regularization Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications		
Mapping of Course Outcomes for Unit III	**CO3: Identify the deep learning architectures with respect to the applications.**	
Unit IV	**Computer Vision**	**6 Hrs.**
Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Convolution neural networks (CNNs), convolution, pooling and its variations, different deep CNN architectures - LeNet, AlexNet, VGG, PlacesNet, DenseNet, Training a CNNs: weights initialization, batch normalization, hyperparameter tuning . **Popular CNN Architectures:** ResNet, AlexNet – Applications.		
Mapping of Course Outcomes for Unit IV	**CO4: Demonstrate different architectures of Convolutional neural networks.**	
Unit V	**Natural Language Processing**	**6 Hrs.**
Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks. Advanced RNN: LSTM, GRU, introduction to Generative Adversarial Networks (GANs).		
Mapping of Course Outcomes for Unit V	**CO5: Discuss natural language processing architectures.**	
Unit VI	**Case Study and Applictions**	**6 Hrs.**
Computer Vision: Image Classification, Image net- Detection-Audio Wave Net. **Natural Language Processing:** Sentimental Analysis, Text preprocessing and chatBot		
Mapping of Course Outcomes for Unit VI	**CO6: Make use of various case studies and deep learning applications.**	
Learning Resources		

Text Books:

1. Nikhil Buduma, “Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms”, 1st Edition, O’REILLY.
2. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press.
3. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press.
4. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media.
5. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press.
6. Ethem Alpaydin,"Introduction to Machine Learning”, 3rd Edition, Prentice Hall of India.
7. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding”, Deep Neural Networks” Apress, 2018.

Reference Books:

1. Goodfellow. I., Bengio.Y., and Courville, A.,“Deep Learning”, MIT Press.
2. Bishop, C.M., “Pattern Recognition and Machine Learning”, Springer.
3. Satish Kumar, “Neural Networks: A Classroom Approach”, Tata McGraw-Hill Education.

MOOC / NPTEL Courses:

1. NPTEL Course on “**Deep Learning**”, by Prof. Prabir Kumar Bhiswas, IIT Kharagpur.

   Link of the Course: https://nptel.ac.in/courses/106105215

2. NPTEL Course on “**Deep Learning - Part I**”, by Prof. Sudarshan Iyengar, Prof Sanatan Sukhija IIT Ropar

   Link of the Course: https://nptel.ac.in/courses/106106184

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University
Fourth Year of E & Tc Engineering (2019 Course)
404187: Lab Practice – 2</td></tr>
<tr><td>Teaching Scheme:</td><td align="center">Credit</td><td>Examination Scheme:</td></tr>
<tr><td>Practical: 04 Hrs. / Week</td><td align="center">02</td><td>Term Work: 25 Marks
Practical: 50 Marks</td></tr>
<tr><td colspan="3">Companion Course, if any:
1. VLSI Design and Technology
2. Speech Processing (Elective - III)
3. PLC SCADA and Automation (Elective - III)
4. JAVA Script (Elective - III)
5. Embedded System and RTOS (Elective - III)
6. Modernized IoT (Elective - III)</td></tr>
<tr><td colspan="3">Guidelines for Student’s Lab Journal
The student’s Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.</td></tr>
<tr><td colspan="3">Guidelines for Lab /TW Assessment
The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.</td></tr>
</table>

Subject: PLC SCADA and Automation (Elective - III)	
Part A (Any 5 to be performed)	
1.	Implementation of Logic Gates Using PLC(Software/Hardware Implementation).
2.	Development of a ladder program for DOL Starter.
3.	Implementation of Boolean Expression using PLC(Software/Hardware Implementation).
4.	Traffic Light Control using PLC (Any Application of Timer using PLC will be accepted) (Software/Hardware Implementation).
5.	Counting Objects (Any Application of Counter using PLC will be accepted) (Software/Hardware Implementation).
6.	Interfacing of Encoder with PLC to control a particular application.
7.	Interfacing of Limit Switch/ Proximity Switch/or any sensor/sensors with PLC to control a particular application.
Part B (Any 2 to be performed)	
1.	Interfacing of RTD with PLC for Temperature control application.
2.	Motor speed control using PLC and VFD.
3.	Pneumatic Trainer Kit/Hydraulic Trainer Kit control using PLC.
4.	Close Loop control using PID Controller (Any One Parameter Like Temperature, Flow, Pressure, Level)
Part C (Any 1 to be performed)	
1.	Any Example Using SCADA.
2.	Study of Hardware and Software Platform for DCS **https://ial-coep.vlabs.ac.in/exp/software-platforms-dcs/procedure.html**
3.	PLC controlled Case study- 1: **[Faculty will give (or students will choose) one problem statement to a group of 2/3 students. Students will develop a program and simulate it on their own]** **Suggested case studies (Not Limited to)** **a. Bottle Filling Plant using PLC** **b. Operation of Lift (Elevator) using PLC** **c. PLC based Gas Detection System using Ladder Logic Project** **d. Alarm Management Systems using PLC** **e. Water Distribution System using PLC**

Virtual Lab:

1. **http://plc-coep.vlabs.ac.in/ (Programmable Logic Controller Lab.)**
2. **http://ial-coep.vlabs.ac.in/List%20of%20experiments.html (Industrial Automation Lab.)**

<table>
<tr><th colspan="2">Subject: JAVA Script (Elective - III)</th></tr>
<tr><th colspan="2">Part A (Compulsory)</th></tr>
<tr><td>1.</td><td>Write a JavaScript program to calculate area of triangle, area of rectangle and area of circle</td></tr>
<tr><td>2.</td><td>Write a JavaScript program to generate the multiplication table of a given number.</td></tr>
<tr><td>3.</td><td>Write a JavaScript program to following operations on a given string,
• Reverse string
• Replace characters of a string.
• String is Palindrome.</td></tr>
<tr><td>4.</td><td>Write a JavaScript program to compare two strings using various methods.</td></tr>
<tr><td>5.</td><td>Write a JavaScript program that will create a countdown timer.</td></tr>
<tr><th colspan="2">Part B (Any 2 to be performed)</th></tr>
<tr><td>1.</td><td>Write a JavaScript program that will create an array and perform following operations
• To remove specific element from the array.
• Check if an array contains a specified value.
• To empty an array</td></tr>
<tr><td>2.</td><td>Write a JavaScript program that will append an object to an array and will check if an object is an array.</td></tr>
<tr><td>3.</td><td>Write a JavaScript program to illustrate different Set operations like-
• Union
• Intersection
• Difference
• Set Difference</td></tr>
<tr><th colspan="2">Part C (Any 2 to be performed)</th></tr>
<tr><td>1.</td><td>Write a JavaScript program to create a Home page of any website and change background color using
• On mouse over event
• On focus event</td></tr>
<tr><td>2.</td><td>Create a student information Form to accept information like Name, Address, City, State Gender, Mobile Number, and email id. Perform validations for:
• Correct Names
• Mobile Names
• Email I.D.'s
• If no entered value
• Re-display for wrongly entered values with message
• Congratulation and Welcome page upon successful entries</td></tr>
<tr><td>3.</td><td>Design and implement a simple calculator using Java script for operations like addition multiplication, subtraction, division, square of a number etc:
• Design a calculator like text field for input and output, buttons for numbers and operations etc.
• Validate input values
• Prompt / Alerts for invalid values etc.</td></tr>
<tr><td colspan="2">Virtual Lab:

1. https://cse02-iiith.vlabs.ac.in/List%20of%20experiments.html (Computer Programming Lab.)</td></tr>
</table>

Subject: Modernized IoT (Elective – III)	
List of Experiments	
1.	Study of Raspberry-Pi, Beagle board, Arduino, and different operating systems for Raspberry-Pi/Beagle board/Arduino. Understanding the process of OS installation on Raspberry-Pi/Beagle board/Arduino
2.	Open-source prototype platform- Raspberry-Pi/Beagle board/Arduino -Simple program digital read/write using LED and Switch -Analog read/write using sensor and actuators.
3.	Interfacing sensors and actuators with Arduino/Raspberry-pi.
4.	IoT based Stepper Motor/DC Motor Control with Arduino/Raspberry Pi.
5.	Introduction to MQTT/ CoAP and sending sensor data to cloud using Raspberry-Pi/Beagle board/Arduino.
6.	Get the status of a bulb at a remote place (on the LAN) through web.
7.	Interfacing Arduino to Bluetooth Module
8.	Communicate between Arduino and Raspberry PI using any wireless medium like ZigBee
9.	IoT based small project implementation on the topics based on small problem statements of the fields like chat bot, smart home (Home Automation), social issues and environmental issues etc. This project can be built on any IoT simulation platform like Tinkercad, Cooja etc.

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404189: Mandatory Audit Course - 7		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.

- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

SEMESTER - VIII

Savitribai Phule Pune University **Fourth Year of E & Tc Engineering (2019 Course)** **404191 (E): Mobile Computing (Elective - V)**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 Hrs. / Week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:
1. Basics of Communication Technologies.
2. Fundamental of Networking

Companion Course, if any:

Course Objectives:
1. To learn Wireless technologies and planning Ad-hoc Network.
2. To study the basics of wireless, cellular technology and the working of Mobile IP, ad hoc network, features of mobile operating systems.
3. To understand the use of M-Commerce application.

Course Outcomes: On completion of the course, learner will be able to -
CO1: Understand concepts of Mobile Communication.
CO2: Analyse next generation Mobile Communication System.
CO3: Understand network layers of Mobile Communication.
CO4: Understand IP and Transport layers of Mobile Communication.
CO5: Study of different mathematical models.
CO6: Understand different mobile applications.

Course Contents

Unit I	**Introduction to Mobile Computing**	**6 Hrs.**

Introduction to Mobile Computing: Applications of Mobile Computing- Generations of Mobile Communication Technologies, Multiplexing: Spread spectrum, MAC Protocols: SDMA, TDMA, FDMA, and CDMA.

Mapping of Course Outcomes for Unit I	**CO1: Understand concepts of Mobile Communication.**

Unit II	**Mobile Telecommunication System**	**7 Hrs.**

Introduction to Cellular Systems, GSM architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS and UMTS: Architecture, Handover, Security.

Introduction to 5G: Introduction, 5G network architecture, Applications, 5G enable technologies, Recent trends in Telecommunication Industries.

Mapping of Course Outcomes for Unit II	**CO2: Analyse next generation Mobile Communication System.**

Unit III	Network Layer	6 Hrs.
Mobile IP, DHCP, AdHoc, Proactive protocol-DSDV, Reactive Routing Protocols: DSR, AODV, Hybrid routing: ZRP, Multicast Routing: ODMRP, Vehicular Ad Hoc networks (VANET), MANET Vs VANET: Security.		
Mapping of Course Outcomes for Unit III	**CO3: Understand network layers of Mobile Communication.**	
Unit IV	**Mobile IP and Transport Layer**	**8 Hrs.**
Mobile IP: Need of mobile IP, IP packet delivery, Agent Discovery, Registration, Tunnelling and encapsulation, Route optimization, IP Handoff. **Transport Layer:** Overview of Traditional TCP and implications of mobility control. Improvement of TCP: Indirect TCP, Snoop TCP, Mobile TCP, Fast Retransmit/fast recovery, Time-out freezing, Selective retransmission, Transaction-oriented TCP.		
Mapping of Course Outcomes for Unit IV	**CO4: Understand IP and TCP layers of Mobile Communication.**	
Unit V	**Fading Channels**	**7 Hrs.**
Rayleigh Fading and Statistical Characterization, Properties of Rayleigh Distribution, BER in Fading, Narrowband vs Wideband Channels, Characterization of Multipath Fading Channels, Choice of Modulation, Coherent versus Differential Detection, BER in Fading , Ricean Fading.		
Mapping of Course Outcomes for Unit V	**CO5: Study of different mathematical models.**	
Unit VI	**Operating System & Applications of Mobile Computing**	**8 Hrs.**
Operating System: A Few Basic Concepts, Special Constraints and Requirements of Mobile OS, A Survey of Commercial Mobile Operating Systems, Windows Mobile, Palm OS, Symbian OS, iOS, Android, Blackberry OS, A Comparative study of Mobile OS, OS for sensor Network. **Applications:** M-Commerce, Business to Consumer (B2C) Applications, Business to Business (B2B) Applications. Structure of M-Commerce, Pros and Cons of M-Commerce, Mobile Payment System, Mobile Payment Schemes, Desirable properties of a Mobile Payment system, Mobile Payment solutions, Process of Mobile Payment, Security Issues.		
Mapping of Course Outcomes for Unit VI	**CO6:** Understand different mobile applications.	
Learning Resources		
Text Books: 1. Clint Smith, Daniel Collins, “Wireless Networks”, 3rd Edition, McGraw Hill Publications, 2. Share Conder, Lauren Darcey, “Android Wireless Application Development”, Volume I, 3rd Edition, Pearson.		

Reference Books:

1. Jochen Schiller, “Mobile Communications”, 2nd Edition, Pearson.
2. Paul Bedell, “Cellular networks: Design and Operation – A real world Perspective”, Outskirts Press.
3. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, “Programming Android”, O”Reilly.
4. Alasdair Allan, “iPhone Programming”, O”Reilly.
5. Donny Wals, “Mastering iOS 12 Programming”.
6. Reza B”Far, “Mobile Computing principles”, Cambridge University Press.

MOOC / NPTEL Courses:

1. NPTEL Course **“**Mobile Computing**”b**y Prof. Sridhar Iyer and Prof. Pushpendra Singh IIT Madras

   Link of the Course: https://nptel.ac.in/courses/106106147

2. NPTEL Course **“Funadamentals of MIMO Wireless Communication”** by Prof. Suvra Sekhar Das IIT Kharagpur

   Link of the Course: https://nptel.ac.in/courses/117105132

3. NPTEL Course **“Principles of Modern CDMA/MIMO//OFDM Wireless Communications”** by Prof. Aditya. K. Jagannatham IIT Kanpur

   Link of the Course: https:// nptel.ac.in/courses/117104115

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404192 (D): Digital Marketing (Elective - VI)

Examination Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	**03**	**In-Sem: 30 Marks** **End Sem: 70 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

1. Digital Business Management

Course Objectives:

1. To understand digital marketing & process of website design.
2. To identify the keywords for a website & understand the SEO.
3. To study the various Digital Marketing Tools.
4. To learn the use of social media websites for Digital Marketing.
5. To be conversant with Linked In platform.
6. To know the recent trends in Digital Marketing.

Course Outcomes: On completion of the course, learner will be able to

CO1: Design websites using free tools like Wordpress and explore it for digital marketing.
CO2: Apply various keywords for a website & to perform SEO.
CO3: Understand the various SEM Tools and implement the Digital Marketing Tools.
CO4: Illustrate the use of Facebook, Instagram and Youtube for Digital Marketing in real life.
CO5: Use Linked in platform for various campaigning.
CO6: Understand the importance of recent trends in digital marketing.

Course Contents

Unit I	Digital Marketing Planning and Structure	7 Hrs.

Importance of Digital Marketing, Digital Marketing Vs. Traditional Marketing, Inbound vs Outbound Marketing, Understanding Demographics. WWW, Buying a Domain, Core Objective of Website and Flow, One Page Website, Strategic Design of Products & Services Page, Strategic Design of Landing Page, Segmentation & Targeting and Positioning to Digital Marketing, Portfolio, Gallery and Contact Us Page, Google Analytics Tracking Code, Designing Wordpress Website. Mobile Friendly Website, Payment Gateway like UPI, e-Commerce

Mapping of Course Outcomes for Unit I	**CO1: Design websites using free tools like Wordpress and explore it for digital marketing.**

Unit II	Search Engine Optimization (SEO)	7 Hrs.

Fundamentals; Keywords and SEO Content Plan; SEO & Business Objectives; Writing SEO Content; On-site & off-site SEO; Optimize Organic Search Ranking, Website SEO Auditing, Web Analytics: Data and Traffic Analysis. Study and analyze the Competitor's Website and their traffic sources.

Mapping of Course Outcomes for Unit II	**CO2: Apply various keywords for a website & to perform SEO.**

Unit III	Search Engine Marketing	7 Hrs.
Importance of Adwords, Google Ad Types, PPC Cost Formula, Ad Page Rank, Billing and Payments, Adwords User Interface, Keyword Planner, Creating Ad Campaigns, Creating Text Ads, Creating Ad Groups, Search Engine Marketing (SEM) Tools, Bidding Strategy for CPC, Case Studies. Conversion Tracking Code, Designing Image Ads, Creating Video Ads, Youtube Video Promotion, Hi-Jack Competitor's Video Audience, Case Studies. Remarketing Strategies, Remarketing Tracking Code, Website or Blog Linking Google Analytics, Designing Remarketing Images, Shared Budget, Mobile Advertising.		
Mapping of Course Outcomes for Unit III	**CO3: Understand the various SEM Tools and implement the Digital Marketing Tools.**	
Unit IV	**Social Media Marketing (SMM) Part 1**	**8 Hrs.**
B to C Perspective, B to B Perspective: Introduction; Major Social Media Platforms for Marketing; Developing Data-driven Audience & Campaign Insights; Social Media for Business; Facebook & Instagram Marketing: Understanding of Facebook Marketing, Types of Facebook Advertising, Creating first ad on Facebook, Setting Campaign and optimization, Facebook Power Editor, Facebook Video Marketing, Facebook App & Shopping Marketing Youtube Marketing: YouTube Account Setup (Create a business account with a personal account), YouTube Monetization, YouTube Ads, YouTube Analytics.		
Mapping of Course Outcomes for Unit IV	**CO4: Illustrate the use of Facebook, Instagram and Youtube for Digital Marketing in real life.**	
Unit V	**Social Media Marketing (SMM) Part 2**	**8 Hrs.**
LinkedIn Advertising: How to use Linkedin Professionally, Types of LinkedIn Advertising, LinkedIn New feed Advertising, LinkedIn Message Pitching, Traffic and Leads Generation, Billing and Report. **Email Marketing:** Email Software and Tools, Importing Email Lists, Planning Email Campaign, Email Templates and Designs, Sending HTML Email Campaigns, Web Forms Lead Importing, Integrating Landing Page Forms, Campaign Reports and Insights, Segmentation Strategy, Responder Tracker		
Mapping of Course Outcomes for Unit V	**CO5: Use Linked in platform for various campaigning.**	
Unit VI	**Upcoming Trends in Digital Marketing**	**6 Hrs.**
Podcast, OTT Platforms, Mob-Ad, No Click Searches, Google Verified Listing, Voice Search, Visual Search, Online Reviews, Automated and Smart Bidding, Chatbots, Affiliate Marketing		
Mapping of Course Outcomes for Unit VI	**CO6: Understand the importance of recent trends in digital marketing.**	

Learning Resources

Text Books:

1. Cory Rabazinsky, “Google-Ad words for Beginners: A Do-It-Yourself Guide to PPC Advertising”
2. Ian Brodie, “Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing”
3. Jan Zimmerman and Deborah, “Social Media Marketing All-In-One for Dummies”
4. Dave Chaffey, Fiona Ellis-Chadwick, Kevin Johnston, Richard Mayer, “Internet Marketing”, Pearson Education.
5. Oliver J Rich, “Digital Marketing”
6. Gerry T. Warner and Joe Wilson Schaefer “Online Marketing”

Reference Books:

1. Prof. Seema Gupta, “Digital Marketing”, Mcgraw Hill Publications.
2. Judy Strauss, Adel Ansary, Raymond Frost, Prentice Hall, “E- Marketing”
3. Dr. Andy Williams ,“WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress”
4. Cecilia Figueroa, “Introduction To Digital Marketing 101”, BPB Publications.

MOOCs / NPTEL:

1. Digital Tools Certification- By Google
   Link of the Course: https://skillshop.exceedlms.com/student/catalog

2. Swayam Certification course on, “**Digital Marketing**”, by Dr. Tejindarpal Singh Panjab University Chandigarh
   Link of the Course: https://swayam.gov.in/nd2_ugc19_hs26/preview

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404196: Lab Practice – 3		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / Week	**01**	**Term Work: 25 Marks** **Practical: 50 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

1. Biomedical Signal Processing (Elective - V)
2. Industrial Drives and Control (Elective - V)
3. Android Development (Elective - V)
4. Embedded System Design (Elective - V)
5. Mobile Computing (Elective - V)

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

Subject: Mobile Computing (Elective - V)

List of Experiments (Any 8 to be performed)

1.	Simulate to elaborate operation of multiple access techniques for CDMA.
2.	Study of GSM architecture and signaling techniques.
3.	Study of GPRS services.
4.	Simulate BER performance over Rayleigh Fading wireless channel with BPSK transmission for SNR 0 to 60 dB.
5.	Configuring a Cisco Router as a DHCP Server.
6.	To understand the handover mechanism. http://vlabs.iitkgp.ernet.in/fcmc/exp8/index.html
7.	To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC (Flat Fading). http://vlabs.iitkgp.ernet.in/fcmc/exp9/index.html
8.	To Perform File Transfer in Client & Server Using TCP/IP.
9.	Case Study on different real time mobile computing services.

Virtual LAB Links:

1. **http://vlabs.iitkgp.ernet.in/fcmc/** **(Fading Channels and Mobile Communication Lab.)**

FACULTY OF ENGINEERING

Savitribai Phule Pune University

Syllabus for the

M.E (Electronics & Telecommunications Engineering – VLSI and Embedded Systems)

(2017 Course)

(w.e.f. June 2017)

M.E. (Electronics and Telecommunications-
VLSI and Embedded Systems)

2017 Pattern
Syllabus Structure

First Year – Semester I

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	504201	Digital CMOS Design	4	50	50	-	-	100	4
2	504202	Reconfigurable Computing	4	50	50	-	-	100	4
3	504203	Embedded System Design	4	50	50	-	-	100	4
4	504204	Research Methodology	4	50	50	-	-	100	4
5	504205	Elective I	5	50	50	-	-	100	5
6	504206	Lab. Practice I	4	-	-	50	50	100	4
		Total	**25**	**250**	**250**	**50**	**50**	**600**	**25**

Elective I:
1. Micro Electromechanical Systems
2. Nano Technology
3. Processor Design
4. Wireless Sensor Networks
5. MOS Device Modeling and Characterization

First Year – Semester II

Sr.No.	Subject Code	Subject	Examination Scheme					Total	Credits
				Paper					
			L/P	ISA	ESA	TW	OR		
1	504207	Analog CMOS Design	4	50	50	-	-	100	4
2	504208	System on Chip	4	50	50	-	-	100	4
3	504209	Embedded Automotive Systems	4	50	50	-	-	100	4
4	504210	Elective II	5	50	50	-	-	100	5
5	504211	Lab. Practice II	4	--	---	50	50	100	4
6	504212	Seminar I	4	-	-	50	50	100	4
		Total	**25**	**200**	**200**	**100**	**100**	**600**	**25**

Elective II :

1. Embedded Product Design
2. High Speed ICs
3. Mixed Signal IC Design
4. Embedded Signal Processor Architectures
5. Real Time Operating Systems

Second Year – Semester I

Sr.No.	Subject Code	Subject	Examination Scheme						Credits
				Paper				Total	
			L/P	ISA	ESA	TW	OR		
1	604201	Testing and Verification ofVLSI Circuits	4	50	50	-	-	100	4
2	604202	ASIC Design	4	50	50	-	-	100	4
3	604203	Elective III	5	50	50	-	-	100	5
4	604204	Seminar II	4	--	----	50	50	100	4
5	604205	Project Stage I	8	--	---	50	50	100	8
		Total	**25**	**150**	**150**	**100**	**100**	**500**	**25**

Elective III:

Elective III Topics for 3 Credits

1 Value Education, Human Rights and Legislative Procedures
2 Environmental Studies
3 Renewable Energy Studies
4 Disaster Management
5 Foreign language
6 Knowledge Management
7 Economics for Engineers
8 Engineering Risk – Benefit Analysis

Elective III Topics for 2 Credits

1 Optimization Techniques
2 Fuzzy Mathematics
3 Design and Analysis of Algorithms
4 CUDA

504205 **Micro Electromechanical Systems (Elective I)**

Credits: 5

Teaching Scheme: **Examination Scheme:**

Lecture : 4 Hrs/week

In-Sem : 50 Marks
End-Sem : 50 Marks

Course Objectives:

1. To introduceprinciples of MEMS devices and micro-fabrication technology
2. To study various MEMS Sensors, Actuators and Filters
3. To learn practical applications of MEMS

Course Outcomes:

On completion of the course, student will be able to-

1. Understand concepts of MEMS and material science
2. Gain knowledge of design and testing of MEMS devices
3. Develop different MEMS based systems

Course Contents

Module I : (10 Hrs)

Micro fabrication: Micro fabrication introduction and overview: Material for fabrication, Fabrication equipment, Growth technology, Silicon-based process. Fabrication technology: Pattern transfer technology, Lithography– photolithography, Resist technology, Micromachining – wet etch and dry etch Materials processing technology: Material deposition methods, Basic ion implantation and diffusion doping process, Low and high temperature process, Device packaging methods Characterization technology for micro fabrication process, Design criteria and fabrication method for micro device applications, Micro fabrication process integration.

Module II : (10 Hrs)

Introduction to MEMS: Magnetic Sensors, Piezoresistive MEMS , Pressure Sensors, Thick-film and Piezo MEMS, MEMS Actuators, MEMS resonant sensors, Measurement systems, Physical sensors, Modeling the dynamics of sensor systems, Intelligent sensors, Thermal sensors, Charge amplifiers. Microfluidics : Principles of miniaturization, scaling laws, Theory of Microfluidics and Nano fluidics , The diffusion of molecules and micro scale mixing, Technological production of components: mixers and pumps.

Module III (10 Hrs)

MEMS Sensors and Actuators: Sensing and Actuation: Introduction, Piezoresistive and Capacitive sensing. Electrostatic actuation, Pressure sensors, Accelerometers, Gyroscopes. Interfacing with Sensors and Actuators: Bridge circuits, Amplifiers, Filtering and signal conditioning. RF MEMS: Tunable capacitors, Inductors on chip, Resonators, Mechanical filters, MEMS for mobile phones On-a-chip.

Module IV : (10Hrs)

Practical Applications of MEMS:Applications of Sensors in Industry, Sensor Performance, Sensor Packaging, 3D printing/rapid prototyping, Design of sensor and packaging, Simulation of physical process, Simulation of electrical interface and behavior, Construction of package, Construction of sensor, Testing, Technical reporting of results.

References :

1. Beeby S P, Ensell Graham, Michael Kraft and Neil White, “MEMS Mechanical Sensors”Artech House Publications, ISBN-10: 1580535364 /ISBN-13: 978-1580535366.
2. Kovacs, “Micro machined Transducers Sourcebook”, McGraw-Hill Publications, ISBN-10: 0072907223/ISBN-13:978-0072907223.
3. Gardner W, Varadan V K &Awadelkarim O O,“ Microsensors, MEMS and Smart Devices: Technology, Applications and Devices”, Julian Publications, ISBN-10: 047186109X/ISBN-13: 978-0471861096.
4. Kaajakari Ville,” Practical MEMS: Analysis and Design of Microsystems”, ISBN-10: 9780982299104, ISBN-13: 978-0982299104.
5. MalufNadim,WilliamsKirt, “ An Introduction to Microelectromechanical Systems Engineering”, John Willy & sons Ltd.ISBN-10: 1580535909/ ISBN-13: 978-1580535908.
6. Mohamed Gad-el-Hak,” The MEMS Handbook”, Second Edition , 3 Volume Set.
7. Stephen D. Senturia,” Microsystem Design”, Second edition.

Laboratory Assignments/Experiments:

1 To simulate the behavior of sensors and actuators for understanding micro motions.
2 To simulate gears to understand principle concepts of gear motion.
3 To explain Hooke’s law in understanding spring force using actuator and spring.
4 To explain ohm law by putting actuators in series and parallel.

504205 **NANOTECHNOLOGY (Elective I)**

Credits: 5

Teaching Scheme:	**Examination Scheme:**
Lecture : 4 Hrs/week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Course Objectives:

1. To get familiar with fundamental science behind Nano technology and systems
2. To acquire basic understanding of material science for designing NEMS based systems
3. To understand the principle of biomaterial and their applications to Bio-medical systems

Course Outcomes:

On completion of the course, student will be able to-

1. Choose suitable material based on the properties for Nanotechnology
2. Learn techniques ofnano-structures and fabrication
3. Gain knowledge of designing and developing NEMS based systems

Course Contents

Module I : (10 Hrs)

The fundamental science behind nanotechnology, bio systems, molecular recognition, quantum mechanics & quantum ideas, optics. Smart materials & Sensors, self-healing structures, heterogeneous nano-structures & composites, encapsulations, natural nano-scale sensors, electromagnetic sensors, biosensors, electronic noses.

Module II : (10Hrs)

Nanostructures, Micro/Nano-devices, nano-materials Synthesis and Applications, Molecule-Based Devices.- Introduction to Carbon nano-tubes.- nano-wires.- Introduction to Micro/Nanofabrication.- Stamping Techniques. Methods and Applications.

Module III : (10Hrs)

Materials Aspects of Micro- and Nanoelectromechanical Systems,- MEMS/NEMS , Devices and Applications. Nanostructure devices –Resonant tunneling diodes, Field-effect transistors, Single-electrode transfer devices. Scanning Probe Microscopy, Noncontact Atomic Force Microscopy.

Module IV (10Hrs)

Low Temperature Scanning Probe Microscopy, Dynamic ForceMicroscopy.-. Nanolithography, Lithography using photons, electron beams soft lithography. Bio-medical applications.

References :

1. Springer Handbook of Nanotechnology
2. Rattner Mark , Rattner Daniel, “Nanotechnology: A Gentle Introduction to the Next Big Idea”
3. KulkarniSulbha K, “ Nanotechnology :Principals & Practices”, Capital Publications
4. VlaimirMitin, “ Introduction to nanoelectronics science, Nanotechnology, Engineering and Applications”, Cambridge University Press

Laboratory Assignments/Experiments:

1. Introduction of analysis and characterization of Nano structured materials, coating and thin film sensors.
2. Surface tension measurement of Nano fluids.
3. To observe size and slope of the Nano sized sample using scanning electron microscopy.
4. Design, simulation and analysis of Nano structures.

504205 **Processor Design (Elective I)**

Credits: 5

Teaching Scheme:	**Examination Scheme:**	
Lecture : 4 Hrs/week	**In-Sem**	**: 50 Marks**
	End-Sem	**: 50 Marks**

Course Objectives:

1. To learn architecture fundamentals of processor design
2. To understand memory management of CISC and RISC processors
3. To gain knowledge of architecture and design issues in DSP
4. To update the information with respect to run time re-configurable processors

Course Outcomes:

On completion of the course, student will be able to-

1. Visualize probable Problems, fallacies and Pitfalls in Processor Design
2. Understand Extreme CISC and RISC, Very Long Instruction Word (VLIW), overly aggressive pipelining, unbalanced processor
3. Gain skills to implement Processor functional components like MAC

Course Contents

Module I : (10 Hrs)

Embedded Computer Architecture Fundamentals: Components of an embedded computer, Architectureorganization, ways of parallelism, I/O operations and peripherals. Problems, Fallacies, and Pitfalls in Processor Design for a high level computer instruction set architecture to support a specific language or language domain, use of intermediate ISAs to allow a simple machine to emulate it's betters, stack machines ,overly aggressive pipelining,unbalanced processor design, Omitting pipeline interlocks, Non-power-of-2 data-word widths for general-purpose computing.

Module II : (10 Hrs)

Memory:Organization, Memory segmentation, Multithreading, Symmetric multiprocessing. Processor Design Flow: Capturing requirements, Instruction coding, Exploration of architectureorganizations, hardware and software development. Extreme CISC and extreme RISC,Very long instruction word (VLIW).

Module III : (10 Hrs)

Digital Signal Processor: Digital signal processor and its design issues, evolving architecture of DSP, nextgeneration DSP. Customizable processors: Customizable processors and processor customization, A benefit analysis ofprocessor customization, use of microprocessor cores in SOC design, benefits of microprocessor extensibility.

Module IV : (10 Hrs)

Run time Re-configurable Processors:Run time Re-configurable Processors,Embedded micro-processortrends, instruction set metamorphosis, reconfigurable computing, run-time reconfigurable instruction set processors,coarse grain reconfigurable processors. Processor Clock Generation and Distribution: Clock parameters and trends, Clock distributionnetworks, de-skew circuits, jitter reduction techniques, low power clock distribution. Asynchronous Processor Design: Asynchronous and self-timed processor design, need of asynchronousdesign, development of asynchronous processors, asynchronous design styles, features of asynchronous design.

References :

1 NurmiJari, “Processor Design-System on Chip Computing for ASIC‟s and FPGA”, Springer Publications.
2 Frantz G, “The DSP and Its Impact on the Technology”.
3 Leibson S, Tensilica, “Customizable Processors and Processor Customization”.
4 Campi F, “Run-Time Reconfigurable Processors”.
5 Garside J, Furber S, “Asynchronous and Self-Timed Processor Design”.
6 Rusu S, “Processor Clock Generation and Distribution”.
7 Dehon Andre, “Reconfigurable Architecture for General purpose Computing”.

Laboratory Assignments/Experiments:

1. Design and implement MAC Unit on PLD
2. Design and implement CPU on PLD
3. Design and implement Carry look-ahead generator on PLD
4. Design and implementation of Translation look-aside buffer.

504205 **Wireless Sensor Network (Elective I)**

Credits: 5

Teaching Scheme: **Examination Scheme:**

Lecture : 4 Hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Objectives:

1. To understand basic WSN Technology and its supporting Protocols
2. To learn routing protocols and their design issues inWSN
3. To understand sensor- management, sensor- network middle ware and operating systems
4. To understand WSN layers' issues and their protocols

Course Outcomes:

On completion of the course, student will be able to-

1 Gain knowledge of Architecture of WSN network
2 Understand Physical, Data link and Network layer aspects with their protocols
3 Learn different techniques of power management and security
4 Exhibit the knowledge of operating systems in WSN systems

Course Contents

Module I : (10Hrs)

Introduction: Motivation for a Network of Wireless Sensor Nodes, Sensing and Sensors Wireless Networks, Challenges and Constraints. Applicationsto :Health care, Agriculture, Traffic and others.

Module II : (10 Hrs)

Architectures: Node Architecture; the sensing subsystem, processor subsystem, communication interface, LMote, XYZ, Hogthrob node architectures. Power Management - Through local power, processor, communication subsystems and other means, time Synchronization need, challenges and solutions overview for ranging techniques. Security Fundamentals, challenges and attacks of Network Security, protocol mechanisms for security.

Module III : (10 Hrs)

Operating Systems -Functional and nonfunctional Aspects, short overview of prototypes–Tiny OS, SOS, Contiki, LiteOS, Sensor grid.

Module IV : (10 Hrs)

Physical Layer- Basic Components, Source Encoding, Channel Encoding, Modulation, Signal Propagation. Medium Access Control –types, protocols, standards and characteristics, challenges Network Layer -Routing Metrics, different routing techniques.

References :

1. Dargie W. , Poellabauer C., "Fundamentals of wireless sensor networks: theory and practice", John Wiley and Sons
2. Sohraby K., Minol, D., Znati T., "Wireless sensor networks: technology, protocols, and applications", John Wiley and Sons
3. Hart J. K.,Martinez K., "Environmental Sensor Networks: A revolution in the earth system science", Earth-Science Reviews.
4. Feng Zhao, Leonidas J.Guibas,"Wireless Sensor Networks: An Information Processing Approach".

Laboratory Assignments/Experiments:

1. Reading data from Sensor node.
2. Implement 50 stationary nodes topology using NS2 for data transmission and record QoS parameters of the Networks/ Test bed.
3. Implement 50 dynamic nodes topology using NS2 for data transmission and record QoS parameters of the Networks /Test bed.
4. On any above topology change the Network layer/Transport layer/MAC layer protocol and monitor the changes between any two protocols/ test bed using Network Simulator.

504205 MOS Device Modeling and Characterization (Elective I)

Credits: 5

Teaching Scheme:	**Examination Scheme:**
Lecture : 4 Hrs/week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Course Objectives:

1. To provide detail understanding of MOS devices' structures and operations
2. To understand the effect of various materials on the characteristics of MOSFET
3. To acquaint the students with SPICE tool for modeling of transistor behavior
4. To provide a brief knowledge of Advanced MOSFET models

Course Outcomes:

On completion of the course, student will be able to-

1 Analyze MOSFET models
2 Learn MOSFET characterization using SPICE simulation
3 Gain information about advanced MOSFET models
4 Understand non-classical MOS structures

Course Contents

Module I : (10 Hrs)

A qualitative Description of MOS Transistor operation, contact potentials, two terminal MOS structure: Flat band voltage, Potential balance and charge balance, Effect of Gate-Substrate voltage on Surface Condition, Inversion, Small signal capacitance.

Module II : (10 Hrs)

Short channel MOSFET, Small Dimension Effects, Channel length Modulation, Barrier lowing two dimensional charge sharing and threshold voltage, Punch through, Carrier velocity Saturation, Hot carrier Effects, Scaling, Effects due to thin oxides and high doping, mobility degradation.

Module III : (10 Hrs)

Modeling of Transistor using SPICE: Basic concepts, The level 1 Equations, The Level 2 Equations, The Level 3 Equations, Comparison of SPICE Models, Capacitance Models, Basic MOSFET models, Comparison of MOSFET Models.

Module IV : (10Hrs)

Advanced MOSFET models for circuit simulators, Surface potential models, inversion charge based models, Compact MOSFET models, threshold voltage based model models, advanced MOSFET structures such as FINFET.

References :

1. YannisTsividis, "Operation and modeling of the MOS transistor", Oxford University Press.
2. Kang S. M , "CMOS Digital Integrated Circuits", Tata Mc-Graw Hill.
3. Carlos Galup&Montoro, "MOSFET Modeling for Circuit Analysis and Design", World Scientific.
4. Donald Neamen, "Semiconductors Physics and Devices", Tata Mc-Graw Hill.
5. Sze S. M, "Physics of Semiconductor Devices, Second Edition, Wiley Publications.

Laboratory Assignments/Experiments:

1. Characterize n-MOSFET with the given model parameters, from the parameters students will reproduce I-V characteristics. Replace the model with any other SPICE model. Compare both the I-V characteristics.
2. Characterize p-MOSFET with the given model parameters, from the parameters students will reproduce I-V characteristics. Replace the model with any other SPICE model. Compare both the device I-V characteristics.
3. Characterize n-MOSFET and p-MOSFET to find out low frequency C-V characteristics behavior with the given model parameters.
4. Characterize n-MOSFET and p-MOSFET to find out high frequency C-V characteristics behavior with the given model parameters.
5. Characterize $gm/I_D$of the MOS devices

504210 **Embedded Product Design (Elective II)**

Credits: 5

Teaching Scheme: **Examination Scheme:**

Lecture : 4 Hrs/week **In-Sem : 50 Marks**

End-Sem : 50 Marks

Course Objectives:

1. To understand design challenges of embedded hardware and software
2. To gain knowledge of testing and verification issues in design cycle
3. To introduce h/w and s/w design models with different technology
4. To learn the importance of documentation for technology transfer

Course Outcomes:

On completion of the course, student will be able to-

1. Learn specifications and design challenges of embedded products
2. Estimate cost of embedded product
3. Understand the aspects of Mechanical Packaging, Testing, reliability and failure analysis, EMI/RFI Certification and Documentation
4. Demonstrate the knowledge of embedded product design related hardware and software design tools

Course Contents

Module I : (10Hrs)

Overview of Embedded Products: Need, Design challenges, product survey, specifications ofproduct need of hardware and software, Partitioning of the design into its software and hardwarecomponents, Iteration and refinement of the partitioning.

Module II : (10Hrs)

Deign Models and Techniques: various models of development of hardware and software, theirfeatures, different Processor technology, IC technology, Design Technology.

Module III : (10Hrs)

Modules of Hardware and Software:Tradeoffs, Custom Single-purpose processors, General-purposeprocessors, Software, Memory, Interfacing, Design technology-Hardware design, FPGA design,firmware design, driver development, RTOS porting, cost reduction, re-engineering, optimization, maintenance, validation and development, prototyping, turnkey product design.

Module IV : (10Hrs)

Testing and verification: Embedded products-areas of technology, Design and verification,Integration of the hardware and software components, testing- different tools, their selectioncriterion. Certification and documentation: Mechanical Packaging, Testing, reliability and failureanalysis, communication protocols, Certification (EMI/ RFI) and its documentation. Study of any two real life embedded products in detail.

References :

1 VahidFrankand Tony Givargis , “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley Publication.

2 Marwedel P, “Embedded System Design”, Springer Publication.

Laboratory Assignments/Experiments:

1. To estimate techno-commercial feasibility of any one embedded product such as mobile phone, programmable calculator, tablet PC, biometrics system, set top box etc.
2. To study design considerations of any one embedded product e.g. laptop, video conferencing system, surveillance/ security system, EMG/ECG machine etc.
3. To design any one embedded product to solve any real life problems.
4. To test the hardware designed for above assignment (3) using suitable simulation tool.
5. To simulate the software designed for the above assignment (3) using suitable simulation tool.

504210 **High Speed ICs (Elective II)**

Credits: 5

Teaching Scheme:	**Examination Scheme:**	
Lecture :4 Hrs/week	**In-Sem**	**: 50 Marks**
	End-Sem	**: 50 Marks**

Course Objectives:

1. To understand basic design aspects of high frequency circuits
2. To explain different characteristics of high speed logic families
3. To learn design issues of interconnects in High Speed Circuit Design

Course Outcomes:

On completion of the course, student will be able to –

1. Acquire knowledge about High Speed VLSI Circuits Design
2. Identify the basic need of high speed digital logic families
3. Understand various types VLSI interconnections
4. Analyze various interconnection delay models
5. Acquire insights of nanotechnology circuits interconnections

Course Contents

Module I : (10Hrs)

A brief history of high-frequency integrated circuits and its design, High-frequency circuits in wireless, fiber-opticand imaging systems.

Module II : (10 Hrs)

High-speed digital logic families, Design methodology for maximum data rate, Bi-CMOS MOS-HBT logic, Pseudo-CML logic, Other bipolar, MOS and Bi-CMOS CML, and ECL gates, CML/ECL gate layout techniques.

Module III : (10Hrs)

Metal-Insulator-Semiconductor Microstrip Line Model of an Interconnection., Transmission Line Analysis of Single Level Interconnections, Transmission Line Analysis of Parallel Multilevel Interconnections, Very High Frequency Losses in a Microstrip Interconnection, Compact Expressions for Interconnection Delays, Interconnection Delays in Multilayer Integrated Circuits

Module IV : (10Hrs)

High Speed Circuit Design:High Speed Properties of logic gates-power, speed and packaging. Cross talk in solid ground and slotted ground planes, Near end and Far end cross talk. End terminators and cross talk in terminators, Vias and its characteristics. Stable voltage references, Connectors and cross talk due to connectors. Clock jitter and signal integrity mechanism for high speed link. Clock and power distribution related problems.

References :

1. VoinigescuSorin, "High-Frequency Integrated Circuits", Cambridge University Press.
2. Goel A K , "High-Speed VLSI Interconnections", Second edition, Wiley-IEEE Press.
3. Nakhla M S, Zhang O J, "Modeling and Simulation of High Speed VLSI Interconnects", Springer Publication.
4. Ludwig Reinhold, BretchkoPavel, "RF Circuit Design Theory and Applications", Pearson education.
5. Howard Johnson, Graham Martin, "High Speed digital Design-A Handbook of Black Magic", Pearson education.

Laboratory Assignments:

1. Simulate RC circuit and comment on transient response.
2. Simulate startup model of RLC.
3. Simulate a transmission line to evaluate VSWR, reflection coefficient parameters considering different loading considerations using analog simulation tool.
4. Plot stability circle, for given values of S parameters.

504210 **Mixed Signal IC Design(Elective II)**

Credits: 5

Teaching Scheme:	**Examination Scheme:**
Lectures : 4 Hrs/week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Course Objectives:

1. To introduced Mixed Signal layout issues in circuit design
2. To explain the Architectures of ADC and DAC
3. To acquire knowledge on Modeling Data Convertors

Course Outcomes:

On completion of the course, student will be able to-

1. Understand the mixed signal issues in circuit design
2. Learn modeling different ADC and DAC
3. Apply methods to improve SNR
4. Explore the operation of delta-sigma/ sigma-delta converterand their issues

Course Contents

Module I : (10 Hrs)

Analog versus discrete time signals, Converting analog signal to digital signal, Sample and hold characteristics, DAC specifications, ADC specifications, Mixed signal layout issues: floor planning, power supply and grounding issues, fully differential design/ matching, guard rings, shielding, interconnect considerations**.**

Module II : (10Hrs)

DAC architectures: Resistor string, R-2R ladder networks, Current steering, Charge-scaling, Pipeline. ADC architectures: Flash, Pipeline, Dual slope, Successive approximation, Oversampling ADC.

Module III : (10Hrs)

Data converter modeling: Sampling and aliasing: A modeling approach, Impulse sampling, AAF and RCF, Time domain description of reconstruction, The sample and hold, S/H spectral response, Circuit concerns for implementing S/H. Quantization noise, RMS quantization noise voltage, treating quantization noise as a random variable, calculating RMS quantization noise voltage from a spectrum

Module IV : (10Hrs)

Data converter SNR: Effective number of bits, Signal to noise plus distortion ratio, Spurious free dynamic range, dynamic range, SNR & SNDR, Clock jitter, Averaging to improve SNR, Spectral density view, Jitter and averaging, Relaxed requirements on AAF, Data converter linearity requirements, Adding noise dither to ADC input, Decimating filters for ADC. Decimating filters for ADCs, Interpolating filters for DACs. Noise-shaping data converters: First order noise shaping, Second order noise shaping, Noise shaping topologies: Higher-order modulators, Miltibit modulators, Cascaded modulators.

References :

1. Baker R J, "CMOS: Mixed Signal Circuit Design", Second edition, Wiley IEEE Press Publications.
2. Baker R J, "CMOS: Circuit Design, Layout and Simulation", Second edition, Wiley IEEE Press Publications.
3. Allen, Phillip E., Holberg, Douglus R., "CMOS Analog Circuit Design", Oxford University Press Publications.

Laboratory Assignments/Experiments:

1. Plot ideal transfer curves for 3 bit and 4 bit DAC, using V_{Ref} = 5V and 3V. Find the resolution for a DAC if the output voltage is desired to change in 1 mV increments.
2. For 3 bit ADC, V_{Ref} = 5V, Plot ideal transfer curve and quantization error.
3. Plot transfer curve and quantization error by shifting entire transfer curve of example 2, left by 1/2 LSB and calculate DNL.
4. Design and simulate anti-aliasing filter with two input sine waves having frequencies 4 MHz and 40 MHz.
5. Design and simulate sample and hold circuit, with 8 MHz sine wave sampled at 100 MHz.

6. Calculate SNR and plot ADC input and DAC output for cascaded 8 bit ADC and DAC operated on VDD=1.5 V, Vin = 24
mV (0.75VPP) and Sampling frequency = 100 MHz.

504210 **Embedded Signal Processor Architectures (Elective II)**

Credits: 5

Teaching Scheme:	**Examination Scheme:**	
Lecture : 4 Hrs/week	**In-Sem**	**: 50 Marks**
	End-Sem	**: 50 Marks**

Course Objectives:

1. To impart knowledge on the theoretical aspects of signal analysis and processing
2. To explore DSP Processor architectures
3. To understand DSP algorithms
4. To elaborate real world DSP applications

Course Outcomes:

On completion of the course, student will be able to-

1. Designing system with linear filters using DFT
2. Develop technical abilities of designing any applications with FIR and IIR filters
3. Port algorithms on DSP Processor Platforms
4. Design Adaptive filters
5. Analyze filter structures

Course Contents

Module I : (10Hrs)

Signal Analysis and Processing: Discrete Fourier Transform, Fast Fourier Transform, Design of FIR Filters using windowing technique, Design of IIR Filters through Impulse invariance and bilinear transformation technique, Algorithms of Adaptive Filters, Design and Applications of Adaptive Filters.

Module II : (10 Hrs)

Introduction to Digital signal processing systems, MAC, Barrel shifter, ALU, Multipliers, Dividers, DSP processor architecture, Software developments, Selections of DSP processors, Hardware interfacing, DSP processor architectures: TMS 320C54XX, TMS 320C67XX, Blackfin processor: Architecture overview, memory management, I/O management, Real time implementation Considerations, Memory System and Data Transfer, Code Optimization.

Module III : (10Hrs)

Representations of the DSP algorithms, Block diagrams, Signal flow graph, Data-flow graph, Dependence graph. Iteration bounds: Critical Path, Loop Bound, Algorithm to compute iteration bound, Longest Path Matrix (LPM).

Module IV : (10Hrs)

Practical DSP Applications: Audio Coding and Audio Effects, Digital Image Processing, Two-Dimensional Filtering, Image Enhancement, DTMF generation and detection, FFT algorithms, Wavelet algorithms, Adaptive algorithms: system identification, inverse modeling, noise cancellation, prediction.

References :

1. Woon-SengGan, Sen M. Kuo, “Embedded Signal Processing With the Micro Signal Architecture”, Wiley-IEEE Press.
2. KuoSen M, Woon-SengGan,“ Digital Signal Processors: Architectures, Implementations and Applications”, Prentice-Hall.
3. Proakis J G, Manolakis D G, “Digital Signal Processing ,Principles, Algorithms and Applications”, Prentice-Hall.
4. Lawrence R. R, Bernard Gold, “Theory and Application of Digital signal Processing”, Prentice-Hall.
5. ParhiKeshab , “VLSI Digital Signal Processing System”, Wiley Publication.

Laboratory Assignments/Experiments:

1. Design and simulate N point FFT by targeting DSP processor platform.
2. Design and simulate N tap FIR filter by targeting suitable DSP processor platform.
3. Design and simulate LMS adaptive filter.
4. Design a system for DTMF signal detection. Write a program to detect the DTMF signal using Goertzel algorithm
5. Performancecomparison of different filter structure.
6. Record a speech file in your own voice with sampling frequency of 8000 Hz. Design a system to decompose a speech signal using Daubechies wavelet using wavelet packet decomposition. Write a program to implement the system and plot the speech signal passed via each wavelet filter.

504210 **Real Time Operating Systems (Elective II)**

Credits: 05

Teaching Scheme:	**Examination Scheme:**	
Lectures : 4 Hrs/week	**In-Sem**	**: 50 Marks**
	End-Sem	**: 50 Marks**

Course Objectives:

1. To understand software Architecture and Development cycle of Operating Systems
2. To learn various management attributes of Operating System
3. To understand RTOS
4. To study Linux/ RT Linux environment

Course Outcomes:

On completion of the course, student will be able to-

1. List Embedded Software Developments Tools
2. Learn Software Development Process Life Cycle
3. Gain knowledge of Real Time Operating Systems with respect to uCOS
4. Understand RT Linux operating System

Course Contents

Module I : (10 Hrs)

Software Architectures, Software Developments Tools, Programming Concepts, Embedded Programming in C and C++, Queues, Stacks, Optimization of Memory needs, Program Modeling Concepts, Software Development Process Life Cycle and its Model, Software Analysis, Design and Maintenance

Module II : (10Hrs)

Operating System Concepts, Processes, Deadlocks, Memory Management, Input /Output, Files, Security, the Shell, Recycling of Concepts. Operating system structure Monolithic Systems: Layered Systems, Virtual Machines, Exo-kernels, Client-Server Model

Module III : (10Hrs)

Real Time Operating Systems (µC/OS):Real-Time Software Concepts, Kernel Structure, Task Management, Time Management, Inter task Communication & Synchronization, Memory Management, and Porting µCos-II.

Module IV : (10Hrs)

Linux/RT Linux: Features of Linux, Linux commands, File Manipulations, Directory, Pipes and Filters, File Protections, Shell Programming, System Programming, RT Linux Modules, POSIX Threads, Mutex Management, Semaphore Management.

References :

1. Labrossy J. J, Lawrence, "µC/OS-II, The real time Kernel", R & D Publication.
2. Dr Prasad K V K K, "Embedded Real Time Systems: Concepts, Design & Programming", Dreamtech Publication.
3. Simon D. E, "An Embedded Software Primer", Pearson education.
4. Tanenbaum A S, "Modern Operating Systems", Prentice Hall.
5. Raj Kamal, "Embedded Systems Architecture, Programming and design", Tata Mc-Graw-Hill.

Laboratory Assignments/Experiments:

1. Multitasking in μCOS- II RTOS using minimum 3 tasks on ARM7. (μCOS - II based Experiments).
2. Semaphore as signaling and synchronizing on ARM7. (μCOS - II based Experiments).
3. Write a program for 4*4 Matrix Keypad Interface (based on Linux Operating System).
4. Develop character device driver for GPIO (based on Linux Operating System).
5. Write a program for External Interrupt (based on Linux Operating System).

Elective-III

Select one subjects from Group-I, and one subject from Group-II from the following list as Elective-III.

Group		Subject	Credit
I	1	Value Education, Human Rights and Legislative Procedures	3
	2	Environmental Studies	3
	3	Renewable Energy Studies	3
	4	Disaster Management	3
	5	Knowledge Management	3
	6	Foreign Language	3
	7	Economics for Engineers	3
	8	Engineering Risk – Benefit Analysis	3
II	1	Optimization Techniques	2
	2	Fuzzy Mathematics	2
	3	Design and Analysis of Algorithms	2
	4	CUDA	2

604203A Value Education, Human rights and Legislative procedures (Elective III)
Credits:3

Teaching Scheme:	**Examination Scheme*:**
Lectures: 3 Hrs/Week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Module I : (8 Hrs)

Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.

Module II : (8 Hrs)

Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.

Module III : (8 Hrs)

Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups. Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries References

References

1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001.
2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002.
3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002.
4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990.
5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Ox ford University Press, New Delhi, 2000.

604203A **Environmental studies (Elective III)**

Credits:3

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : **(8 Hrs)**

Introduction and Natural Resources: Multidisciplinary nature and public awareness, Renewable and nonrenewal resources and associated problems, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Conservation of natural resources and human role. Ecosystems: Concept, Structure and function, Producers composers and decomposers, Energy flow, Ecological succession, Food chains webs and ecological pyramids, Characteristics structures and functions of ecosystems such as Forest, Grassland, Desert, Aquatic ecosystems.

Module II : **(8 Hrs)**

Environmental Pollution- Definition, Causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, human role in prevention of pollution, Solid waste management, Disaster management, floods, earthquake, cyclone and landslides.

Module III : **(8 Hrs)**

Social issues and Environment- Unsustainable to sustainable development, Urban problems related to energy, Water conservation and watershed management, Resettlement and re-habitation, Ethics, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents, holocaust, Waste land reclamation, Consumerism and waste products, Environment protection act, Wildlife protection act, Forest conservation act, Environmental issues in legislation, population explosion and family welfare program, Environment and human health, HIV, Women and child welfare, Role of information technology in environment and human health.

References

1. Agarwal, K.C., “Environmental Biology”, Nidi Publication Ltd., Bikaner, 2001.
2. BharuchaErach, “Biodiversity of India,” Mapin Publishing Pvt. Ltd., Ahmadabad, 2002.
3. Bukhootsow, B.,” Energy Policy and Planning”, Prentice Hall of India, New Delhi, 2003.
4. Cunningham, W.P., “ Environmental Encyclopedia”, Jaico Publishing House, Mumbai, 2003.

604203A **Renewable Energy Studies (Elective III)**

Credits:3

Teaching Scheme:	**Examination Scheme*:**
Lectures:3 Hrs/Week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Module I : Solar Energy: (8 Hrs)

Photovoltaic Systems: Introduction to the Major Photovoltaic System Types, Current–Voltage Curves for Loads, Grid-Connected Systems: Interfacing with the Utility, DC and AC Rated Power, The "Peak-Hours" Approach to Estimating PV Performance, Capacity Factors for PV Grid Connected Systems¸ PV Powered Water Pumping, PV systems – off grid systems and scope for inclusive growth of rural India.

Module II :Wind Energy: (8 Hrs)

Wind Energy: wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Choice of generators, electrical load matching, power control, Effect of wind speed variations, tower height and its effect, Variable speed operation, maximum power operation, control systems, Design consideration of wind farms and control

Module III : Other Energy Sources: (8 Hrs)

Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Co-firing, Generation from municipal solid waste, Issues in harnessing these sources. Mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion (OTEC) systems – schemes, feasibility and viability. Fuel cell- types and operating characteristics, efficiency, energy output of fuel cell

References

1. Renewable energy technologies - R. Ramesh, Narosa Publication.
2. Energy Technology – S. Rao, Parulkar
3. Non-conventional Energy Systems – Mittal, Wheelers Publication.
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
5. Renewable Energy Technologies – Chetan Singh Solanki, PHI Learning Pvt. Ltd.

604203A Disaster Management (Elective III)

Credits:3

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (8 Hrs)

Introduction :Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation). Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility

Module II : (8 Hrs)

Disaster Impacts :Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate-change and urban disasters.

Module III : (8 Hrs)

Disaster Risk Reduction (DRR) : Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

References

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority).
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. PradeepSahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management,APH Publishing Corporation.

604203A **Knowledge Management (Elective III)**

Credits:3

Teaching Scheme:
Lectures:3 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (8 Hrs)

Introduction: Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge; Learning organization: five components of learning organization, knowledge sources, and documentation. Essentials of Knowledge Management; knowledge creation process, knowledge management techniques, systems and tools.

Module II : (8 Hrs)

Organizational knowledge management; architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization. Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies

Module III : (4 Hrs)

Futuristic KM: Knowledge Engineering, Theory of Computation, Data Structure.

References

1. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004.
2. Knowledge Management- Elias M. AwadHasan M. Ghazri, Pearson Education
3. The KM Toolkit – Orchestrating IT, Strategy & Knowledge Platforms, AmritTiwana, Pearson, PHI, II Edn.
4. The Fifth Discipline Field Book – Strategies & Tools For Building A learning oganizationPeterSenge et al. Nicholas Brealey 1994
5. Knowledge Management – Sudhir Warier, Vikas publications
6. Leading with Knowledge, MadanmohanRao, TataMc-Graw Hill.

604203A **Foreign Language (Elective III)**

Credits:3

Teaching Scheme:
Lectures:3 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : **(8 Hrs)**

Pronunciation guidelines; Single vowels, Accentuated vowels, Vowels and consonants combinations, Consonants; Numbers 1-10 Articles and Genders; Gender in French, Plural articles, Some usual expressions. Pronouns and Verbs; The verb groups, The pronouns, Present tense, Some color Adjectives and Plural ; Adjectives, Some adjectives, Our first sentences, More Numbers.

Module II : **(8 Hrs)**

Sentences Structures; Some Prepositions, Normal Sentences, Negative Sentences, Interrogative Sentences, Exercises The Family; Vocabulary ,Conversation, Notes on Pronunciation, Notes on Vocabulary, Grammar, Liaisons Guideline. D'oùviens-tu (Where do you come from); Vocabulary, Conversation, Notes on Vocabulary, Liaisons Guidelines . Comparer (Comparing); Vocabulary, Conversation, Notes on Vocabulary, Grammar Liaisons Guidelines, Ordinal Numbers

Module III : **(8 Hrs)**

Le temps (Time); Vocabulary, Grammar, Time on the clock Additional French Vocabulary; Vocabulary related to - The Family, Vocabulary related to - Where do you come from? French Expressions and Idioms; Day-to-day Life, At Work, The car, Sports, Specia Events Other French Flavours; Nos cousins d'Amérique - Québec et Accadie, Au pays de la bière et des frites, Mettez-vous à l'heure Suisse, Vé, peuchère, le françaisbien de chez nous

References

http://www.jump-gate.com/languages/french/index.html

604203A **Economics for Engineers (Elective III)**

Credits:3

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (8 Hrs)

Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering, Technology and Economic Development. Production Possibility Curve, Nature of Economic Law, Time Value of Money: concepts and application. Capital budgeting; Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI (with the help of case studies)

Module II : (8 Hrs)

Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry. Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (Main features). Supply and law of supply, Role of demand and supply in price determination.

Module III : (8 Hrs)

Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks

References :

1. Jain T.R., Economics for Engineers, VK Publication
2. Singh Seema, Economics for Engineers, IK International
3. Chopra P. N., Principle of Economics, Kalyani Publishers
4. Dewett K. K., Modern economic theory, S. Chand
5. H. L. Ahuja., Modern economic theory, S. Chand

604203A Engineering risk – Benefit and Analysis (Elective III)

Credits:3

Teaching Scheme:	**Examination Scheme*:**
Lectures: 3 Hrs/Week	**In-Sem : 50 Marks**
	End-Sem : 50 Marks

Module I : (8 Hrs)

Introduction- Knowledge and Ignorance, Information Uncertainty in Engineering Systems, Introduction and overview of class; definition of Engineering risk; overview of Engineering risk analysis. Risk Methods: Risk Terminology, Risk Assessment, Risk Management and Control, Risk Acceptance, Risk Communication, Identifying and structuring the Engineering risk problem; developing a deterministic or parametric model System Definition and Structure: System Definition Models, Hierarchical Definitions of Systems, and System Complexity.

Module II : (8 Hrs)

Reliability Assessment: Analytical Reliability Assessment, Empirical Reliability Analysis Using Life Data, Reliability Analysis of Systems

Module III : (8 Hrs)

Reliability and probabilistic risk assessment (RPRA), decision analysis (DA), and cost-benefit analysis (CBA). All of these pertain to decision making in the presence of significant uncertainty. In ERBA, the issues of interest are: The risks associated with large engineering projects such as nuclear power reactors, the International Space Station, and critical infrastructures; the development of new products; the design of processes and operations with environmental externalities; and infrastructure renewal projects.

References

1. Risk Analysis in Engineering and Economics, B. M. Ayyub, Chapman-Hall/CRC Press, 2003.
2. Hoyland, Arnljot, and Rausand, Marvin. System Reliability Theory. Hoboken, NJ: WileyInterscience, 1994. ISBN: 9780471471332.
3. Clemen, Robert, ― Making Hard Decisions: An Introduction to Decision Analysis (Business Statistics) ― PHI publications

604203B Optimization Techniques (Elective III)

Credits:2

Teaching Scheme:
Lectures: 2 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (6 Hrs)

First and second order conditions for local interior optima (concavity and uniqueness), Sufficient conditions for unique global optima; Constrained optimization with Lagrange multipliers; Sufficient conditions for optima with equality and inequality constraints;

Module II : (8 Hrs)

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning

Books:

1. Stephen Boyd and LievenVandenberghe, Convex Optimization, Cambridge University Press.
2. A. Ben-Tal, A. Nemirovski, Lectures on Modern Convex Optimization: Analysis,Algorithms, and Engineering Applications, SIAM.
3. D. P. Bertsekas, A. Nedic, A. E. Ozdaglar, Convex Analysis and Optimization,Athena Scientific.
4. D. P. Bertsekas, Nonlinear Programming, Athena Scientific.
5. Y. Nesterov, Introductory Lectures on Convex Optimization: A Basic Course, Springer.
6. J. Borwein and A. S. Lewis, Convex Analysis and Nonlinear Optimization:Theory and Examples, Springer.

604203B Fuzzy Mathematics (Elective III)

Credits:2

Teaching Scheme:
Lectures: 2 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (8 Hrs)

Definition of a Fuzzy set; Elements of Fuzzy logic. Relations including, Operations, reflexivity, symmetry and transitivity; Pattern Classification based on fuzzy relations

Module II : (6 Hrs)

Fuzzy Models: Mamdani , Sugeno, Tsukamoto

Books:

1. Neuro-Fuzzy and Soft Computing by S.R.Jung, Sun, Mizutani,

604203B Design and Analysis of Algorithm (Elective III)

Credits:2

Teaching Scheme:
Lectures: 2 Hrs/Week

Examination Scheme*:
In-Sem : 50 Marks
End-Sem : 50 Marks

Module I : (8 Hrs)

Introduction- Fundamental characteristics of an algorithm. Basic algorithm analysis – Asymptotic analysis of complexity bounds– best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms.

Module II : (8 Hrs)

Properties of big-Oh notation – Recurrence equations – Solving recurrence equations – Analysis of linear search. Divide and Conquer: General Method – Binary Search – Finding Maximum and Minimum – Merge Sort – Greedy Algorithms: General Method – Container Loading – Knapsack

Books:

Algorithm Design – Jon Kleinberg and Eva Tardos Introduction to Algorithms – T.H. Corman

604103 **CUDA** **Group II**

ELECTIVE- III B

Teaching Scheme:
Lectures 2 Hrs/ Week

Examination Scheme:
Theory : 50 Marks (In Semester)
50 Marks (End Semester)
Credits : 2

Module I :

History of GPUs leading to their use and design for HPC- The Age of Parallel Processing, The Rise of GPU Computing ,CUDA, Applications of CUDA, Development Environment, Introduction to CUDA C, Kernel call, Passing Parameters, Querying Devices, Using Device Properties

Module II:

Parallel Programming in CUDA C - CUDA Parallel Programming, Splitting Parallel Blocks, Shared Memory and Synchronization, Constant Memory, Texture Memory, CUDA events, Measuring Performance with Events.

Books:

1. Programming Massively Parallel Processors: A Hands-on Approach –second edition by David
   B. Kirk, Wen-mei W. Hwu.
2. CUDA by Example - An Introduction to General-Purpose GPU Programming by Jason Sanders ,Edward Kandrot- Addison Wesley
3. GPU Computing Gems Emerald Edition -Applications of GPU Computing Series by Wen-mei,
   W. Hwu
4. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs by shane cook

JSPM’s Bhivarabai Sawant Institute of Technology & Research, Wagholi, Pune (412207)

CRITERION 1 - CURRICULAR ASPECTS

1.2
Academic Flexibility

1.2.1

Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

DEPARTMENT OF ELECTRICAL ENGINEERING

Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Second Year Electrical Engineering

(2019 Course)

(w.e.f. AY: 2020-21)

Savitribai Phule Pune University

Syllabus: Second Year (SE) Electrical Engineering (2019 Course) w.e.f. AY:2020-2021

SEMESTER-I

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
207006	Engineering Mathematics-III	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203141	Power Generation Technologies	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203142	Material Science	03	04#	--	30	70	25	--	25	**150**	03	02	--	**05**
203143	Analog and Digital Electronics	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203144	Electrical Measurement & Instrumentation	03	04#	--	30	70	25	25	--	**150**	03	02	--	**05**
203150	Applications of Mathematics in Electrical Engineering	--	02*	--	--	--	25	--	--	**25**	--	01	--	**01**
203151	Soft Skill	--	02	--	--	--	25	--	--	**25**	--	01	--	**01**
203152	Audit Course-III	--	--	--	--	--	--	--	--	**--**	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

SEMESTER-II

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
203145	Power System-I	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203146	Electrical Machines-I	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203147	Network Analysis	03	02	--	30	70	25	--	--	**125**	03	01	--	**04**
203148	Numerical Methods & Computer Programming	03	02	--	30	70	--	25	--	**125**	03	01	--	**04**
203149	Fundamental of Microcontroller and Applications	03	04$	--	30	70	25	--	25	**150**	03	02	--	**05**
203152	Project Based Learning	--	04	--	--	--	50	--	--	**--**	--	02	--	**--**
203153	Audit Course-IV	--	--	--	--	--	--	--	--	**--**	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

* - Lab sessions on application of Mathematics in Electrical Engineering using professional software.

- Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week :Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field .

$ - Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week : IOT application in Electrical Engineering using microcontroller and GSM module to bridge gap between curriculum and enhance application knowledge.

Abbreviation: TH: Theory, PR: Practical, TUT:Tutorial, ISE: Insem Exam, ESE: End Sem Exam, TW: Term Work, OR: Oral

207006: Engineering Mathematics-III

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisites: - Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Vector algebra and Algebra of complex numbers.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary differential equations, Laplace transform, Fourier transform & Z-transform, Statistics & Probability, Vector Calculus and functions of a Complex Variable. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: At the end of this course, students will be able to:

CO1:Solve higher order linear differential equation using appropriate techniques to model and analyze electrical circuits.

CO2: Apply Integral transforms such as Laplace transform, Fourier transform and Z-Transform to solve problems related to signal processing and control systems.

CO3: Apply Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to energy management, power systems, testing and quality control.

CO4: Perform Vector differentiation and integration, analyze the vector fields and apply to wave theory and electro-magnetic fields.

CO5: Analyze Complex functions, conformal mappings, and perform contour integration in the study of electrostatics, signal and image processing.

Unit I: Linear Differential Equations (**LDE**) and Applications (08Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral,General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II: Laplace Transform (**LT**) (07Hours)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear differential equations.

Unit III: Fourier and Z - transforms (08 Hours)

Fourier Transform (**FT**): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.

Z - Transform **(ZT):** Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit IV: Statistics and Probability (07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test.

Unit V: Vector Calculus (08 Hours)

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI: Complex Variables (08 Hours)

Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).

203141: Power Generation Technologies

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite:

- Fuel calorific value.
- Semiconductor materials for PV cells.
- Work, power and energy calculation.

Course Objective:

- To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.
- To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.
- To commence interconnection of energy source to gird, stand alone and hybrid system.

Course Outcome: Upon successful completion of this course, the students will be able to:

CO1: Identify components and elaborate working principle of conventional power plants.
CO2: Recognize the importance and opportunities of renewable energies.
CO3: Calculate and control power output of wind solar, and hydro power plant.
CO4: Describe process of grid interconnection of distributed generation and requirements.
CO5: Interpret the environmental and social impact of various generation technologies.

Unit 01: Thermal Power Plant (06 hrs)

Basic thermodynamic cycles: Carnot cycle, Rankine cycle; Actual Rankine cycle; Reheat cycle (theoretical only); heat rate (Numerical on Heat rate).

Thermal Power Plants: Site selection, Main parts and its working. Types of boilers (FBC, Fire tube, and Water tube). Assessment of heat recovery systems Steam turbines Fuel Handling, Ash disposal and dust collection, Draught systems, electrostatic precipitator.

Unit 02: Nuclear, Diesel, Gas Power Plant (6 Hrs)

A. Nuclear Power Plant: Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal.

B. Diesel Power Plants: Main components and its working, Diesel plant efficiency and heat balance (Numerical), Site selection of diesel power plant.

C. Gas Power Plant: Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants, concept of heat to power ratio.

Unit 03: Hydro Power Plant (6 Hrs)

Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydro graphs and number of turbine required. Small, mini and micro hydro power plant (Introduction only).

Unit 04: Wind Energy Systems (6 Hrs)

Historical Development of Wind Power, Types of wind turbine, Impact of Tower Height, Power in the Wind. Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind (Numerical). Wind Turbine Generators (WTG) - Synchronous and Asynchronous (block diagrams only), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.

Unit 05: Solar Energy (6 Hrs)

Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. Over view of recent development of PV technologies. A Generic

Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, Numerical on number of solar panel selection. The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I–V curves, System: Introduction to the Major Photovoltaic System Types.

Unit 06: Other Sources and Grid Connection (6 Hrs)

Biomass energy, conversion to electricity, municipal solid waste to energy conversion, geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection criteria, stand alone, hybrid stand alone and grid connected renewable systems and their requirements.

Industrial Visit: One industrial visit to conventional /non-conventional power plant is necessary. A separate report file should be maintained in the department.

Text Books:

[T1] P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
[T2] Dr. P. C. Sharma, "Power Plant Engineering", S.K. Kataria Publications.
[T3] R. K. Rajput, "A text book on Power System Engineering", Laxmi Publications (P) Ltd.
[T4] Chakrabarti, Soni, Gupta, Bhatnagar, "A text book on Power System Engineering", DhanpatRai publication.
[T5] R.K. Rajput, "Non-Conventional Energy Sources and Utilization", S. Chand Publications.
[T6] M.M. Wakil, "Power Plant Engineering", McGraw Hill, Indian Edition.
[T7] G. D. Rai, "Renewable Energy Sources", Khanna Publications.
[T8] Chetan singh solanki " Solar Photovotaics: Fundamentals, Technology and Application" PHI Publications.

Reference Books:

[R1] Arora and Domkundwar, "A Course in Power Plant Engineering", DhapatRai Publication.
[R2] Dr. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publication.
[R3] Mukund Patel, "Wind and Solar Power Plants", CRC Press.
[R4] Gilbert Masters John, "Renewable Energy", Wiley and sons' publications.
[R5] Robert Foster, Majid Ghassemi, Alma Cota "Solar Energy" CRC Press

Unit	Text Books	Reference Books
1	T1, T2, T3	R1
2	T1, T2, T3	R1
3	T1, T2, T3	R1
4	T6, T7	R3, R4
5	T5, T6, T8	R2, R3, R4, R5
6	T5, T7	R4

203142: Material Science

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating, magnetic and resistive along with their basic characteristics.

Course Objectives: The course aims to :

1. Explain classification,properties and characteristics of electrical engineering materials.
2. Describe applications and measuring methods for parameters of dielectric, insulating, magnetic, conducting and resistive materials.
3. Illustrate solving of simple problems based on dielectric, magnetic and conducting materials.
4. Impart knowledge of Nano-technology to electrical engineering.5. Demonstrate testing methods of dielectric, insulating, magnetic, conducting and resistive materials as per IS.
5. Enable students to create self learning resource material through active learning based on practical /case study/assignments.

Course Outcomes:

Upon successful completion of this course, the students will be able to :

CO1: Discuss classification,properties and characteristics of different electrical engineering materials.

CO2: State various applicationsmeasuring methods for parameters of different classes of electrical engineering materials.

CO3: Solve simple problems based on dielectric, magnetic and conducting materials.

CO4: Apply knowledge of Nano-technology to electrical engineering.

CO5: Execute tests ondielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of thematerials.

CO6: Create learning resource material ethically to demonstrate **self learning leading to** lifelong learning skills and usage of ICT/ online technology through collaborative/active learning activities.

Unit 01: Dielectric Properties of Insulating Materials: (6 Hrs)

Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations-Electronic, Ionic and Orientation Polarization (descriptive treatment only), Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta.

Unit 02: A) Dielectric Breakdown: (2 Hrs) Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.

Unit 02: B) Testing of Materials: (4Hrs) Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.

1. Measurement of dielectric loss tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of dielectric strength of solid insulating material-IS 2584.
3. Measurement of dielectric strength of liquid insulating material -IS 6798.
4. Measurement of dielectric strength of gaseous insulating material as per IS.

Unit 03 : Insulating Materials, Properties & Applications: (6 Hrs)

Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF_6.

Insulating Materials for Power and Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

Unit 04 : Magnetic Materials: (6 Hrs)
Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Anti-ferromagnetism, Ferrites, Applications of Ferro magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials.

Unit 05 : Conducting Materials: (6 Hrs)
General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High and Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Kanthal, Silver and Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Electrical Carbon Materials. Materials used for Lamp Filaments, Solders, Metals and Alloys for different types of Thermal Bimetal and Thermocouples.

Unit 06 : Nanotechnology: (6 Hrs)
Introduction, Concepts of Energy bands and various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires. Nano materials used in Batteries, Photovoltaic Cells and in Supercapacitors.

Industrial Visit:
Minimum one visit should be arranged to an industry related to manufacturing of batteries, capacitors, cables, transformers, motors (Any one industry). A hand written report should be submitted by every student as a part of term work

***Guidelines for TW Assessment will be given later.**
There is **Term Work of 25 marks**for the subject.
Practical section will comprise of two parts: (Refer SE Structure 2019 Pattern)
PART A: 2 Hours per week:
Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory. Out of 25 marks of Term Work, **15 Marks** will be based on continuous assessment that should be carried out such as checking of previous experiment along with its mock oral session (minimum 4-5 questions to each student), while conducting new experiment.
PART B: 2 Hours a week:
Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field. **10 Marks**
<u>List of Experiments:</u>
Part A: Term Work **(TW): 15 Marks**
List of total 12 numbers of experiments out of which conduction of 8 numbers of experiments will be mandatory.

1. To measure dielectric strength of solid insulating material-IS 2584.
2. To measure dielectric strength of liquid insulating material-IS 6789.
3. To measure dielectric strength of gaseous insulating material as per IS using Sphere Gap-Unit.
4. To obtain hysteresis loop of the ferromagnetic material.
5. To understand the principle of thermocouple and to obtain characteristics of different thermocouples.
6. To measure insulation resistance and kVAr capacity of power capacitor.
7. To measure resistivity of high resistive alloys.
8. To observe development of tracks due to ageing on different insulating materials e.g. Bakelite, Perspex, polyesters, Mica, Fiberglass etc.
9. Testing of resins and polymers.
10. Measurement of Tangent of Dielectric Loss Angle (tan δ) of solid/liquid dielectric materials.
11. Measurement of Flux Density by Gauss-meter.
12. Write report on visit to an industry related to manufacturing of batteries, capacitors, cables,

transformers (Any one industry).

List of Experiments: Part B:Part B :2 Hours per week (**Term Work(TW) : 10 Marks) (Total 6 activities from the list below are mandatory for evaluation of Term Work for Part B. Activity numbers 1, 4 and 6 are compulsory)**

Practical/case studies/assignments to enable self,active, collaborative **learning leading to** lifelong learning, based on advances related to subject to bridge gap between curriculum and enhance application knowledge of the subject.

Guidance/monitoring/assessment/presentation/field visits /expert sessions related activity can be carried out in **'Part B'** practical schedules .

1) Review of research/on line literature from latest journal papers /transactions related to different insulating, magnetic, semiconducting and conducting materials, advanced material developments and their applications. Draft of paper, presentation among students, in conference /publishing it.
2) Detailed case study of complete insulation system in transformer, comparison of various types of solid, liquid materials and study of recent advances related with major and minor insulating materials.
3) Detailed study of patents on caster oil used in transformer, its properties and comparison with other liquid insulating material.
4) Mini project on development of prototype of various electrical gadgets right from draft of specifications,design, selection of conducting, magnetic and insulating material.
5) Testing and diagnosis of induction motor, cable, transformer insulation by measurement of Polarization index, Dielectric Absorption Ratio, Step Voltage, dielectric discharge and ramp testing using 5/10KV IR Tester.
6) Laboratory visits/survey/role play/games/debates/any activity focusing collaborative, student centrist, active learning on Industrial/ Social/ Sustainability/ Public Health/ Safety/Ethical/Cultural/ Societal and Environmental aspects related to advanced materials Presentations of industrial case studies related with material science.
7) Two - Three household appliances like mixer -motor, ceiling fan- motor etc can be opened up by students either individually or by group of students and analyzed w.r.t. the materials found in it. Name each material used and to which category of materials does it belong, other applications of the same materials can be listed.
8) Detailed study of insulation system of resin casted transformer, comparison of various resins, study of testing of insulation system with applicable IS/IEC /IEEE standards
9) Visit to NABL accredited Laboratory to study testing of oil for DGA, furan analysis, study of equipment's used, test procedure and applicable IS/IEEE/IEC standard and recommended limits.
10) Discussions/Presentations/any activity using or related to IS/ IEC /IEEE standards/Recent Patents related with insulating, conducting and magnetic materials .
11) Case study on failure modes of various insulating materials and measures to reduce failure. Recent advancement in testing and diagnostic of solid and liquid insulating materials.
12) Case study on recent advancement of magnetic materials, high temperature superconductors and its applications.
13) Any activity using advanced ICT tool like Virtual Labs/animations/simulations/advanced software/on line certificate course like NPTEL/on line quiz etc related to curriculum.

Guidelines for Instructor's Manual - Practical Sessions

Instructor's Manual should contain following things related to every experiment-

1. The circuit diagram of the experiment should be drawn at the start.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Five - six questions based on that experiment should be written at the end.

Guidelines for Student's Lab Journal

Student's Lab Journal should be **Hand Written/ Drawn** containing, following things related to every experiment-

1. The circuit diagram of the experiment should be drawn on the graph paper at the start of the experiment.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Students should write answers to five - six questions based on that experiment at the end.

Guidelines for Laboratory Conduction

1. The circuit diagram should be explained to students in such a way that they should be able to develop it at their own.
2. Detail explanation of the experiment along with its circuit diagram, observation table, calculations, result table and plotting of graphs (if any).
3. While conducting new experiment, assessment of previous experiment should be carried out by its checking along with its mock oral session (minimum 4 -5 questions to each student).

Text Books:

[T1] "A Course in Electrical Engineering Materials", by S.P. Seth, Dhanpat Rai and Sons publication.

[T2] A Textbook of "Electrical Engineering Materials" by R.K.Rajput, Laxmi Publications (P) Ltd.

[T3] "Electrical Engineering Materials", by T.T.T.I, Madras.

[T4] "Electrical Engineering Materials", by K. B. Raina and S. K. Bhattacharya, S. K. Kataria Sons.

[T5] "Material Science for Electrical Engineering", by P.K. Palanisamy, Scitech Pub. Pvt. Ltd., Chennai (India).

[T6] "Introduction to Nanotechnology" by Charles P. Poole, Jr. Frank & J. Ownes (Wiley Student Edition)

Reference Books:

[R1] "Electrical Power Capacitors-Design & Manufacture", by D. M. Tagare, Tata McGraw Hill Publication.

[R2] "Electrical Engineering Materials", by S. P. Chalotra and B. K. Bhattacharya, Khanna Publishers, Nath Market.

[R3] "Electrical Engineering Materials", by C. S. Indulkar and S. Thiruvengadam, S. Chand and Company Ltd.

[R4] "High Voltage Engineering" by Kamraju and Naidu, Tata McGraw Hill Publication.

[R5] "Introduction to Material Science for Engineering", Sixth Edition by James F. Shackelford & M. K. Muralidhara, Pearson Education.

[R6] "Insulation Technology Course Material" of IEEMA Ratner, Pearson Education.

[R7] "Materials Science for Engineering Students", by Traugott Fischer, Elsevier Publications.

[R8]"Energy Conversion Systems", by Rakosh Das Begamudre, New Age International Publishers.

[R9] "Advanced Nanomaterials and Their Applications in Renewable Energy", by Jingbo Louise Liu, Sajid Bashir, ELSEVIER Publications.

Unit No.	Text Book	Reference Book
1	T1, T2	R1, R3, R8
2	T1, T2, T3	R1, R2, R4
3	T1, T2, T3, T4	R1, R3, R4, R6
4	T1, T2, T3, T4	R3, R5
5	T1, T2, T4	R7, R8
6	T6	R9

203143: Analog And Digital Electronics

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite: Basic Electronics Engineering, Numbering system, Logic Gates and flip flops,Diode and BJT

Course Objectives:

1) To use K map for Boolean algebra reduction and design digital circuit
2) To introduce digital memories and logical families.
3) To construct sequential and combinational circuits using flip flops and K map
4) To develop the concept of basics of operational Amplifier and its applications.
5) To design uncontrolled rectifier

Course Outcomes: Upon successful completion of this course, the students will be able to :-

CO1: Design logical, sequential and combinational digital circuit using K-Map.
CO2: Demonstrate different digital memories and programmable logic families.
CO3: Apply and analyze applications of OPAMP in open and closed loop condition.
CO4: Design uncontrolled rectifier with given specifications

Unit 01 : Design of combinational circuit:(6 hrs)

Booleans algebra, De-Morgan theory etc, Karnaugh map: structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map. Design of combinational circuits using Boolean expression and K-map, encoder, decoder, half and full adder.

Unit 02: Design of sequential circuit:(6 hrs)

Introduction to sequential circuit. Design of synchronous (K-map) and asynchronous counters. Up down counters, N modulo counters, Shift registers, ring and twisted ring counters

Unit 03: Digital memories and logic families:(6 hrs)

A) Digital memories: SRAM, DRAM, ROM, EPROM
B) **Digital logic families:** PAL,PLA, CPLD, FPGA

Unit 04: Operational Amplifier Applications: (6 hrs)

Open loop and close loop configuration of Op-Amp. Applications of Op- Amp- zero crossing detectors, Comparator, Schmitt trigger, V-I and I-V converters, Instrumentation amplifier, peak detector, Waveform generation using Op-amp - sine, square, saw tooth and triangular generator,

Unit 05: Other Analog circuits:(6 hrs)

Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters using OPAMP, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using IC78xx, 79xx, LM 317

Unit 06: Diode rectifier:(6 hrs)

Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load.

List of Experiments:

Perform any **eight (three experiment should be on bread board/trainer kit)** experiment from following list:

1. Design of logical circuit for display of decimal number on seven segment display. **(Hardware)**
2. Deign 3:8 decoder for binary to octal decoding.**(Hardware)**
3. Design three bit full adder using any open source software. **(Software)**
4. Design logical circuit to convert binary to EXCESS 3/Gray number system. **(Hardware)**
5. Design digital clock or stop watch using decade counter.(IC74192) **(Hardware)**
6. Find phase angle difference between same frequency signal using ZCD and AND gate. **(Hardware)**
7. Design of comparator and schmitt trigger. **(Hardware)**
8. Study of Instrumentation amplifier using three Op-amp, CMRR measurement **(Hardware)**

9. Design sine, and triangular wave generator. **(Hardware)**
10. Design first order high pass and low pass filter using OPAMP in any open source software. (For this provide one statement to each of four students to perform with desired cut-off frequency. Each group will demonstrate their result and prepare documentation) **(Software)**
11. Design of monostable mutivibrator using IC555 and digital circuit to count number of pulses. **(Hardware)**
12. Design astable multivibrator using IC-555. **(Hardware)**
13. Design of single phase bridge rectifier with output voltage and specified ripple.(this practical should be design by each students, perform in simulation and demonstrate with hardware in laboratory with design documents) **(Software and Hardware)**

Guidelines for Instructor's Manual Practical Sessions

The Instructor’s Manual should contain following related to every experiment: Brief theory related to the experiment,Connection diagram /circuit diagram, Observation table,,Sample calculations for one reading,Result table, Graph and Conclusions,,Data sheets of the ICs used. Few questions related to the experiment (10 marks) List of components required with their specifications .

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment: Theory related to the experiment, Connection diagram /circuit diagram , Observation table, Sample calculations for one reading, Result table, Graph and Conclusions, Data sheets of the ICs used, List of components required with their specifications,

Guidelines for Lab Assessment

- There should be continuous assessment.
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do connections on bread board and get the results.
- Timely submission of journal.

Guidelines for Laboratory Conduction

- First half an hour should be utilized for explaining the circuit diagram and theory related to the experiment.
- Next one hour for connection and conduction of the experiment.
- Remaining half an hour for continuous assessment and timely checking of the experiment (This time slot can be adjusted as per convenience)
- Separate breadboard should be provided for every student for those experiments which are compulsory to be performed on breadboard or trainer kit (**ready made set up is not allow**)

Books & Other Resources:

Text Books:

[T1] Floyd and Jain, “Digital Fundamentals”, Pearson Education.
[T2] R. P. Jain, “Digital Electronics”, Tata McGraw Hill, New Delhi.
[T3] Malvino, “Digital Computer Electronics- An Introduction to Microcomputers,” Tata McGraw Hill.
[T4] Gaikwad R., “Operational Amplifier”, PHI New Delhi.
[T5] Floyd, “Electronics Devices”, Pearson Education.
[T6] Mottershed, “Electronics Devices & Circuits”, PHI New Delhi
[T7] Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, 3rd edition, Pearsons Education.
[T8] Fundamental of digital circuits, 4th Edition, by A Anand Kumar, PHI learning private limited publication

Reference Books:

[R1] Tokheim, “Digital Electronics-Principles and Application”, 6th edition, Tata McGraw Hill, New Delhi.
[R2] A Jaico and Charles H. Roth, “Fundamentals of Logic Design” Jr. Forth Edition.
[R3] K. R. Botkar, “Integrated Circuits”, Khanna Publication, New Delhi.
[R4] James, “Operational Amplifier and Linear Integrated Circuits Theory and Application.”
[R5] P John Paul, “Electronics Devices and circuits”, New Age international Publications.

[R6] P. S. Bimbhra, "Power Electronics", Khanna Publications.
[R7] NPTEL course on Digital Electronics Circuit, IIT, Kharagpur.
https://nptel.ac.in/courses/108105132/
[R8] NPTEL course on Integrated circuit, MOSFET, OPAMP and there applications IISC Banglore. https://nptel.ac.in/courses/108/108/108108111/
[R9] NPTEL course on power electronics by IIT Kharagpur.
https://nptel.ac.in/courses/108/105/108105066/

Unit 01	**Test Books**	**References**
1	T1, T2, T8	R1, R7
2	T1, T2, T3, T8	R2, R7
3	T8	R7
4	T4, T5	R3, R4, R8
5	T4, T5	R3, R4, R8
6	T7	R6, R9

203144: Electrical Measurements and Instrumentation

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Practical** : 25 Marks

Course Objectives:

1. To understand the necessity and importance of measurement and instrumentation.
2. To know about various types of measurement techniques, instruments and sensors.
3. To learn to apply proper methods of measurement and use of sensors in instrumentation.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Define various characteristic and classify measuring instruments along with range extension techniques.

CO3: Apply measurement techniques for measurement of resistance, inductance and capacitance.

CO4: Demonstrate construction, working principle of electrodynamo type and induction type instruments for measurement of power and energy.

CO5: Make use of CRO for measurement of voltage, current and frequency.

CO6: Classify transducer and apply it for measurement of physical parameters in real time.

Unit 01: (7 Hrs)

A. Classification of Measuring Instruments: Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) instruments (attraction and repulsion). block diagram and operation of digital ammeter & voltmeter.

B. Range Extension: Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02: (6 Hrs)

A. Measurement of Resistance: Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger. Earth tester for earth resistance measurement.

B. Measurement of Inductance: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Maxwell's inductance, Maxwell's inductance – Capacitance Bridge, Anderson's bridge.

Unit 03: (6 Hrs)

Measurement of Power: Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method.

Unit 04: (5 Hrs)

Measurement of Energy: Construction, working principle, torque equation of single phase conventional (induction type) energy meter. Block diagram and operation of single phase and three phase static energy meter. Calibration of static energy meter. TOD meter.

Unit 05: (6 Hrs)
A. Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO.
B. Transducers: Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers.
C. Pressure Measurement: Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.

Unit 06: (6 Hrs)
A. Level Measurement: Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic.
B. Displacement Measurement: LVDT & RVDT – construction, working, applications, specifications, advantages & disadvantages, effect of frequency on performance.
C. Strain Gauge: Introduction, definition of strain, types of strain gauge: wire strain gauge, foil strain gauge, semiconductor strain gauge; their construction, working, advantages and disadvantages.

Industrial Visit(s)

Minimum one visit should be arranged to electrical instrument manufacturing company or where electrical instruments are calibrated or where various measuring instruments (Electrical/Mechanical) can be seen or observed.

List of Experiments

Practical section will comprise of two part; part A and part B.
Practical examination will be conducted on Part A.
Distribution of term works marks; Part A : 10 Marks, Part B : 15 Marks.
Part A: Minimum eight experiments are to be conducted from the following experiments:
1. Extension of ammeter range using CT, voltmeter range using PT and watt meter range using CT / PT.
2. i) Measurement of medium resistance by Ammeter- Voltmeter method.
   ii) Measurement of low resistance using Kelvin's Double Bridge.
3. Measurement of inductance using Anderson's bridge / Maxwell's bridge.
4. Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two way switch.
5. Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.
6. Measurement of three phase active & reactive power by two wattmeter method procedure.
7. Measurement of active power in three phase, four wire system using three CTs & two wattmeter.
8. Calibration of single phase wattmeter at different power factors.
9. Calibration of single phase static energy meter at different power factors.
10. Measurement of voltage, current, time period, frequency & phase angle using CRO.
11. To study and plot the characteristics of LVDT.
12. Electrical methods for measurement of liquid level.

Part B: Minimum eight experiments / case studies are to be conducted from the following:
1. Study of various standards (IS/IEC) related to calibration process of various instruments and NABL accredited Test Laboratory visit.
2. Measurement of soil resistivity using four pin wenner method.
3. Study of programmable LCR meter; Measure L, C, R, Q, dissipation factor and power factor of given component.
4. Demonstration of Power analyser and multifunction meter for measurement of various

electrical quantities.

5. Study of Digital Storage Oscilloscope:
   a) Different modes in DSO such as Roll, Average, Peak detection.
   b) Capture transients
   c) FFT analysis
   d) Various MATH operations
6. Study and demonstration of net meter and four quadrant TOD Meter.
7. Detailed study of various temperature transducers, their selection procedure, specifications, characteristics and comparison, calibration process of temperature transducer.
8. Determination of polarities and ratio, phase angle and ratio error of various CTs and PTs.
9. Study and demonstration of DIAF / Woodward alternator synchronization relay used in industrial power system for synchronization of DG sets and Alternators.
10. Detailed study of on line Energy Monitoring System, various parameters, EMS software capabilities, trending with IOT applications. Demonstration of EMS system by inviting Expert.
11. Virtual instrument modeling using software like LABVIEW.
12. Study of advanced metering infrastructure in smart grid.

Guidelines for Instructor's Manual

- The instructor’s manual is to be developed as a hands-on resource and reference.
- The instructor's manual need to include prologue (about University / program / institute / department / foreword / preface etc), University syllabus, conduction and assessment guidelines, topics under consideration - concept, objectives, outcomes, list of experiments, references etc.
- The feedback seeking sheet for enhancement of instructor's manual may be added as annexure.

Guidelines for Student's Lab Journal

- The laboratory experiments are to be submitted by student in the form of journal.
- Journal consists of prologue, Certificate, table of contents, and write-up of each experiment (Title, Objectives, Outcomes, List of apparatus, Circuit diagram, Theory, Observation Table, Sample Calculation, Result Table, Conclusion / Analysis, exercises - MCQs, assignments, Date of Completion, Assessment grade and assessor's sign with date).

Guidelines for Lab /TW Assessment

- Each experiment will be assigned grade based on parameters with appropriate weightage.
- Suggested parameters include - timely completion, performance, innovation, punctuality and neatness.

Guidelines for Laboratory Conduction

- The instructor is expected to shortlist necessary experiments from the suggested list of experiments. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
- Proper safety instructions and demonstration of the experiment is to be given before asking the students to perform the experiment. The experiment is carried out by the students under the supervision of the instructor.
- The instructor should take utmost care towards safety of the students, self and other hazards that may be caused by improper operation of the equipment.
- The instructor may also design an experiment which is relevant to the subject and beyond the scope of syllabus.

Text Books

[T1] A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”, Dhanpat Rai & Co.

[T2] J. B. Gupta, “A Course in Electronics and Electrical Measurements and Instrumentation”, S. K. Kataria & Sons,

[T3] R. K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, “Instrumentation Measurement and Analysis”, Tata

McGraw Hill.

Reference Books

[R1] E. W. Golding & F. C. Widdies, “Electrical Measurements & Measuring Instruments”, Reem Publications.
[R2] Dr. Rajendra Prasad, “Electronic Measurements & Instrumentation”, Khanna Publishers.
[R3] Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, PHI Publication.
[R4] M. M. S. Anand, “Electronics Instruments and Instrumentation Technology”, PHI Publication.

Unit	Text Books	Reference Books
I	T1,T2,T3,T4	R1,R2,R3,R4
II	T1,T2	R1,R4
III	T1,T2	R1,R2
IV	T1,T2	R1,R2
V	T1,T2,T3,T4	R2,R3,R4
VI	T1,T2,T3	R2,R3

203150: Applications of Mathematics in Electrical Engineering

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Prerequisite: Basic mathematics, Engineering Mathematics-I, II

Course Objective: Course Objectives are:

- To relate mathematics and electrical problems.
- To introduce software solution
- To develop mathematical and complex problem solving skill.

Course Outcome: At the end of this course, learner will be able to

CO1: Apply fundamentals of mathematics in solving electrical engineering problem

CO2: Analyze complex electrical engineering problem using mathematical techniques.

CO3: Implement program and simulation for problems in electrical engineering.

CO4: Demonstrate self lifelong learning skills with applications of mathematics in electrical engineering through software.

Perform any **Eight** experiments from following list using any professional software:

1. To solve ordinary differential equations in electrical circuits or DC motors:
2. To apply Laplace Transform for solving ordinary differential equations in electrical circuits or DC motors:
3. To analyze the waveform generated using Fourier series.
4. To solve difference equations using z-Transform:
5. To Perform convolution of two discrete signal using software programming:
6. To solve linear simultaneous equations from electrical network (KVL/KCL) using software programming:
7. To determine a phasor of AC signal using Discrete Fourier Transform.
8. To perform mathematical addition, subtraction, multiplication and division of electrical signals.
9. To calculate rms and average values of given waveform using software programming.
10. To calculate electrical power under sinusoidal and non sinusoidal voltage and current

Perform any **Two** experiments from following list using any professional software:.

1. To determine maxima and minima of single/two variable problem.
2. To convert three phase electrical signal quantities dq0 transformation.
3. To apply partial difference equation in Electromagnetic (Maxwell equation)
4. To apply graph theory in network analysis
5. To calculate poles and zeros in complex electrical network.

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm
- Three to four different sets of problem statement
- Solve numerical using appropriate method
- Ten questions based on experiment
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm
- Problem statement
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on experiment

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

203151: Soft Skill

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Course Objective: The course aims to:-

- To possess knowledge of the concept of Self-awareness and Self Development.
- To understand the importance of Speaking Skills, listening skills, Presentation Skills and leadership skills.
- To gain the knowledge of corporate grooming & dressing, Email & telephone etiquettes, etiquette in social & office setting.
- To get conversant with Team work, Team effectiveness, Group discussion, Decision making.
- To recognize the importance of time management and stress management.

Course Outcome: Students will be able to :-

CO1: DoSWOC analysis.

CO2: Develop presentation and take part in group discussion.

CO3: Understand and implement etiquette in workplace and in society at large.

CO4: Work in team with team spirit.

CO5: Utilize the techniques for time management and stress management.

Unit 01 : Self-Awareness & self-Development: (4Hrs)

A) Self-Assessment , Self-Appraisal, SWOT, Goal setting - Personal & career - Self Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self-appraisal, Personal Goal setting,

B) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting and prioritization.

Unit 02 : Communication Skill: (6 Hrs)

A) Importance of communication, types, barriers of communication, effective communication.

B) Speaking Skills: Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self-expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

C) Listening Skills:Law of nature- you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, Avoid selective listening

D) Group Discussion:Characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

E) Presentation skills:Planning, preparation, organization, delivery.

F) Written Skills: Formal & Informal letter writing, Report writing, Resume writing - Sentence structure, sentence coherence, emphasis. Paragraph writing. Letter writing skills – form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

Unit 03 : Corporate / Business Etiquette: (2 Hrs)

Corporate grooming & dressing, Email & telephone etiquette, etiquette in social & office setting: Understand the importance of professional behavior at the work place, Understand and Implement etiquette in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquette (targeted at young professionals who are just entering business environment), Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

Unit 04 : Interpersonal relationship: (4 Hrs)

A) Team work, Team effectiveness, Group discussion, Decision making – Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.

B) Group Discussion- Preparation for a GD, Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD, Conflict management, Do's and Don'ts in GD

Unit 05 : Leadership skills: (2 Hrs)

Leaders' role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example,effective feedback.

Unit 06 : Other skills: (2 Hrs)

A) Time management- The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to priorities using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions , to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individualized plan of action.

B) Stress management- understanding the stress & its impact, techniques of handling stress.

C) Problem solving skill, Confidence building Problem solving skill, Confidence building

Term Work/Assignments: Term work will consist the record of any 8 assignments of following exercises

1. SWOT analysis
2. Personal & Career Goal setting – Short term & Long term
3. Presentation Skill
4. Letter/Application writing
5. Report writing
6. Listening skills
7. Group discussion
8. Resume writing
9. Public Speaking
10. Stress management
11. Team Activity-- Use of Language laboratory

Teaching Methodology:

Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below.

Practical Assignments (Term work)

Minimum 8 assignments are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should explain the topics mentioned in the syllabus during the practical sessions followed by the actual demonstration of the exercises. Students will submit report of their exercise (minimum 8) assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed.

1. **SWOT analysis**: The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.
2. **Personal & Career Goal setting** – Short term & Long term
3. **Presentation Skills**: Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
4. **Letter/Application writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
5. **Report writing**: The teacher should teach the students how to write report. The teacher should give proper format and layouts. Each student will write one report based on visit / project /

business proposal etc.
6. **Listening skills**: The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.
7. **Group discussion**: Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.
8. **Resume writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
9. **Public Speaking**: Any one of the following activities may be conducted : A) Prepared speech(topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver. B) Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic) C) Story telling (Each student narrates a fictional or real life story for 5 minute search) D) Oral review(Each student orally presents a review on a story or a book read by them)
10. **Team Activity**-- Use of Language laboratory

Text Books:

[T1] Sanjay Kumar and PushpaLata, “Communication Skills”, Oxford University Press.
[T2] Krishna Mohan, MeeraBanerji, “Developing Communication Skill”, McMillan India Ltd.
[T3] Simon Sweeney, “English for Business Communication”, Cambridge University Press
Reference Books:
[R1] Accenture, Convergys, Dell et.al, “NASSCOM-Global Business Foundation Skills, Foundation Books, Cambridge University Press.
[R2] E. H. McGraw, “Basic Managerial Skills for all”, Eastern Economy Edition, Prentice hall
[R3] Barun K. Mitra, “Personality Development and Group Discussions”, Oxford University Press.
[R4] PriyadarshiPatnaik, “Group Discussions and Interview Skills: Foundation Books”, Cambridge University Press.
[R5] Napoleon Hill, “Thinks and Grow Rich”, Ebury Publishing, ISBN 9781407029252.
[R6] Tony Robbins, “Awaken the Giant Within”, Harper Collins Publishers, ISBN139780743409384. S.E. Electrical Engineering (2015 course) – Savitribai Phule Pune University 25
[R7] Wayne Dyer, “Change Your Thoughts, Change Your Life”, Hay House India, ISBN-139788189988050.
[R8] Stephen Covey, “Habits of Highly Effective People”, Pocket Books, ISBN139781416502494.
[R9] Dr. Joseph Murphy, “The Power of Your Subconscious Mind”, MaanuGraphics, ISBN-13 9789381529560.
[R10] Daniel Coleman, “The new Leaders”, Sphere Books Ltd, ISBN-139780751533811.
[R11] Richard Koch, “The 80/20 Principal”, Nicholas Brealey Publishing , ISBN-13 9781857883992.
[R12] Julie Morgenstern, “Time management from inside out”, Owl Books (NY),ISBN-13 9780805075908.
[R13] Shiv Khera, “You can win”, Macmillan, ISBN-139789350591932.
[R14] Gopalaswamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”

203152 : Audit Course-III

List of three audit course is provided. Students can choose any one from 203152(A) 203152(B) and 203152(C)

203152 (A) : Solar Thermal System

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	No credit	Grade: PP/NP Quiz and term paper

Description: The course will introduce the basics of: solar energy, availability, applications, heat transfer as applied to solar thermal systems, various types of solar thermal systems, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The field visits will be designed for first-hand experience and basic understanding of the system elements.

Course Objective:

- To understand basics and types of solar thermal systems.
- To get knowledge of various types of concentrators.
- To make students aware of different Standards and certification for Concentrator Solar Power.

Course Outcome: Student will be able to

CO1: Differentiate between types of solar Concentrators

CO2: Apply software tool for solar concentrators

CO3: Design different types of Solar collectors and balance of plant

Course Contents:

- Sun, Earth and seasons
- Solar Radiation
- Basics of heat transfer
- Absorption, reflection and transmission of radiation
- Types of Solar thermal systems
- Basic design of different types of systems
- Applications of solar thermal systems and their economics
- Need for solar concentration
- Various types of solar concentrators
- Movement of Sun and tracking
- Control systems for solar tracking
- Concentrating solar thermal (CSP)
- Concentrating solar PV (CPV)
- Balance of plant for CSP
- Critical points in concentrating solar system installation
- Operation and maintenance of CSP
- Typical financial analysis of CSP
- Software tools for concentrating solar power
- Environmental impact assessment
- Standards and certification for CSP
- Basics of solar thermal (STH) systems
- Elements of various STH systems
- Design, materials and manufacturing of
  - ➢ Flat plate solar collector
  - ➢ Evacuated tube solar collector
  - ➢ Parabolic trough collector
  - ➢ Dish type solar concentrators
  - ➢ Concentrating PV systems
  - ➢ Balance of plant
- Manufacturing standards

- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Assignment

- Design of solar thermal system for residential/ commercial building.

References:

1. Trainers Textbook Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India
2. Students Workbook for Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India

203152 (B) : C Language Programming

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Course Objective:

- To give basic idea about C programming language
- To prepare students for writing algorithm, draw flow chart and program in C language
- To learn data types and syntax in C language.

Course Outcome: Student will be able to

CO1: Elaborate data types, arithmetic, logical and conditional operators

CO2: Apply control and looping statements in C programming

CO3: Write programming using C language with functions, arrays and pointers.

Course Contents:

Unit 01: The language of C : Phases of developing a running computer program in C, Data concepts in C :Constants, Variables, Expressions, Operators, and operator precedence in C., Statements : Declarations, Input-Output Statements, Compound statements, Selection Statements. Conditions, Logical operators, Precedence. Repetitive statements, While construct, Do-while Construct, For construct., Data types, size and values. Char, Unsigned and Signed data types. Number systems and representations. Constants, Overflow., Arrays. Strings. Multidimensional arrays and matrices.

Unit 02: Functions :The prototype declaration, Function definition.Function call : Passing arguments to a function, by value, by reference. Pointers : Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer

Assignment

- Write C program for arithmetic operations such as +,-,*,/,%.
- Write C program for decision making statements such as if, else-if etc.
- Write C program for Representative statements such as for, while, do-while.
- Write C program to determine roots of an quadratic equation using functions.
- Write C program to enter matrix data and printing its inverse.
- Write C program to demonstrate use of pointers.

References:

1. A.R. Bradley, "Programming for Engineers", Ringer, 2011
2. Hankering and Chitchat, "The C Programming Language", (2nd ed.) Prentice Hall, 1988

203152(C) Japanese Language-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Course Objective:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome: On completion of the course student

- Will have ability of basic communication.
- Will have the knowledge of Japanese script.
- Will get introduced to reading , writing and listening skills
- Will develop interest to pursue professional Japanese Language course.

Course Contents:

Unit 1: Introduction to Japanese Language. Hiragana basic script, colors, Days of the week

Unit 2: Hiragana: modified Kana, double consonant, Letters combined with ya, yu, yo Long vowels, Greetings and expressions

Unit 3: Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one's age.

References:

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Text book 1-1 (IndianEdition), Goyal Publishers & Distributors Pvt. Ltd.

Guidelines for Conduction

(Any one or more of following but not limited to)

- Guest Lectures
- Visiting lectures
- Language Lab

Guidelines for Assessment (Any one of following but not limited to)

- Written Test
- Practical Test
- Presentation
- Paper
- Report

203145: Power System-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite courses if any: Power Generation, Various insulating materials and properties, Knowledge of fundamentals of electrical circuit components and engineering mathematics.

Course Objectives:

1. To learn the basic structure of electrical power systems, various electrical terms related with power system and understand various types of tariff.
2. To understand the specifications and applications of various major electrical equipment present in power plant.
3. To get the knowledge of mechanical and electrical design of overhead and underground transmission system.
4. To learn representation of transmission lines for performance evaluation.

Course Outcomes:

Upon successful completion of this course, the students will be able to:

CO1: Recognize different patterns of load curve and calculate associated different factors with it and tariff.

CO2: Draft specifications of electrical equipment in power station.

CO3: Design electrical and mechanical aspects in overhead transmission and underground cables.

CO4: Evaluate the inductance and capacitance of different transmission line configurations.

CO5: Analyse the performance of short and medium transmission lines

Unit 01: Structure of Electrical Power Systems and Tariff [6Hrs]

A) **Structure of Electrical Power Systems:** Structure of electrical power system, Different factors associated with generating stations such as Connected load, Maximum demand, Demand factor, Average load, Load factor, Diversity factor, Plant capacity factor, Reserve capacity, Plant use factor, Load curve, Load duration curve, Concept of base load and peak load stations, Advantages of interconnected grid system, Fitting of available generating station into the area load duration curve. **[4 Hrs]**

B) **Tariff:** Introduction of Tariff, Tariff setting principles, desirable characteristics of tariff, various consumer categories and implemented tariff such as two part tariff, three part tariff(Numerical on two part and three part tariff), Time of day tariff for H.T and L.T industrial and commercial consumers, Introduction to Availability based tariff (ABT), kVAh tariff(Descriptive treatment only).[**2 Hrs**]

Unit 02 Major Electrical Equipment's in Power Station & Underground Cables [6Hrs]

A) Major Electrical Equipment's in Power Station: Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, Power transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays. Current transformers, potential transformers, Lightning arresters, Earthing switches, isolators, Carrier current equipment's (P.L.C.C), Control panels, battery rooms, metering and other control room equipment in generating station**. [3Hrs]**

B)Underground Cables: Construction of Cables, Classification of cables, XLPE cables, Capacitance of single core and three core cable, Dielectric stresses in single core cable, Grading of cables, inter sheath grading, capacitance grading. **[3Hrs]**

Unit 03: Mechanical Design of Overhead lines and Insulators: [6Hrs]

A) Mechanical Design of Overhead lines: Main components of overhead lines, Various types of line supports, Conductor spacing, Length of span, Calculation of sag for equal and unequal supports and effect of ice and wind loading. **[3Hrs]**

B) Overhead Line Insulators: Types of insulators, its construction and their applications such as Pin type, Suspension type, Strain type, Shackle type, Post insulators, bushing. Potential distribution over suspension insulators, String efficiency, (Numerical on string efficiency and up to four discs only), Methods of improving string efficiency (Descriptive treatment only). **[3Hrs]**

Unit 04:Resistance and Inductance of Transmission Line: [6Hrs]

Resistance of transmission line, Skin effect and proximity effect, Factors responsible for production of these effects, Internal and external flux linkages of single conductor, Inductance of single phase two wire line, Necessity of transposition, Inductance of three phase line with symmetrical and unsymmetrical spacing with transposition, Concept of G.M.R and G.M.D, Inductance of bundled conductors.

Unit 05: Capacitance of Transmission Line: [6Hrs]

Electric potential at single charged conductor, Potential at conductor in a group of charged conductors, Capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R and G.M.D for capacitance calculations, need of transposition for capacitance calculations, Capacitance of three phase line with symmetrical and unsymmetrical spacing with transposition. Capacitance of single circuit and double circuit three phase line with symmetrical and unsymmetrical spacing considering transposition (without considering earth effect).

Unit 06: Performance of Transmission Line [6Hrs]

Classification of lines based on length and voltage levels such as short, medium and long lines, Performance of short transmission lines with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Π' and 'Nominal T' circuits using R,L and C parameters, Ferranti effect, Representation of 'T' and 'Π' models of lines as two port networks, Evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of efficiency and regulation of short and medium lines**.**

Industrial Visit: Compulsory one visit to EHV substation is recommended

Text Books:

[T1] V.K.Meheta, Rohit Mehta, "Principles of Power System", S. Chand Publication.
[T2] J.B.Gupta, "Transmission and Distribution", S.K.Kataria and Sons, New Delhi.
[T3] J.B.Gupata,"Generation and Economic Considerations",S.K.Kataria & Sons, New Delhi.
[T4] Dr.B.R.Gupta, "Generation of Electrical Energy", S. Chand Publication.
[T5] A Chakraborty, M.L.Soni, P.V. Gupta, U.S.Bhatnagar,"A text book on Power System Engineering", Dhanpatrai & Co, Delhi.
[T6] S.N.Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

[R1] Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications
[R2] D. Das," Electrical Power System", New Age Publication
[R3] W.D.Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] M.V.Deshpande," Elements of Power Station Design", Wheeler Publishing.
[R5] I.J. Nagrath and D.P.Kothari," Modern Power System Analysis", Tata McGraw Hill
[R6] NPTEL course on Power System Engineering, IIT Kharagpur https://nptel.ac.in/courses/108/105/108105104/
[R7] NPTEL course on Power System Analysis, IIT Kharagpur https://nptel.ac.in/courses/108/105/108105067/
[R8] NPTEL Power System Analysis, IIT Kharagpur https://www.youtube.com/playlist?list=PLRWKj4sFG7-6gWwDMLI0Wy5DDRqyKP1uQ
[R9] MAHADISCOM Website for tariff: https://wss.mahadiscom.in/wss/wss?uiActionName=getEnergyBillCalculator
[R10] Maharashtra Electricity Regulatory Commission www.merc.gov.in

Units	Text Books	Reference Books
1	T1,T3,T6	R1,R3,R4,R8,R9,R10
2	T1,T4	R4,R6
3	T1,T5	R4,R6
4	T1,T2,T5,T6	R1,R7,R8
5	T1,T2,T5,T6	R1,R7,R8
6	T1,T2,T5	R3,R5,R7,R8

203146: Electrical Machines-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite:

- Magnetic circuit, mutual induced EMF, dynamically induced EMF, Direction of magnetic field in current carrying conductor, Flemings LHR & RHR, Electromechanical energy conversion.

Course Objective:

- To understand energy conversion process.
- To understand selection of machines for specific applications.
- To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.
- To test & analyse the performance of machine.

Course Outcome: Upon successful completion of this course, the students will be able to:

CO1: Evaluate performance parameters of transformer with experimentation and demonstrate construction along with specifications as per standards.

CO2: Distinguish between various types of transformer connections as per vector groups with application and to perform parallel operation of single/three phase transformers.

CO3: Select and draft specifications of DC machines and Induction motors for various applications along with speed control methods.

CO4: Justify the need of starters in electrical machines with merits and demerits.

CO5: Test and evaluate performance of DC machines and Induction motors as per IS standard.

Unit 01: Transformers: (6 Hrs)

Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer, Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Auto transformers, their ratings and applications. Comparison with two winding transformers with respect to saving of copper and size.

Unit 02: (6 Hrs)

Transformers:

Polarity test. Parallel operation of single-phase transformers, conditions to be satisfied, loadsharing under various conditions. & Welding Transformer

Three Phase Transformers:

Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V connections. Three winding (tertiary windings) transformers

Unit 03: D.C. Machines (Part-1): (6 Hrs)

Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F, torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.

Unit 04: D.C. Machines (Part-2): (6 Hrs)

Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors.

Commutation: Process of commutation, time of commutation, reactance voltage, different form of commutations, causes of bad commutation and its remedies (Descriptive treatment only)

Unit 05: Three Phase Induction Motor: (6 Hrs)

Construction: Stator, Squirrel cage & wound rotors. Production of rotating mmf. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram, Relation between rotor input power, rotor copper loss & gross mechanical power developed, efficiency.

Unit 06: Three Phase Induction Motor: (6 Hrs)

Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors, comparison of various starters. Testing of three phase induction motor as per IS 325 & IS 4029.

Industrial Visit:

Minimum One visit to above machines manufacturing industry (mentioned in syllabus) is recommended.

List of Experiments:

Compulsory Experiments:

1. O.C. and S.C. test on single phase Transformer
a. Determination of equivalent circuit parameters from the test data
b. Determination of voltage regulation and efficiency
2. Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedance.
3. Speed control of D.C. Shunt motor and study of starters.
4. Load test on 3-phase induction motor.

Any four experiments are to be conducted of following experiments:

1. Polarity test on single phase and three phase transformer.
2. Brake test on D.C. Shunt motor
3. Load characteristics of D.C. series motor.
4. Hopkinson's test on D.C. shunts machines.
5. No load & blocked-rotor test on 3-phase induction motor:
a) Determination of parameters of equivalent circuit.
b) Plotting of circle diagram.
6. Calculation of motor performance from (a) & (b) above.
7. Determination of sequence impedance of the transformer
8. To study Sumpner's test.
9. Measurements of non-sinusoidal current waveform of transformer at no load
10. Swinburne Test on DC shunt Motor.

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", Dhanpat Rai& Sons.
[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
[T4] Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, Third Edition.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", TataMcGraw

Hill Publication Ltd., Fifth Edition.
[R3] A.S. Langsdorf, “Theory and performance of DC machines”, Tata McGraw Hill.
[R4] M.G. Say, “Performance and Design of AC. Machines”, CBS Publishers and Distributors.
[R5] Smarajit Ghosh, “Electrical Machines”, Pearson Education, New Delhi.
[R6] Charles I Hubert, “Electrical Machines Theory, Application, & Control”, Pearson Education, New Delhi, Second Edition.

Unit No.	Text Book	Book Reference
I	T1, T2, T3, T4	R2, R4, R5
II	T1, T2, T3, T4	R2, R4, R5
III	T2, T3, T4	R1, R3, R5
IV	T2, T3, T4	R1, R3, R5
V	T1, T3, T4, T5, T6	R4, R5, R6
VI	T1, T3, T4, T5, T6	R4, R5, R6

203147: Network Analysis

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks

Prerequisite: □
Terminology of electrical networks, series and parallel combinations of resistance, Laplace transforms , linear differential equations.

Course Objective:□
1. To develop the strong foundation for Electrical Networks.
2. To develop analytical qualities in Electrical circuits by application of various theorems. □
3. To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach. □
4. To apply knowledge of laws and Network theory for analysis of 2-port networks and design of other circuits like filters.

Course Outcome:
Upon successful completion of this course, the students will be able to :- □

CO1: Calculate current/voltage in electrical circuits using simplification techniques, Mesh, Nodal analysis and network theorems.□
CO2: Analyze the response of RLC circuit with electrical supply in transient and stead state. □
CO3: Apply Laplace transform to analyze behaviour of an electrical circuit.
CO4: Derive formula and solve numerical of two port network and Design of filters
CO5: Applyknowledge of network theory to find transfer function, poles and zeroes location to perform stability analysis and parallel resonance

Unit 1 Types of Network, Mesh and Nodal analysis [6 Hrs]
Lumped and Distributed, Linear and Nonlinear, Bilateral and Unilateral, Time-variant and Time-invariant. Independent and Dependent (controlled) voltage and current sources. Concept of voltage and current divider, Source transformation and shifting. Network Equations: Network equations on Loop basis and Node basis, choice between Loop analysis and Nodal analysis. Concept of super node and super mesh, mutual inductance, Dot convention for coupled circuits, Concept of duality and dual networks.

Unit 2: Network Theorem:[6 Hrs]
Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity, Millman theorems applied to electrical networks with all types of sources.
Graph Theory : Tree ,Co-tree, Incidence matrix ,F-cutest Matrix, Tie set B Matrix

Unit 3: Transients in RLC circuit[6 Hrs]
Solutions of differential equations and network equations using classical method for R-L, R-C and R-L-C circuits, Initial and Final Condition (series and parallel).

Unit 4: Laplace Transform[6 Hrs]
Basic Properties of Laplace Transform, Laplace Transform of Basic R, L and C components, Solutions of differential equations and network equations using Laplace transform method for RL, R-C and R-L-C circuits (series and parallel), Inverse Laplace transforms, transformed networks with initial conditions. Analysis of electrical circuits with applications of step, pulse, impulse & ramp functions, shifted & singular functions the convolution integral,application of initial and final value theorem.

Unit 5 Two port network and Filters [6 Hrs]
Two Port Network: Z, Y, H and transmission parameters, Interrelations between parameters. Introduction to passive filters, low pass filters, high pass filters and m-derived LPF and HPF filters and design.

Unit 6 Network Functions: [6 Hrs]
Poles and Zeros: Terminal pairs or ports, network functions for the one port and two ports, the calculation of network functions, general networks. Poles and zeros of network functions, Restrictions on poles and zeros locations for transfer functions and driving point function, Time –

domain behavior from the pole and zero plot. Stability of active networks. Parallel Resonance, Resonance frequency, Quality factor, Current and resonance.

List of Experiments: Any four experiments from the first five of the following and any four experiments from rest of the list. (Minimum four experiments should be based on simulation software along with hardware verification)

1. Verification of Superposition theorem in A.C. circuits.
2. Verification of Thevenin's theorem in A.C. circuits.
3. Verification of Reciprocity theorem in A.C. circuits.
4. Verification of Millmans' theorem.
5. Verification of Maximum Power Transfer theorem in A.C. circuits.
6. Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor)
7. Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit)
8. Determination of time response of R-L-C series circuit to a step D.C. voltage input.
9. Determination of parameter of Two Port Network.
10. Determination of current under parallel Resonance condition .
11. Determination of Resonance, Bandwidth and Q factor of R-L-C series circuit.

Guidelines for Instructor's Manual□

- Specify objective(s) of the experiment. □
- List out equipment required to perform the experiment with their ratings. □
- Include circuit diagram with specifications. □
- Related theory of the experiment must be included. □
- Include step by step procedure to perform the experiment. □
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable. □
- It should include the formula required to calculate desired results. □ Instructions for plotting the graphs must be included wherever required. □
- Provide space to write conclusion on their own. □
- For simulation experiments using MATLAB, the Simulink diagram with proper details must be included.

Guidelines for Student's Lab Journal □

- Students are expected to write the journal in the following sequence: □
  - ➢Aim □
  - ➢Equipment □
  - ➢Circuit diagram □
  - ➢Theory
  - ➢Procedure
  - ➢Observation table□
  - ➢Calculations □
  - ➢Graphs□
  - ➢Conclusion. □
- Students are expected to draw the circuit diagrams on 1mm graph paper. □
- For plotting the characteristics they must use 1mm graph papers. □
- Students should write conclusion. □
- Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Lab

- TW Assessment should be on the basis of: □
- Neatness of circuit diagram. □
- Completed write up including theory, procedure. □
- The detail calculations to obtain results. □
- Graph with title, scale, labeling of axes etc. □
- Conclusion. □

- Punctuality, discipline, attendance, understanding and neatness of the journal. Few questions on the basis of the experiment can be asked to verify the understanding of the students about that experiment.

Guidelines for Laboratory Conduction □

- Give the safety instructions to students. □
- Allow 4-5 students per group for performing the experiment. □
- Explain theory related to the experiment to be conducted. □
- Introduce the equipment required to students. □
- Explain students the calibration process of equipment. □
- Explain the circuit diagram of the experiment. □
- Connections should be completed by the students according to circuit diagram. □ Perform the experiment in the presence of instructor. □
- Verify the results obtained.

Text Book:

[T1] Network Analysis Third Edition by M. E. Van Valkenburg, Prentice Hall of India Private Limited.

[T2] Network Analysis & Synthesis by G. K. Mittal, Khanna Publication.

[T3] Network Analysis and Synthesis by Ravish R Singh, McGraw Hill.

[T4] Introduction to Electric Circuits by Alexander & Sadiku, McGraw Hill.

[T5] Introduction to Electric Circuits by S. Charkarboorty, Dhanpat Rai & Co.

[T6] Fundamentals of Electrical Networks by B.R.Gupta & Vandana Singhal- S.Chand Publications 8. Electrical Circuit Analysis 2nd Edition by P. Ramesh babu, Scitech Publication India Pvt Ltd.

Reference Books:

[R1] Network Analysis by Cramer , McGraw Hill Publication.

[R2] Engineering Circuit Analysis by William H. Hayt, Jr. Jack E. Kemmerly, McGraw Hill Publication.

[R3] Schaum's Outline of Electric Circuits, McGraw-Hill Education; 7 edition

Unit	Text book	Reference
1	T1,T2, T3 T5	R1,R3
2	T1,T2, T3, T4	R1,R3
3	T2, T3,T5	R2,R3
4	T2, T3,T5	R2,R3
5	T2, T3, T4	R3
6	T5,T6	R3

203148: Numerical Methods and Computer Programming

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 25 Marks

Prerequisite:

1. Differentiation and integration of a single real variable, ordinary differential equations.
2. Programming and Problem solving.
3. Linear Algebra.

Course Objectives:

1. To emphasize the need of computational techniques and analyze errors involved in the computation.
2. To provide sound knowledge of various numerical methods.
3. To apply various numerical methods to obtain solution of different types of equations such as transcendental, simultaneous, ODE etc. and also for interpolation, integration and differentiation.
4. To impart skills to develop algorithms and programs for various numerical methods.

Course Outcomes:

On completion of the course, student will be able to

CO1: Demonstrate types of errors in computation and their causes of occurrence.

CO2: Calculate root of algebraic and transcendental equations using various methods.

CO3: Apply numerical methods for various mathematical problems such as interpolation, numerical differentiation, integration and ordinary differential equation.

CO4: Solve linear simultaneous equation using direct and indirect method.

CO5: Develop algorithms and write computer programs for various numerical methods.

Unit 01 : Numerical Computations, Errors and Concept of root of equation (6hrs)

A) Basic principle of numerical computation. Floating point algebra with normalized floating point technique, Significant digits. **Errors**: Different types of errors, causes of occurrence and remedies to minimize them, Generalized error formula (Derivation and Numerical)

B) **Concept of roots** of an equation. Descartes' rule of signs, Intermediate value theorem, Roots of Polynomial Equations using Birge-Vieta method.

Unit 02: Solution of Transcendental and polynomial equation and Curve Fitting: (6hrs)

A) Solution of Transcendental and polynomial equation using Bisection, Regula- Falsi, Newton-Raphson method for single variable and two variables.

B) Curve fitting using least square approximation – First order and second order

Unit 03: Interpolation (6hrs)

Forward, Backward, Central and Divided Difference operators, Introduction to interpolation.

A)Interpolation with equal Intervals - Newton's forward, backward interpolation formula (Derivations and numerical), Stirling's and Bessel's central difference formula (Only numericals)

B) Interpolation with unequal Intervals- Newton's divided difference formula and Lagrange's interpolation (Derivations and numerical).

Unit 04: Numerical Differentiation and Integration (6hrs)

A) **Numerical Differentiation** using Newton's forward and backward interpolation formula (Derivation and numerical).

B) Numerical Integration: Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single integral. Numerical on double integrals using Trapezoidal and Simpson's 1/3 rd rule.

Unit 05:Solution of linear simultaneous equation (6hrs)

A) Solution of linear simultaneous equation: Direct methods - Gauss elimination method, concept of pivoting – partial and complete. Gauss Jordan method, Iterative methods – Jacobi method and Gauss Seidel method.

B)Matrix Inversion using Gauss Jordan method

Unit 06: Solution of Ordinary Differential Equation(ODE) (6hrs)

A) Solution of First order Ordinary Differential Equation (ODE) using Taylor's series method, Euler's method, Modified Euler's method (Derivation and numerical). Runge-Kutta fourth order method (Numerical).

B)Solution of Second order ODE using 4th order Runge-Kutta method (Numerical)

List of Experiments:
Develop computer program using **Python language**
Compulsory Experiments-1,2,3,4,7,10
Any one from 5 or 6 and any one from 8 or 9

1. Develop algorithm, draw flow chart and write a program to implement following:
   (a) for loop and while loop-- application in Descarte's rule of sign.
   (b) if-else and functions-- application in Intermediate value theorem.
   (c) 2DArray formation-- application in matrix data entry, transposition and printing matrix.
2. Develop algorithm, draw flow chart and write a program to implement Birge-Vieta method.
3. Develop algorithm, draw flow chart and write a program to implement Bisection/Regula falsi /Newton-Raphson method (single variable) in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Finding critical clearing angle in power system stability (give equation directly)
   (b) Relation between voltage and current in solar PV.
4. Develop algorithm, draw flow chart and write a program to implement curve fitting using least square approximation in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging.
   (b) Relate temperature and resistance in thermocouple.
   (c) Current through inductor during excitation.
5. Develop algorithm, draw flow chart and write a program to apply Newton's forward/backward interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging
   (b) Relation of speed and armature voltage in DC motor.
   (c) Relation of breakdown voltage and thickness of insulation
6. Develop algorithm, draw flow chart and write a program to apply Newton's divided difference/Lagrange's interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Power transfer equation to find power at particular angle
   (b) Transformer efficiency at particular loading (data of % loading and efficiency in known at a particular power factor)
   (c) Growth of electricity consumption in India (year Vs. Per capita electrical consumption).
7. Develop algorithm, draw flow chart and write a program to implement trapezoidal/ Simpson (1/3)rd rule in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) RMS/Average value of given waveform.
   (b) Finding current through first order circuit (RL series)
   (c) kWh consumption from load curve
   (d) Magnetic field intensity in overhead transmission line
8. Develop algorithm, draw flow chart and write a program to implement Gauss elimination/Jordan in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
9. Develop algorithm, draw flow chart and write a program to implement Gauss Jacobi/Seidel in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
10. Develop algorithm, draw flow chart and write a program to implement Modified Euler's/4th order RK method in following applications (formulate problem statement in any one of following area(but not limited to)
   (a) Response of RC series circuit with DC
   (b) Response of RL circuit with DC
   (c) Deflection angle in MI type instrument

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm and Flowchart of the method
- Three to four different sets of problem statement for numerical method

- Solve numerical using appropriate method
- Ten questions based on method and related Python commands
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm and Flowchart of the method
- Problem statement for numerical method
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on method and related Python commands

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken in the lecture prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

Books & Other Resources:

Text Books:

[T1] M. K. Jain, S.R.K. Iyangar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Publications.
[T2] Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences", Khanna Publishers.
[T3] P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis", Krishna Prakashan Media Ltd, Meerut.
[T4] T. Veerarajan and T. Ramchandran, "Numerical Methods with Programs in C and C++", Tata McGraw Hill Publication.
[T5] S Arumugam, "Numerical Methods" Scitech Publication

Reference Books:

[R1] J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH, New Delhi.
[R2] Steven Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publication.
[R3] S.S. Sastry, "Introductory methods of Numerical Analysis", PHI Learning Private Ltd.
[R4] P. Thangaraj, "Computer oriented Numerical Methods", PHI Learning Private Ltd.
[R5] Yashwant Kanitkar, "Let us Python", pbp publications
[R6] NPTEL course on Numerical Analysis, IIT, Roorkee.
https://nptel.ac.in/courses/111107062/
[R7] NPTEL course on MATLAB Programming on Numerical Computation, IIT Madras
https://nptel.ac.in/courses/103106118/
[R8] NPTEL course on Python for Data Science, IIT Madras
https://nptel.ac.in/courses/106106212/
[R9]Jaan Kiusalaas, "Numerical methods in Engineering with Python", Cambridge University Press

Unit No	Text Books	References
1	T5, T4	R2, R3, R6
2	T1, T5	R2, R3, R6
3	T3, T4, T5	R4, R2, R1, R6, R7
4	T2, T3,T5	R2, R3, R7
5	T2, T3,T5	R2, R3, R7
6	T2, T3,T5	R2, R3, R6, R7
Python	--	R5, R8,R9

203149: Fundamental of Microcontroller and Applications

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

- Knowledge of numbering systems and Boolean algebra.
- Knowledge of combinational and sequential logic circuits.

Course Objective: Objectives of the course are to

- Explain the microcontroller architecture & describe the features of a typical microcontroller.
- To use the 8051 addressing modes and instruction set and apply this knowledge to develop programs in assembly language and C language.
- To define the protocol for serial communication and understand the microcontroller development systems.
- Explain the interrupt structure of the microcontroller and to develop programs related to interrupt handling
- To introduce students to Global System for Mobile Communication (GSM)
- To provide students with interfacing concepts and develop interfacing circuits for simple devices.

Course Outcome: Upon successful completion of this course, the students will be able to:-

CO1: Describe the architecture and features of various types of the microcontroller.

CO2: Illustrate addressing modes and execute programs in assembly language for the microcontroller.

CO3: Write programs in C language for microcontroller 8051.

CO4: Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809

CO5: Define the protocol for serial communication and understand the microcontroller development systems.

CO6: Interface input output devices and measure electrical parameters with 8051 in real time.

Unit 01 : (6 Hrs)

Introduction to concept of microcontroller, Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer. Overview of special function registers,Data transfer instructions and programs in assembly language.

Unit 02 : (6 Hrs)

Arithmetic and logical instructions and programs in assembly language.Boolean and Program Branching instructions and programs in assembly language.Addressing modes of 8051.

Unit 03 : (6 Hrs)

8051 Programming in C , Data types in C . Ports of 8051, their use, and programming in C (Byte Level and Bit-level). Time delay programming in C.

Timers and counters in 8051, Timer modes 0,1,2 and its programming in C and counter-programming.

Unit 04 : (6 Hrs)

Interrupt structure of 8051 and SFR associated with interruptsProgramming of External hardware interrupts in C.Interfacing of ADC 0809 with 8051.

Unit 05 : (6 Hrs)

Serial port Structure in 8051. Programming of Serial port for transferring and receiving data in C in mode 1.

Introduction to GSM module, AT commands, Programming to send and read SMS.

Unit 06 : (6 Hrs)

Measurement of electrical parameters such as voltage, current (Theoretical Treatment only).

Interfacing of Stepper motor with 8051 and its programming in C.Interfacing and programming of single Key, LED, and Relay with 8051 in C.

Guidelines for Instructor's Manual

1. Commands to be followed to operate the 8051 microcontroller kit.
2. The architecture of the 8051 microcontroller kit-Functional block diagram & its explanation.
3. Pin Diagram of 8051 microcontrollers with a description of all the 40 pins.
4. Addressing modes-Explanation with an example.
5. Instruction set for Data transfer, Arithmetic, Logical, Branching & Bit manipulation along with an explanation.
6. User manuals of all the interfacing kits such as stepper motor, DC motor, DAC, ADC &LED.

Guidelines for Student's Lab Journal

1. Title of the program.
2. The program has to be written in the following format. Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on a separate page.

Guidelines for Laboratory Conduction

1. Each group in the lab should have not more than three students.
2. Each student within the group has to enter and execute the program turn wise.
3. A faculty member has to check the result of all the groups after the execution of the program.

List of Experiments:

PART A: [TW: 15 Marks]

Compulsory Experiments:

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for the arithmetic operation of 8-bit numbers.
3. Assembly Language Program for finding the largest number and smallest number from a given an array of 8-bit numbers.
4. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order and descending order.

Any four experiments are to be conducted of the following experiments using embedded C :

1. Implementation of Serial Communication by using 8051 serial ports.
2. Programming using a cross-assembler.
3. The blinking display of LED’s interfaced with 8051.
4. Interfacing of 8 bit DAC 0808 with 8051 to generate various waveforms.
5. Interfacing of 8 bit ADC 0809 with 8051 Microcontroller.
6. Interfacing of the relay with 8051.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of matrix keyboard/ 7 segment display with 8051.
9. Interfacing of LCD with 8051.

PART B: [TW: 10 Marks]

Prerequisite: Programming exercises of C language.

Compulsory Experiments:

1. Study of GSM Module SIM800/SIM900/QUECTEL M95 and AT Commands
2. Study of IoT system
3. Interfacing of GSM with a computer through COM port to Send and Receive SMS.
4. Interfacing GSM with 8051 trainer kit and develop a program to send AT commands.

Any two experiments are to be conducted of the following experiments:

1. Develop a program in C to read and send SMS from the GSM module.
2. Measurement of physical parameters (Temperature/Pressure/Humidity) using 8051 and send value to GSM after an interval of the specified interval.
3. Measurement of electrical parameters (Voltage/Current) using 8051 and send value to the GSM module after an interval of 10min.
4. Develop a program to turn on and turn off induction Motor using 8051 and GSM module.
5. Development of mobile app for various applications in electrical engineering.

Text Books:

[T1] Muhammad Ali Mazidi, J.G. Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearsons Publishers.
[T2] V Udayashankara and M S MallikarjunaSwamy, “8051 Microcontroller, Hardware, software and applications”, TATA McGraw Hill.
[T3] Ajay Deshmukh, “Microcontroller 8051” –TATA McGraw Hill.
[T4] Theagrajan,” Microprocessor and Microcontroller”, BS Publication.
[T5] K. J. Ayala, “The 8051 Microcontrollers- Architecture, Programming and Applications”, Peram International Publications.
[T6] SubrataGhoshal, “8051 microcontroller”, Pearsons Publishers.
[T7] Han-Way Huang,” Embedded System Design with C8051”, Cengage Learning

Reference Books:

[R1] Scott Mackenzie, “8051 Microcontroller”, Pearson Education.
[R2] Intel Microcontroller data book.
[R3] Intel Corporation 1990- 8 bit embedded controller handbook.

203152: Project Based Learning

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 04 Hrs/ Week	**PR**:02	**Term Work**: 50 Marks

Preamble: For better learning experience, along with traditional classroom teaching and laboratory learning, project-based learning has been introduced to motivate students to learn by working in a group cooperatively to solve a problem. Project-Based Learning (PBL) is a student-centered and experimental approach to education promoting 'deeper learning' through active exploration of real-world problems and challenges. A central goal of PBL is to facilitate the deeper learning process and support students' acquisition of complex cognitive competencies, e.g., rigorous content knowledge and critical thinking skills. The PBL engages students in the problem definition, design process, contextual understanding, and systems thinking approaches. In the PBL approach, learning based on memorization is de-emphasized and more emphasis is given on understanding and application of engineering design principles. Because of frequent assessments throughout the course, plagiarism can be more easily controlled.

Course Objectives: Objectives of this course are to

1. Impart technical knowledge and skills, and develop deeper understanding to integrate knowledge and skills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovation amongst students
3. Make students aware of their own academic, personal, and social developments.
4. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyond own ideas and knowledge

Course Outcomes: At the end of this project-based learning, students will be able to

CO1: Identify, formulate, and analyze the simple project problem.

CO2: Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.

CO3: Learn to work in teams, and to plan and carry out different tasks that are required during a project.

CO4: Understand their own and their team-mate's strengths and skills.

CO5: Draw information from a variety of sources and be able to filter and summarize the relevant points.

CO6: Communicate to different audiences in oral, visual, and written forms.

Procedure: A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted. The complete work-plan should be divided in the form of the individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be presenting the work completed and submitting the report. A group should be promoted to participate in a competition or write a paper.

A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity. It may have

- ✓ A few hands-on activities that may or may not be multidisciplinary.
- ✓ Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.
- ✓ Activities on solving real-life problems, investigation /study, and writing reports of in-depth study, fieldwork.

Assessment:

The department/mentor is committed to assess and evaluate both students' performance and course effectiveness. The progress of PBL is monitored regularly every week. During the process

of monitoring, continuous assessment and evaluation the individual and team performances are to be measured by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning, and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in the assessment and evaluation processes. Groups may demonstrate their knowledge and skills by developing a solution to the problem, public product, and/or report and/or presentation. ✓ Individual assessment for each student (Understanding individual capacity, role, and involvement in the project) ✓ Group assessment (roles defined, distribution of work, intra-team communication and togetherness) ✓ Documentation and presentation
Evaluation and Continuous Assessment: It is recommended that all activities are to be recorded in a PBL workbook regularly, regular assessment of work to be done and proper documents are to be maintained at the department level by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department. Recommended parameters for assessment, evaluation, and weightage are as follows. ✓ Idea Inception **(5%)** ✓ Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product **(50%)** (Individual assessment and team assessment) ✓ Documentation (Gathering requirements, design and modeling, implementation/execution, use of technology and final report, other documents) **(25%)** ✓ Demonstration (Presentation, User Interface, Usability, etc.) **(10%)** ✓ Contest Participation/ publication **(5%)** ✓ Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%)** ✓ PBL workbook will serve the purpose and facilitate the job of students, mentors, and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken

203153: Audit Course-IV

List of three audit course is provided. Students can choose any one from 203153(A) 203153(B) and 203153(C)

203153(A): Solar Photovoltaic Systems

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Prerequisite: Completion of FE or equivalent

Description: The course will introduce the basics of: solar energy, availability, semiconductors as photovoltaic convertors and solar cells, applications of photovoltaic, various types of solar photovoltaic systems, and introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The practical will be designed for basic understanding of the system elements.

Course Objective:

- To learn Solar PV system and its appliances
- To get knowledge of balance of PV system, batteries, inverters etc.
- To understand grid tied SPV solar plants

Course Outcome: Students will be able to

CO1: design of Solar PV system for small and large installations

CO2: handle software tools for Solar PV systems

Course Contents:

- Physics of photovoltaic (PV) electricity
- Photodiode and solar cell
- Solar radiation spectrum for PV •
- Types of solar cell and comparison
- Introduction to various types of solar module manufacturing
- Basic system design and economics
- Types of systems
- Common applications of solar PV
- Introduction to solar PV (SPV) systems
- SPV appliances
- Small capacity SPV power plants
- Grid tied SPV power plants
- Large scale SPV power plants
- Balance of system
- Solar inverters
- Batteries
- Financial modelling of SPV
- Operation and maintenance of SPV
- Software tools for SPV
- Environmental impact assessment
- Standards and certification for SPV
- Basics of SPV systems
- Elements of SPV appliances and power plants Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly
- Manufacturing standards
- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication

- Typical shop layouts
- Inventory management
- Economics of manufacturing

Practical:

- PV characterization
- Batteries and energy storage
- PV system design

Assignment

- Design of solar PV system for department / college.

References:

[1] A.S.Kapur -A Practical Guide for Total Engineering of MW capacity Solar PV Power Project
[2] Solanki C.S- Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers- PHI
[3] Solanki C.S- SolarPhotovoltaics - Fundamentals, Technologies and Applications- PHI
[4] S. Sukhatme -Solar Energy : Principles of Thermal Collection and Storage- McGraw Hill

203153(B) Installation & Maintenance of Electrical appliances

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Prerequisite: Completion of FE/DEE or equivalent

Course Objective: This course has been designed to provide the knowledge of Repairing and Maintenance of home appliances. Students will be familiar with maintenance of everyday household necessities.

Course Outcome: At the end of the course the students will be having knowledge of: -

- Observing the safety precautions while working,
- Test line cord for continuity with test lamp/ multimeter
- Dismantle and reassemble an electric iron
- Heater, kettle, room heater, toaster, hair dryer, mixer grinder etc.
- Install a ceiling fan and the regulator
- Check a fluorescent lamp chock, starter and install it
- Domestic installation testing before energizing a domestic installation

Course Contents:

- General safety & electrical safety
    - ➢ What is safety, Why safety is needed
    - ➢ Tools for electrical safety
    - ➢ Safety rules
    - ➢ Precaution during electrical maintenance
- Crimping & crimping tool, soldering
    - ➢ What is crimping, crimping tool, How to use RJ-11 connector, telephone wire, UTP Cable
    - ➢ crimping technique, precaution during crimping
    - ➢ Soldering Iron, Soldering wire, Soldering Flux,
    - ➢ Soldering method, Zero defect soldering
- Earthing& types of Earthing
    - ➢ Introduction of Earthing
    - ➢ Need of Earthing, Hazard
    - ➢ Types of Earthing
    - ➢ Advantage of Earthing, working of Earthing
- Simple house wiring circuit
    - ➢ Introduction of Wiring ,types of wiring
    - ➢ need of wiring, advantage of wiring
    - ➢ wiring methods
    - ➢ electrical panel
    - ➢ cable type
- Install, service and repair of automatic electric iron, mixer grinder, ceiling and table fan, heater, iron, kettle, washing machine etc
    - ➢ Installation procedure of electric iron,
    - ➢ Installation procedure mixer grinder
    - ➢ Installation procedure of ceiling and table fan,
    - ➢ Installation procedure heater, iron, kettle
    - ➢ Installation procedure washing machine
    - ➢ fault finding & removal of faulty component in electric iron, mixer grinder, ceiling and table fan
    - ➢ fault finding & removal of faulty component in heater, iron, kettle, washing machine
- Assemble and install of a fluorescent lamp
    - ➢ Parts of fluorescent lamp,
    - ➢ Working principle of fluorescent lamp

  - Assembling procedure of lamp
- Thermostat heat controls of Automatic electric iron, steam iron, spray irons.
  - Thermostat, Bimetal, Wax Pallet , Gas Expansion, Pneumatic,
  - Bimetallic Switching thermostat, Simple two wire thermostats
  - Combination heating/Cooling regulation, Heat Control of Steam Iron, Electric Iron
- Maintenance of decorative serial lamp for a required supply voltage
  - What is decorative lamp, Working of decorative lamp
  - Description of decorative serial lamp,
  - Maintenance of decorative serial lamp
- Introduction to re- winding Insulating material used
  - Material, Types of Material
  - Insulating Material, Types of Insulating Material
  - Need of insulating material, winding, re-winding

References:

[1] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House
[2] B. K. N. Rao -Hand book of condition monitoring- Elsevier Advance Tech., Oxford (UK).
[3] Eric Kleinert-Troubleshooting and Repairing Major Appliances / Edition 3- McGraw Hill
[4] Service Manual of Electrical Home Appliances

203153(C) Japanese Language-II		
Teaching Scheme **Lectures: 2hrs/week**	**Credits** **No credit**	**Examination Scheme** [Marks] **Grade: PP/NP** **Quiz and term paper**

Course Objective:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome: On completion of the course student

- Will have ability of basic communication.
- Will have the knowledge of Japanese script.
- Will get introduced to reading , writing and listening skills
- Will develop interest to pursue professional Japanese Language course.

Course Contents:

Unit 1: Katakana basic Script, Denoting things (nominal & prenominal demonstratives)Purchasing at the Market / in a shop / mall (asking & stating price)

Unit 2: Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowelsDescribing time, describing starting & finishing time (kara ~ made) Point in time (denoting the time when any action or the movement occurs)

Unit 3: Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle

References:

1. Minna No Nihongo, “Japanese for Everyone”, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.

Guidelines for Conduction

(Any one or more of following but not limited to)

- Guest Lectures
- Visiting lectures
- Language Lab

Guidelines for Assessment (Any one of following but not limited to)

- Written Test
- Practical Test
- Presentation
- Paper
- Report

Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Third Year Electrical Engineering (2019 course)

(w.e.f. 2021-22)

Savitribai Phule Pune University, Pune
Syllabus: Third Year (TE) Electrical Engineering (2019 course)
(w.e.f 2021-22)

SEMESTER-I

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303141	Industrial and Technology Management	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303142	Power Electronics	3	4#	0	0	30	70	0	50	0	150	3	2	0	0	5
303143	Electrical Machines-II	3	2	0	0	30	70	25	25	0	150	3	1	0	0	4
303144	Electrical Installation Design and Condition Based Maintenance	3	4#	0	0	30	70	25	0	25	150	3	2	0	0	5
303145	Elective-I	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303146	Seminar	0	0	0	1	0	0	50	0	0	50	0	0	0	1	1
303147	Audit course-V	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		**15**	**10**	**0**	**1**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**5**	**0**	**1**	**21**

303145: Elective-I	303147 : Audit Course-V
303145A : Advanced Microcontroller and Embedded System	303147A : Energy storage systems
303145B : Digital Signal Processing	303147B : Start-up & Disruptive innovation
303145C : Open Elective	

SEMESTER-II

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303148	Power System-II	3	2	1	0	30	70	25	50	0	175	3	1	1	0	5
303149	Computer Aided Design of Electrical Machines	3	4#	0	0	30	70	50	0	25	175	3	2	0	0	5
303150	Control System Engineering	3	2$	1$	0	30	70	25	0	25	150	3	1	0	0	4
303151	Elective-II	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303152	Internship	0	0	0	4	0	0	100	0	0	100	0	0	0	4	4
303153	Audit Course VI	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		12	8	2	4	120	280	200	50	50	700	12	4	1	4	21

303151: Elective-II	303153 : Audit Course-VI
303151A : IoT and its Applications in Electrical Engineering	303153A: Ethical Practices for Engineers
303151B : Electrical Mobility	303153B :Project Management
303 151C: Cybernetic Engineering	
303151D: Energy Management	

#Practical consists of Part A & part B. PART A; Regular experiments & part B; to bridge the gap between theory & actual industrial practices. For subject 303144; there will be auto cad drawing on Electrical installation, Electrical wiring, cabling etc. For 303149, Part A, Regular drawing by hand & part B same drawing by AutoCAD.
$ tutorial credit merged with Practical.
* Conduct over and above these lectures.

303141: Industrial and Technology Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Course Objectives: This course aims to

- Possess knowledge of types of business organizations.
- Explore the fundamentals of Industrial economics and Management.
- Understand the basic concepts of Technology management and Quality management.
- Analyze and differentiate between marketing management and financial management.
- Recognize the importance of Motivation, Group dynamics, Teamwork, leadership skill and entrepreneurship.
- Explain the fundamentals of Human Resource management.
- Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.
- Software programming to construct and use simple mathematical model.
- Ability to carry out basic manufacturing and testing procedure.

Course Outcomes: At the end of this course, student will be able to

CO1	Differentiate between different types of business organizations and discuss the fundamentals of economics and management.
CO2	Explain the importance of technology management and quality management.
CO3	Explain the importance of IPR and role of Human Resource Management.
CO4	Understand the importance of Quality and its significance.
CO5	Describe the characteristics of marketing & its types and overview of financial Management.
CO6	Discuss the qualities of a good leader and road map to Entrepreneurship.

Unit 01 | Introduction to Management and Economics | 07 hrs

A) **Management:** Meaning, scope, function, and importance of management. Difference between administration and management.

B) **Industrial Economics:** Definition of economics, Demand and Supply concept, Demand Analysis. Types of Demand, Determinants of Demand, Law of demand and supply, Elasticity of demand and supply, Law of Diminishing Marginal utility, Demand forecasting: Meaning and methods.

C) **Business Organizations:** Line organization, Staff organization and Functional Organization, (Project, Matrix, Committee Organization.)

D) **Business Ownership and its Types:** Types of business ownership, Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership) (Act 2008). One person company, Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU).

Unit 02 | Technology Management | 05 hrs

A) **Technology Management:** Definition of technology Management and its relation with society, development, application and its scope.

B) **Classification of Technology Management:** Classification of technology management at various levels- its importance on National Economy, Ethics in technology management, Critical factors in technology management.

Unit 03 | Intellectual Property Rights (IPR) & Human Resource Management (HRM) | 06 hrs

A) **Introduction to Intellectual Property Rights (IPR):** Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy rights and trademark (Descriptive treatment only).

B) **Human Resource Management:** Introduction, importance, scope, HR planning, Recruitment, selection, training and development, Performance management.

Unit 04	Quality Management	06 hrs
A) Quality Management: Definition of quality, continuous improvement, Types of quality, Quality of design, Seven QC Tools, Poka Yoke (Mistake Proofing), Quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma. Basic software used for inventory management and quality management like Zoho inventory, Oracal, Netsuite, Vyapar, Quick book commerce. **B) Quality Management Standards (Introductory aspects only):-** The ISO9001:2000 Quality Management System Standard-The ISO14001:2004, ISO26000, ISO 10004:2012, ISO 9001:2012 ISO 9001:2016, Environmental Management System Standard.		
Unit 05	**Marketing and Financial Management**	**06 hrs**
A) **Marketing Management**: Meaning of Market, Marketing strategy, motives, market characteristics and its types, Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. New product development, Product life cycle, Marketing and selling, methods of selling, marketing planning. Market survey and market research, Online Marketing (Digital Marketing). B) **Financial Management:** Definition of financial management, cost Concept, Types of costs (Fixed, Variable, average, marginal, and total cost) and methods of costing price, capital. Debit, credit, Profit and loss statement, Balance sheet, Depreciation Analysis, causes and significance, methods of calculation of depreciation, Taxation system, and type of taxes.		
Unit 06	**Motivational Theory and Entrepreneurship**	**06 hrs**
A) Motivation: Introduction to Motivation, theories of work motivation, Content Theories: Maslow's Hierarchy of Needs, Herzberg's Two factor theory, McClelland's Three Needs Theory, McGregor's Theory X and Theory Y. Process Theories: Adam's Equity Theory, Vroom's Expectancy Theory, Taylor's Motivation Theory **B) Leadership:** Importance of Leadership, Types of Leadership: Autocratic, Democratic and Laissez-Faire Leadership, qualities of good Leader. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning. **C) Entrepreneurship**: Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India.		

Test Books:

[T1]	O. P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.
[T2]	E. H. McGraw, S. J. Basic managerial skill for all.
[T3]	Tarek Khalil, Management of Technology Tata McGraw Hill Publication Pvt. Ltd.
[T4]	Prabuddha Ganguli Intellectual Property rights Tata McGraw Hill Publication Company
[T5]	Management Accounting and financial management by M. Y.Khan and P.K. Jain, Tata Mcgraw Hill-Tata-ISBN.

Reference Books:

[R1]	C. B. Mamoria and V. S. P. Rao- Personnel Management , Himalaya Publishing House, 30th Edition 2014.
[R2]	Harold Koonlz and OD'onnel–Management. Tata McGraw Hill Publication1980.
[R3]	Philip Kotler-Marketing Management. Pearson Edition 2008.
[R4]	Robert Heller, Managing Teams, Dorling Kindersley, London.
[R5]	Kelly John M, Total Quality Management, InfoTech Standard, Delhi.
[R6]	Joseph M. Juran, Juran's Quality Handbook TATA McGraw-Hill.
[R7]	Dale H. Bester field and Carol Bester field Total Quality Management Prentice Hall of India Pvt. Ltd.
[R8]	Shiv Sahai Singh [Editor] The Law of Intellectual Property rights.
[R9]	N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.
[R10]	Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Deepak

	Bhivpathki.
[R11]	Financial Management by I. M. Pandey, Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler- Marketing Management.

Unit	**Text Books**	**Reference Books**
Unit 1	T1	R2,R10
Unit 2	T1, T2,T3	R5
Unit 3	-	R3,R5,R6
Unit 4	T5	R3, R11
Unit 5	T1	R1,R2
Unit 6	T4	R8

303142: Power Electronics

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					PR	50 Marks

Prerequisite:

1. Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics.
2. Working of Diode based rectifier, concept of RMS and average value
3. Use square notebooks for notes and plotting of waveforms.

Course Objectives: The course aims :-

To enable students to gain knowledge and understanding in the following aspects:

1. Fundamentals of power electronic devices and characteristics.
2. The concepts and operating principles of power electronics circuits.
3. Design procedures and techniques of power electronics systems.

Course Outcomes: At the end of this course, student will be able to

CO1	Develop characteristics of different power electronic switching devices.
CO2	Reproduce working principle of power electronic converters for different types of loads.
CO3	Choose the appropriate converter for different applications.

Unit 01	**Power Semi-Conductor Devices**	**06 hrs**

Construction, Static and dynamic Characteristics, specifications/rating of SCR , Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C & D), Protection (over voltage, over current, and Thermal), Gate Turn Off (GTO) Thyristor (Construction, Working and Application), TRIAC- four mode operation, triggering of TRIAC using DIAC, Application-light dimmer.

Unit 02	**Transistor based Devices and DC-DC converter**	**06 hrs**

Transistor based Devices: MOSFET & IGBT- Construction, working, Static and Dynamic Characteristics

DC-DC converter: Principle of operation of chopper, classification on the basis of operating quadrants (A, B, C, D, E), Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step-up Chopper and Numerical with RLE load. Buck Boost Chopper (Descriptive Treatment), Applications- Chargers for Battery operated vehicles.

Unit 03	**Single Phase AC-DC Converter**	**06 hrs**

Single phase Converter: Fully controlled converter, Half controlled converter (Semi- converter)- Operation of all converters with R & RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations, Single phase dual converter (Descriptive treatment only), Application-Speed control of DC motor.

Unit 04	**Three Phase Converter and AC Voltage Regulator**	**06 hrs**

Three phase converters: Fully controlled converter, Half controlled converter (Semi converter)- Operation of all converters with R, RL load, derivation of Average and RMS output voltage. Numerical based on output voltage and current calculations.

AC voltage regulator: Single phase AC Voltage regulator; operation with R and RL Load, derivation of Average and RMS output voltage. Concept of two stage AC voltage regulator (Descriptive treatment only).

Unit 05	**Single phase DC-AC Converter (Transistor based)**	**06 hrs**

Full bridge VSI, derivation of output voltage and current, Numerical, current source inverter with ideal switches and load commutated CSI, Voltage control techniques, Application- UPS.		
Unit 06	**Three phase DC-AC Converter (Transistor based)**	**06 hrs**
Three phase VSI for 120^0 and 180^0 modes of operation and their comparison, PWM based VSI, voltage control and harmonic elimination techniques (Single Pulse Modulation, Multilevel Control), Multilevel Converter concept its classification (Neutral Point Clamped Converter, Flying Capacitor Converter, cascaded multilevel converter) and their comparison, Application- Speed control of 3 phase Induction motor.		

Test Books:

[T1]	M. H. Rashid - Power Electronics 2nd Edition, Pearson publication.
[T2]	Ned Mohan, T.M. Undel and, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons.
[T3]	B.W. Williams: Power Electronics 2nd edition, John Wiley and sons.
[T4]	Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
[T5]	Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
[T6]	K. Hari Babu, Power Electronics, Scitech Publication.

Reference Books:

[R1]	Vedam Subramanyam - Power Electronics , New Age International , New Delhi
[R2]	Dubey, Donalda, Joshi, Sinha, Thyristorised Power controllers, Wiley Eastern New Delhi.
[R3]	M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill.
[R4]	Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
[R5]	L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
[R6]	J. Michael Jacob – Power Electronics Principal and Applications.
[R7]	M. H. Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
[R8]	V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.

Online Resources:

[O1]	NPTEL Web course and video course on Power Electronics by Dr. B. G. Fernandis, IIT, Mumbai.

Unit	Text Books	Reference Books
Unit 1	T5, T6	R3, R8, O1
Unit 2	T4, T5, T6	R3, R5, R6, R9, O1
Unit 3	T1, T5	R3, O1
Unit 4	T5, T6	R1, R7, O1
Unit 5	T1, T2, T3	R3, O1
Unit 6	T1, T2, T3	R3, O1

List of Experiments

Part A:

Minimum 8 hardware experiments to be conducted

1. Static VI characteristic of SCR / GTO.
2. Static VI characteristic of TRIAC.
3. Study of Gate firing circuits of SCR (R, RC & UJT).
4. Single phase Half controlled converter with R and RL load.
5. Single phase fully controlled converter with R load.
6. Single Phase fully controlled converter with and without Free Wheeling diode with RL load.

7. Three phase AC-DC fully controlled bridge converter R and RL load.
8. Study of DC step down chopper.
9. Single phase A.C. voltage regulator with R and RL load.
10. Output and Transfer Characteristic of MOSFET and IGBT (Both).
11. Three phase voltage source inverter using 120^0 and 180^0mode
12. Study of three phase inverter (VSI).

Part B:

Any 8 experiments to be conducted (either hardware or simulation)

1. Fabrication of buck converter/inverter/ac voltage regulator. (compulsory)
2. Study of 1-ø bridge inverter SPWM.
3. Study of Forced commutation circuits of SCR (Class C and Class D).
4. Study and design of SMPS.
5. Study of PWM controls of a single-phase inverter.
6. Power Quality Analysis (Harmonic and PF measurement) at AC side of Single phase controlled Converter.
7. Power Quality Analysis (Harmonic and PF measurement) at AC side of Three phase controlled Converter.
8. Performance analysis of three phase diode clamped Multilevel inverter.
9. Performance analysis of three phase cascaded H-Bridge Multilevel inverter.
10. Study of three phase Active power filter.
11. Study of Standalone/ Grid connected converters for interfacing of renewable energy sources.
12. Industrial Visit to Power Electronics manufacturing unit/Renewable energy power plant.

Guidelines for Instructor's Manual:

- Title and circuit diagram of power electronic switching device and converter circuit.
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit.
- Procedure to carry out the experiment.

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.
- Analyze and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory conduction

- Each group in the lab should have not more than three students.
- All the students in the group must do the connections and perform the practical under the guidance of the staff member.
- Staff member must check the result of all the groups.

303143: Electrical Machines-II

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**PR**	01	**ESE**	70 Marks
					PR	25 Marks
					TW	25 Marks

Prerequisite:

- Magnetic circuits, Force on current carrying conductor placed in magnetic field, Fleming Right Hand & Left Hand Rule.
- Working principle and construction DC Machines, transformer & 3-ph induction motor.
- Phasor diagram and equivalent circuit of single phase transformer.

Course Objectives: The course aims to:

- Learn construction & working principle of three phase synchronous machines and 1-ph induction motors.
- Calculate voltage regulation of Alternator by different methods.
- Study the applications of different machines in industrial, commercial & social sectors.
- Determine the performance indices of AC series & single phase motors by experimentation.

Course Outcomes: At the end of this course, student will be able to

CO1	Learn construction, working principle of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO2	Understand characteristics of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO3	Select the above machines in Power System, industrial, household & Military Engineering applications.
CO4	Testing of machines to evaluate the performance through experimentation.

Unit 01	**Three phase Synchronous machines.**	**06 hrs**

Three phase Synchronous machines:
Construction, rotating-field type and rotating-armature type, salient-pole and non-salient-pole type and their comparison. Excitation Methods.

Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation and winding factors (No derivation), rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation.

Three phase Synchronous generator (salient pole type):
Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of salient-pole generator and calculation of voltage regulation.

Unit 02	**Voltage regulation of Three phase Synchronous generator**	**06 hrs**

Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio.

Parallel operation of 3-phase alternators:
Necessity, conditions, Load sharing between two alternators in parallel (Descriptive treatment only). Process of synchronizing alternator with infinite bus-bar by lamp method (one dark & two equally

bright lamp method) and by the use of synchroscope, Synchronizing current, power and torque (no numerical).		
Unit 03	**Three phase synchronous motor**	**06 hrs**
Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant load and variable excitation ('V' curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Comparison of 3 phase synchronous motor with 3-phase induction motor.		
Unit 04	**3-ph induction motor, Induction generator and special purpose motors**	**06 hrs**
Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super Conducting Generator. **Special Purpose Motors :** Construction, principle of working, characteristics, ratings and applications of Brush less D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.).		
Unit 05	**A.C. series motor**	**06 hrs**
Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies. **Compensated series motor:** Compensating winding, conductively and inductively compensated motor. Approximate phasor diagram. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors. **Universal motors:** Ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.		
Unit 06	**Single phase induction motor**	**06 hrs**
Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run motor and permanent capacitor motor). Comparison of 1-phase induction motor with 3-phase induction motor.		

Test Books:

[T1]	Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.
[T2]	S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3]	A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill
[T4]	P. S. Bimbhra, Electric Machinery, Khanna Publications.
[T5]	B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6]	B. L Theraja –Electrical Technology, Vol II , S. Chand publication.
[T7]	V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publication
[T8]	Krishna Reddy –Electrical Machines Vol.II and III, SCITECH publications.
[T9]	Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10]	M V Deshpande, Electrical Machines, Prentice Hall of India

Reference Books:

[R1]	M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R2]	J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3]	Samarjit Ghosh, Electrical Machines, Pearson Publication.
[R4]	Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinery and Transformer, 3rd Edition, Oxford University Press.
[R5]	E G Janardanan, Special Electrical Machines, Prentice Hall of India.
[R6]	Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipment (Rotating Machines) Wiley publication.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T6,T7,T9	R3
Unit 2	T4, T6,T7,T9	R2
Unit 3	T1,T4, T6,T7	R2,R4
Unit 4	T4, T6,T7,T9	R5,R6
Unit 5	T4,T6,T3	R1,R2
Unit 6	T2,T3, T6,T7,T9	R2,R3

Industrial Visit:

Compulsory visit to Synchronous Machines / Induction motor manufacturing company.

List of Experiments: **To perform any eight experiments from the following list.**

Compulsory experiments:

1. Determination of voltage regulation of cylindrical rotor alternator by a) EMF method b) MMF method.
2. Determination of voltage regulation of cylindrical rotor alternator by Potier method.
3. Determination of voltage regulation of salient pole alternator by slip test.
4. V and inverted V curve of synchronous motor at constant load.
5. Speed control of three phase induction motor by V/F method.

B) Optional experiments (any three)

1. Determination of voltage regulation of alternator by direct loading.
2. Load test on three phase synchronous motor.
3. Load test on Single -phase induction motor.
4. Load test on Single-phase series motor.
5. No load and blocked-rotor test on a single phase Capacitor-start induction motor and Determination of its equivalent circuit parameters.
6. Synchronization of three phase alternator by Lamp and Synchroscope methods.
7. Simulation of three phase induction motor on MATLAB to obtain its performance.
8. Speed control of three phase induction motor by rotor resistance control method.
9. Speed control of BLDC Motor.

Guidelines for Instructor's Manual:

Prepare 3/4 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges etc.

Theory: Brief theory explaining the experiment.

Circuit / connection diagram or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.

Procedure: Write down step by step procedure to perform the experiment.

Observation table:

Sample calculation: For obs. number ---

Result table:

Nature of graph:
Conclusion:
Questions / Answers: Write minimum 4 /5, questions / answers based on each experiment.
Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
(Use black or blue ink pen for writing.)

Guidelines for Laboratory conduction

1. Check the whether the MCB / main switch is off.
2. Students should go through the name plates of machines.
3. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
4. Perform the experiment only in presence of teacher or Lab Assistant.
5. Do the calculations and get it checked from the teacher.
6. After completion of experiment, switch off the MCB / main switch.
7. Write the experiment in the journal and get it checked within week.

303144: Electrical Installation, Design and Condition Based Maintenance

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					OR	25 Marks
					TW	25 Marks

Prerequisite:

Basic Electrical Engg, Power System 1, Electrical Machines I and Electrical Machines II.

Course Objectives: The course aims: -

1. To classify different types of distribution supply system and determine economics of distribution system.
2. To compare and classify various substations, bus-bars and Earthing systems.
3. To demonstrate the importance and necessity of maintenance.
4. To analyze and test different condition monitoring methods.
5. To carry out estimation and costing of internal wiring for residential and commercial installations.
6. To apply electrical safety procedures.

Course Outcomes: At the end of this course, student will be able to

CO1	Classify different types of distribution supply system and determine economics of distribution system. compare and classify various substations, bus-bars and Earthing systems.
CO2	Demonstrate the importance and necessity of maintenance.
CO3	Analyse and test different condition monitoring methods.
CO4	Carry out estimation and costing of internal wiring for residential and commercial installations.
CO5	Apply electrical safety procedures.

Unit 01	Economics of Distribution Systems:	06 hrs

Classification of supply systems (State Only)
(i) DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical). Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical). Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02	Substation and Earthing	06 hrs

Substation: Classification of substations, Various equipment used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

Earthing: Necessity of Earthing, Types of Earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation Earthing grid as per IEEE standard 80-2013.

Unit 03	Maintenance and Condition Monitoring	08 hrs

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors,

Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipment. Advance tools and techniques of condition monitoring, Thermography. Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, on load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis. Hot Line Maintenance - Meaning and advantages, special types of non-conducting Materials used for tools for hot line maintenance.		
Unit 04	**Basics of Estimation and Costing**	**04 hrs**
Purpose of estimating and costing, qualities of good estimator, essential elements of estimating and costing, tender, guidelines for inviting tenders, quotation, price catalogue, labor rates, schedule of rates and estimating data (only theory),		
Unit 05	**Installation and estimation of distribution system**	**06 hrs**
Introduction cable sizing, Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numerical) installations and estimate for underground LT service lines.		
Unit 06	**Testing and Electrical Safety**	**06 hrs**
Understanding CAT Ratings & Using CAT rated Instrument, Electrical Installation Testing Procedures- Insulation resistance test between installation and earth, Insulation resistance test between conductors (use of GUARD Terminal in IR test & Application) (methods used for IR Testing) Testing of polarity, Testing of earth continuity paths (Applications of PAT Tester "Portable Appliance Tester" in commercial like hotels, hospital & Industry also) and Earth resistance test (methods for earth testing 2-pole, 3-pole new methods clamp on type where we can performs test in Live) Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area. *(Introduction to OSHA)*		
Test Books:		
[T1]	B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.	
[T2]	S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.	
[T3]	S. L. Uppal - Electrical Power - Khanna Publishers Delhi.	
[T4]	Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).	
[T5]	S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.	
[T6]	B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.	
[T7]	Hand book on Electrical Safety.	
Reference Books:		
[R1]	P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.	
[R2]	S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.	
[R3]	Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.	
[R4]	Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi	
[R5]	B.D. Arora-Electrical Wiring, Estimation and Costing, - New Heights, New Delhi.	
[R6]	M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.	
[R7]	S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication .	
[R8]	Power Equipment Maintenance and Testing (Power Engineering Book 32) by Paul Gill	

Unit	Text Books	Reference Books
Unit 1	T1, T3	R1, R7
Unit 2	T1, T2, T3	R1, R4, R6
Unit 3	T2, T4, T5, T6	R6, R7, R8
Unit 4	--	R2, R3, R4, R5
Unit 5	T1, T3	R2, R3, R4, R5
Unit 6	T7	R8

List of Experiments

Part-A: (Any Eight of the following)

1) Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2) Study of thermograph images and analysis based on these images.
3) Practice of Earthing and Measurement of Earth resistance of Campus premises by using 4 Pole, 3 Pole, new technology practicing in industry clamp on method.
4) Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe Earthing. (Drawing sheets 1 using AutoCAD or other CAD software)
5) Assignment on design of Earthing grid for 132/220 kV substation.
6) Design and estimation of light and power circuit of labs/industry.
7) Measurement of insulation resistance of motors and cables.
8) Precautions from Electric shock and method of shock treatment.
9) Using of Installation Multifunction Testers for RCD testing, Phase Sequence Indication, Insulation resistance measurement, Continuity testing.
10) Use REVIT / any BOQ (Bill of Quantity) estimation software for estimation and costing
11) Design and estimation of light and power circuit of residential wiring.

Part-B:(Any 4 out of these)

1) Estimation and costing for 11 kV feeders and substation. (voltage drop calculation, SLD, substation layout)
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (**Any one**). i) Three phase induction motor ii) Transformer iii) Power Cable
3. Trouble shooting of household equipment – Construction, working and troubleshooting of any two household Electrical equipment’s (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults) (Here we perform Practical by using PAT Testers)
4) Design, Estimation and costing of Earthing pit and Earthing connection for computer lab, Electrical Machines Lab.
5) Wiring installation and maintenance of pump motor.
6) Activity: Interview of Electrical maintenance personnel/Technician/Electrician.
7) Activity: Safety awareness for housing societies/schools/Junior colleges.
8) Activity: Preparation of Tender notice and studying the Tender notices published in newspapers.
9) Any innovative activity related to EIDCBM syllabus.

Industrial Visit (if any): Visit to substation/ installation sites.

303145A: Elective-I: Advanced Microcontroller and Embedded System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

1. Knowledge of Number system and Basic logic components.
2. Programming basics of C language.
3. Advantage of Microcontroller over Microprocessor.

Course Objectives: The course aims to:

1. Help Students understand Architecture of PIC 18F458 microcontroller.
2. Create and enhance ability to write and Interpret Assembly and C language for PIC 18F458.
3. Make students understand procedure to interface peripherals with PIC 18F458 for various Applications.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain architecture of PIC 18F458 microcontroller, its instructions and the addressing modes.
CO2	Use Ports and timers for peripheral interfacing and delay generation.
CO3	Interface special and generate events using CCP module.
CO4	Effectively use interrupt structure in internal and External interrupt mode.
CO5	Effectively use ADC for parameter measurement and also understand LCD interfacing.
CO6	Use Serial Communication and various serial communication protocols.

Unit 01	**PIC Architecture and Embedded C**	**07 hrs**

Comparison of CISC and RISC Architectures, Data and Program memory organization, Program Counters, Stack pointer, Bank Select Register, Status register, Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations.

Unit 02	**Port and Timer 0 Programming**	**05 hrs**

I/O Ports and related SFRs, I/O port programming in C. PIC 18 Timer 0 Programing in C. Delay programming (with and without Timer0). LED Interfacing and its programming.

Unit 03	**CCP Module and its applications**	**06 hrs**

CCP module in PIC 18 microcontroller, Timers required for CCP Applications, Applications of CCP mode Generation of Square waveform using Compare mode of CCP module. Period measurement of unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module.

Unit 04	**Interrupt structure and its Programming**	**05 hrs**

Interrupt Programming, Programming of Timer0 interrupts, Programming of External interrupts INT0.

Unit 05	**ADC structure and LCD interfacing**	**07 hrs**

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and Power. Using PIC microcontroller. Interfacing of LCD (16x2) in 4 bit mode.

Unit	**Serial Communication and its protocols**	**06 hrs**

06		
Serial Communication structure and its programming (Data transmit and Receive), Introduction to Communication protocols as SPI and MODE BUS		

Test Books:	
[T1]	PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.
[T2]	Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.
[T3]	Programming And Customizing the PIC Microcontroller by Myke Predko, TATA McGraw-Hill.
[T4]	PIC microcontroller: An introduction to software and Hardware interfacing by Han-Way-Huang Thomson Delmar Learning.
[T5]	Microcontroller Theory and Applications with PIC18F, M. Rafiquzzaman, John Wiley and Sons
Reference Books:	
[R1]	PIC18F458 datasheet
[R2]	MPLAB IDE user guides
[R3]	MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall

Unit	**Text Books**	**Reference Books**
Unit 1	T1,T2,T3,T4	R1
Unit 2	T1, T2,T3,T4,T5	R1,R2
Unit 3	T1,T4,T5	R1
Unit 4	T1,T2,T3,T4	R1
Unit 5	T1,T2,T3,T4	R1
Unit 6	T1,T2,T3,T4	R1,R3

<table>
<tr><td colspan="9">303145B: Elective-I: Digital Signal Processing</td></tr>
<tr><td colspan="3">Teaching Scheme</td><td colspan="2">Credits</td><td colspan="2">Examination Scheme</td></tr>
<tr><td>Theory</td><td>03</td><td>Hr/Week</td><td>TH</td><td>03</td><td>ISE</td><td>30 Marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>ESE</td><td>70 Marks</td></tr>
</table>

Prerequisite:

Knowledge of basic signals and systems

Course Objectives: The course aims:

1. To introduce discrete signals and systems.
2. To ability to analyse DT signals with Z transform, DTFT and DFT.
3. To introduce Digital filters and analyze the response.
4. To explore DSP Applications in electrical engineering.

Course Outcomes: At the end of this course, student will be able to

CO1	Analyse discrete time signals and systems.
CO2	Construct frequency response of LTI system using Fourier Transform.
CO3	Design and realize IIR and FIR filters.
CO4	Apply concepts of DSP in applications of electrical engineering.

Unit 01 | **Discrete time signal and system** | **06 hrs**

Analog, Discrete-time and Digital signals, Basic sequences and sequence operations, Discrete time systems, Properties of D. T. Systems and Classification, Linear Time Invariant Systems, impulse response, linear convolution and its properties, properties of LTI systems: stability, causality, Periodic Sampling, Sampling Theorem, Frequency Domain representation of sampling, reconstruction of a band limited Signal, A to D Conversion Process: Sampling, quantization and encoding.

Unit 02 | **Z and Inverse Z transform** | **06 hrs**

Revision of Z-transform, Numerical of Z transform, Inverse Z transform using partial fraction and power series method, Linear constant coefficient difference equations, solution of difference equation, stability and causality using ROC of Z-transform.

Unit 03 | **Discrete Time Fourier Transform** | **06 hrs**

Representation of Sequences by Fourier Transform, Symmetry properties of D. T., F. T. theorems: Linearity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, Frequency response analysis of first and second order system, steady state and transient response.

Unit 04 | **Discrete Fourier Transform** | **06 hrs**

Sampling in frequency domain, The Discrete Fourier Transform, Relation with z transform Properties of DFT: Linearity, circular shift, duality, symmetry, Circular Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT.

Unit 05 | **Design of IIR filter** | **06 hrs**

Ideal frequency selective filters, Concept of filtering, specifications of filter, IIR filter design from continuous time filters: Characteristics of Butterworth and Chebyshev, impulse invariant and bilinear transformation techniques, Design examples (Butterworth low pass filter) , Basic structures for IIR Systems: direct form, cascade form

Unit 06 | **Design of FIR Filter and DSP Applications** | **06 hrs**

A) Specifications of properties of commonly used windows, Design Examples using rectangular and hanning windows. Basic Structures for FIR Systems: direct form. Comparison of IIR and FIR Filters. B) Applications: Measurement of magnitude and phase of voltage, current, power, frequency and power factor correction, harmonic Analysis and measurement, applications to machine control, DSP based protective relaying.

Test Books:

[T1]	Proakis J., Manolakis D., “Digital signal processing”, 3rd Edition, Prentice Hall, ISBN 81-203-0720-8.
[T2]	P. Ramesh Babu, “Digital Signal Processing”, 4th Edition SciTech Publication.

[T3]	Dr. S. D. Apte, "Digital Signal Processing",2nd Edition Wiley India Pvt. Ltd ISBN: 97881-265-2142-5
[T4]	W. Rebizant, J. Szafran, A. Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0

Reference Books:

[R1]	Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete Time Signal Processing", 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists",1st Edition Elsevier, ISBN: 9780750674447

Unit	Text Books	Reference Books
Unit 1	T1,T2	R1, R2, R3
Unit 2	T1,T2	R2, R3
Unit 3	T1,T2	R2, R3
Unit 4	T1,T2	R2, R3
Unit 5	T1,T2,T3	R1,R2,R3
Unit 6	T2, T4	R3

303146: Seminar

Teaching Scheme			Credits		Examination Scheme	
SEM	01	Hr/Week	**SEM**	01	**TW**	50 Marks

Course Objectives:

1. Gaining of actual knowledge (terminology, classification, methods and advanced trends)
2. Learning fundamental principles, generalization or theories.
3. Discussion and critical thinking about topics of current intellectual importance.
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

Course Outcomes: At the end of this course, student will be able to

CO1	Relate with the current technologies and innovations in Electrical engineering.
CO2	Improve presentation and documentation skill
CO3	Apply theoretical knowledge to actual industrial applications and research activity.
CO4	Communicate effectively.

Seminar should be based on a detailed study of any topic related to the advance areas/applications of Electrical Engineering. Topic should be related to Electrical Engineering. However, it must not include contents of syllabus of Electrical Engineering. It is expected that the student should collect the information from journals, internet and reference books in consultation with his/her teacher/mentor, have rounds of discussion with him/her. The report submitted should reveal the student assimilation of the collected information. Mere compilation of information from the internet and any other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly typed on white paper. The typing shall be with normal spacing, Times New Roman (12 pt) font and on one side of the paper. (A-4 size).
2. Illustrations downloaded from internet are not acceptable.
3. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
4. Front cover: This shall have the following details with Block Capitals
    a. Title of the topic.
    b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
    c. Name of the guide with designation below the candidate's details.
    d. The name of the institute and year of submission on separate lines at the bottom.
5. Certificate from institute as per specimen, Acknowledgement and Contents.
6. The format of the text of the seminar report should be as follows
    I. The introduction should be followed by literature survey.
    II. The report of analytical or experimental work done, if any.
    III. The discussion and conclusions shall form the last part of the text.
    IV. They should be followed by nomenclature and symbols used.
    V. The Reference Books are to be given at the end.
7. The total number of typed pages, excluding cover shall from 20 to 25 only.
8. All the pages should be numbered.
9. Two spiral bound copies of the seminar report shall be submitted to the college.
10. Candidate shall present the seminar before the examiners.
11. The total duration of presentation and after-discussion should be about 30 minutes.

The assessment for the subject shall be based on:

1. Content. 2. Presentation 3. Report

Rubrics for assessment

	Does not meet criterion	Meets criterion somewhat	Meets criterion fully
Content			
Background/Intro is sufficient to understand how this project fits into larger field	0	1	2
Description of methodology is sufficient for audience to understand the procedure	0	1	2
Explanations are understandable/clear	0	1	2
Conclusions stated are supported to topic	0	1	2
References/Sources are cited correctly	0	1	2
Audience questions are answered honestly (i.e. no bluffing or guessing)	0	1	2
Presentation Quality			
Speaking is understandable/clear	0	1	2
Speaker can answer questions professionally	0	1	2
Speaker makes eye contact with audience	0	1	2
Speaker uses professional body language	0	1	2
Visuals/PPT are clear and readable	0	1	2
Visuals/PPT have appropriate amount of text, diagrams	0	1	2
Visuals/PPT are free of errors/typos	0	1	2
Report Writing			
Abstract is meaningful	0	1	2
Graphs/diagrams are labeled completely	0	1	2
References/Sources are cited correctly	0	1	2
At least one reference is from a journal	0	1	2
Grammar is correct	0	1	2
Spelling is correct	0	1	2
Report format is clear	0	1	2
Total	_____/40 (convert to 50)		

303147A: Audit Course V: Energy Storage System

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Batteries, Inductor and Capacitor.

Course Objectives:

To elaborate various energy storage systems

To be familiar with various aspects such as hybridization, selection of storage system.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain and differentiate various types of energy storage for suitable applications
CO2	Understand battery recycling techniques

Unit 01	Energy Storage Fundamentals	12 hrs

(A) Battery: Energy Density, Power Density, Cycle life, C-rate, State of Charge (SoC), State of Health (SoH), Depth of Discharge (DoD), Characteristic.

(B) Types of Batteries: Nickel Metal Hydrate, Nickel Cadmium, Lithium ion, Lithium Polymer, Flow Batteries (Vanadium, Zinc, Manganese)

(C) Super capacitor, Superconducting Magnetic Energy Storage, Compressed Air Energy Storage, Flywheel storage

(D) Hybridization of energy storage

Energy storage sizing, Selection of storage as per application

Unit 02	Recent Trends in Storage	12 hrs

Solid state batteries, Aluminum air and Aluminum ion batteries, Lithium ion Capacitor, Advances in Thermal energy storage systems. Batteries recycling techniques and policies, Case studies.

Reference Books:

[R1]	Handbook of Energy Storage: Demand, Technologies, Integration Michael Sterner, Ingo Stadler.
[R2]	Energy Storage: Fundamentals, Materials and Applications, Robert Huggins.

Industrial Visit: Manufacturing industry of battery or Capacitor.

303147B: Start-up and Disruptive Innovations

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Course Objectives:

To learn fundamentals related to Start-up and initiatives taken by government along with policies.
To understand Disruptive technologies.

Course Outcomes: At the end of this course, student will be able to

CO1	Describe role of incubation for Startup and recent national policy.
CO2	Identify various types of Startups.
CO3	Explain impacts of disruptive innovation and Differentiate between disruptive innovation and disruptive technology

Unit 01	Start-up	12 hrs

Startup Fundamentals

Startup: Stages of startup life cycle, business model, business plan, Business incubation, Startup financing life cycle, Funding options for startup, Market, Market Segments.
Entrepreneurship: Types of Entrepreneurship: Social, Rural, Women, Agri-preneurship. Factors affecting Entrepreneurship Growth

Government Initiatives and Policies

Initiatives taken by the government, Startup India Scheme, National Innovation and Startup Policy 2019, Approvals and other regulatory processes, Challenges faced by startups in India, Students Startup, Faculty Startup.

Types of Startups and Case Studies

Types of Startups: E-commerce Startups, EdTech Startups, FinTech Startups, Food and Beverages Startups, Health Care Startups, Block chain Startups etc.
Case study : Airbnb, Paytm, Byju, Zomato, Red bus, Ola, Razorpay

Unit 02	Disruptive Technologies	12 hrs

Disruptive Innovation Fundamental

What is invention? What is innovation? Defining Disruptive Innovation, Sustaining Innovation, Disruptive Innovation Theory, Disruptive innovation model, Disruptive strategy, Impact of Disruptive Innovation, Requirements of Disruptive Innovation, Types of Disruptive Innovations.
Inventor vs. Entrepreneur vs. Manager: Schumpeter's Trumpeters
Schumpeter's "creative destruction"
Maslow's Hierarchy of Needs Revisited, Disrupting Brands, Disrupting Religion.

Disruptive Technologies

Agricultural Revolution, Scientific Revolution, Industrial Revolution, Digital Revolution
Disruptive Innovation Vs Disruptive Technology
IoT, AI, Cloud Computing, Digital Twin, CRISPR, Block chain, 3D printing, Advanced Energy Storage, Hyperloop, Autonomous Vehicles, Nano technology, Industrial Automation (Industry 4.0)

Reference Books:

[R1]	The $100 Startup : Reinvent the Way you Make a Living, Do What You Love and Create a New Future, Chris Guillebeau
[R2]	Creating a Successful Business Plan, Entrepreneur Magazine
[R3]	Thomas Kuhn and The Theory of Scientific Revolutions revisited, CRC Press
[R4]	P. Armstrong. Disruptive Technologies: Understand, Evaluate, Respond Kogan Page Publishers. (2017)
[R5]	Innovator's Solution: Creating and Sustaining Successful Growth – Clayton Christensen, 16 December 2013
[R6]	Digital Disruption: Unleashing the Next Wave of Innovation – James McQuivey, 26

	February 2013
Online Resources:	
[O1]	https://ipindia.gov.in/
[O2]	https://www.wipo.int/about-ip/en/
[O3]	https://www.weforum.org/agenda/2016/06/what-is-disruptive-innovation/

303148: Power System-II

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**	01	**PR**	50 Marks
					TW	25 Marks

Note: TW marks: 15 for Tutorial and 10 for continuous assessment of lab work

Prerequisite:

Power Generation Technology, Power System-I, Electrical machine I and II

Course Objectives:

1) Develop analytical ability for Power system.
2) Introduce concept of EHVAC and HVDC System.
3) Demonstrate different computational methods for solving problems of load flow.
4) Analyze the power system under symmetrical and Unsymmetrical fault conditions.

Course Outcomes: At the end of this course, student will be able to

CO1	Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
CO2	Calculate per unit values and develop Y bus for solution power flow equations in power transmission networks
CO3	Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

Unit 01	Performance of Transmission Lines	06 hrs

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow.

Unit 02	EHVAC Transmission	05 hrs

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.

Unit 03	Per Unit System and Load Flow Analysis	07 hrs

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.

Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using bus incidence matrix method, Numerical based on Y bus Matrix, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (polar method) Decoupled and Fast decoupled load flow (descriptive treatment only).

Unit 04	Symmetrical Fault Analysis	06 hrs

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical

Based on symmetrical fault analysis.		
Unit 05	**Unsymmetrical Fault Analysis**	**07 hrs**
Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedance of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.		
Unit 06	**HVDC Transmission**	**05 hrs**
Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.		
Test Books:		
[T1]	I.J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.	
[T2]	B R Gupta , “Power System Analysis and Design”, S. Chand.	
[T3]	Ashfaq Hussain, “Electrical Power Systems”, CBS Publication 5th Edition.	
[T4]	J. B. Gupta. “A course in power systems” S.K. Kataria Publications.	
[T5]	P.S.R. Murthy, “Power System Analysis”, B.S. Publications	
Reference Books:		
[R1]	H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.	
[R2]	G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.	
[R3]	M. E. El- Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.	
[R4]	Rakash Das Begamudre, “Extra High voltage A.C. Transmission Engineering”, New age publication.	
[R5]	M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.	
[R6]	Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.	
[R7]	K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.	
[R8]	Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.	
[R9]	V. K. Chandana, Power Systems, Cyber tech Publications.	
[R10]	P. Kundur, Power System Stability And Control, McGraw Hill	
Online Resources:		
[O1]	NPTEL Course on power system engineering:Debpriya Das https://nptel.ac.in/courses/108/105/108105104/	
[O2]	NPTEL Course on power system analysis By Dr. A.K. Sinha https://nptel.ac.in/courses/108/105/108105067/	
[O3]	NPTEL Course on power system analysis By Dr. Debpriya Das https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee72/	

Unit	Text Books	Reference Books
Unit 1	T1, T4	R1, R2, R3, R10
Unit 2	T2	R3, R4
Unit 3	T1, T3, T4	R1, R2, R3, R6, R8, R10
Unit 4	T3, T4	R1, R2, R3, R6, R8, R9, R10
Unit 5	T3	R1, R2, R3, R6, R8
Unit 6	T2, T3, T4	R3, R7, R9, R10

Industrial Visit:

Compulsory visit to EHV-AC substation/ HVDC substation

List of Tutorial: (Minimum 10 Tutorial should be conducted) (Maintain Record in file or separate notebook)

(Such types of numerical also in INSEM and ENDSEM examination)

1) ABCD parameters of long transmission line--(3 numerical)
2) power flow using generalized constant--(3 numerical)
3) power flow and losses in EHVAC transmission line for specified ratings. --(3 numerical)
4) Determination of Y-bus for three, four and five bus system--(3 numerical)
5) Load flow analysis using NR method for three bus system (1 numerical)
6) Calculation of symmetrical fault current and determine value of current limiting reactor suitable for given circuit breaker rating (2 numerical)
7) Determination of line/phase current, voltage and power calculation using symmetrical component. (4 numerical)
8) Calculation of unsymmetrical fault current (4 numerical)
9) Write a report on different HVDC project in India / world wide
10) Solve challenging questions related to syllabus (5 numerical)
11) Receiving end Power Circle diagram (1 Numerical)

List of Experiments

List of Experiments (Compulsory experiments):

1. Measurement of ABCD parameters of a medium transmission line with magnitude and angle.
2. Measurement of ABCD parameters of a long transmission line with magnitude and angle.
3. Performance study of the effect of VAR compensation using capacitor bank on the transmission line.
4. Formulation and calculation of Y- bus matrix of a given system using software.
5. Static measurement of sub-transient reactance of a salient-pole alternator.
6. Measurement of sequence reactance of a synchronous machine (Negative and zero).

Any three experiments are to be performed out of following:

1. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
2. Solution of a load flow problem using Newton-Raphson method using software.
3. Simulation of Symmetrical fault of single machine connected to infinite bus.
4. Simulation of Unsymmetrical fault of single machine connected to infinite bus.
5. Simulation of HVDC system.

Guidelines for Instructor's Manual:

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.

- Graph and Conclusions.
- Few questions related to the experiment.

Guidelines for Student's Lab Journal

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

There should be continuous assessment for the TW.

- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

303149: Computer Aided Design of Electrical Machines

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**TU**	00	**ESE**	70 Marks
Tutorial	00	Hr/Week/batch	**PR**	02	**OR**	25 Marks
					TW	50Marks

Prerequisite:

1. Knowledge of fundamentals of electrical engineering.
2. Knowledge of various materials used in electrical machines.
3. Knowledge of types, construction and working of transformer.
4. Knowledge of types, construction and working of three phase induction motor.

Course Objectives: The course aims to:-

1. Design of transformer based on specifications.
2. Determine performance based on the parameters of transformer.
3. Design of Induction motor based on specifications.
4. Determine performance based on the parameters of Induction motor.
5. Apply computer aided design techniques to transformer and induction motor design.

Course Outcomes: At the end of this course, student will be able to

CO1	Summarize temperature rise, methods of cooling of transformer and consider IS 2026 in transformer design.
CO2	Design the overall dimensions of the transformer.
CO3	Analyze the performance parameters of transformer.
CO4	Design overall dimensions of three phase Induction motor
CO5	Analyze the performance parameters of three phase Induction motor.
CO6	Implement and develop computer aided design of transformer and induction motor.

Unit 01	**Transformer Design: Part 1**	**06 hrs**

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Methods of cooling of transformer. Types and constructional features of core and windings used in transformer. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of three phase transformers as per IS 2026 (Part I). Introduction to computer aided design

Unit 02	**Transformer Design: Part 2**	**06 hrs**

Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of core, estimation of overall dimensions of frame and windings of transformer. Design of tank with cooling tubes.

Unit 03	**Performance parameters of Transformer**	**06 hrs**

Estimation of resistance and leakage reactance of transformer. Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04	**Three phase Induction Motor Design:Part1**	**06 hrs**

Specifications and constructional features. Types of ac windings. Specific electrical and magnetic loadings, ranges of specific loadings. Output equation with usual notations. Calculations for main dimensions, turns per phase and number of stator slots.

Unit 05	**Three phase Induction Motor Design:Part2**	**06 hrs**

Suitable combinations of stator and rotor slots. Selection of length of air gap, factors affecting length of air gap. Design of rotor slots, size of bars and end rings for cage rotor. Conductor size, turns and area of rotor slots for wound rotor.

Unit 06	**Performance parameters of Three Phase Induction motor**	**06 hrs**

Leakage flux and leakage reactance: Slot, tooth top, zig - zag, overhang. Leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency. Computer aided design of induction motor, generalized flow chart for design of induction motor.

Test Books:

[T1]	M. G. Say–Theory and Performance and Design of A.C. Machines,3rd Edition, ELBS London.
[T2]	A.K. Sawhney–A Course in Electrical Machine Design, -Dhanpat Rai and sons New Delhi
[T3]	K. G. Upadhyay- Design of Electrical Machines, New age publication
[T4]	R. K. Agarwal–Principles of Electrical Machine Design, S. K. Katariya and sons.
[T5]	Indrajit Dasgupta –Design of Transformers–TMH

Reference Books:

[R1]	K. L. Narang, A Text Book of Electrical Engineering Drawings, Reprint Edition, Satya Prakashan, New Delhi.
[R2]	A Shanmuga sundaram,G. Gangadharan, R. Palani,-Electrical Machine Design Data Book,3rd Edition, 3rd Reprint 1988- Wiely Eastern Ltd.,- New Delhi
[R3]	Vishnu Murti, “Computer Aided Design for Electrical Machines”, B. S. Publications.
[R4]	Bharat Heavy Electricals Limited, Transformers - TMH.

Unit	**Text Books**	**Reference Books**
Unit 1	T1,T2,T4,T5	R1,R2,R4
Unit 2	T1,T2,T4,T5	R1,R4
Unit 3	T2,T5	R3,R4
Unit 4	T1,T2,T3,T4	R1,R2,R3
Unit 5	T2	R3
Unit 6	T2	R3

Industrial Visit:

Industrial visit to a transformer and Induction motor manufacturing/repairing unit.

List of Experiments

1. Details and assembly of transformer with design report. (Sheet in CAD)
2. Details and layout of single layer three phase winding with design report. (Sheet in CAD)
3. Details and layout of double layer three phase winding with design report. (Sheet in CAD)
4. Details and layout of three phase mush winding with design report. (Sheet in CAD)
5. Assembly of three phase induction motor. (Sheet in CAD)
6. Use of Finite Element Analysis(FEA) software for analysis of electrical machines, the report should include:
   a. Schematic diagram (Diagram/FEA model/Layout)
   b. Current/Flux/Force/Heat distribution.
   c. Analysis by variation of design parameters.
7. Report based on transformer manufacturing/repairing unit.
8. Report based on induction motor manufacturing/repairing unit.

Guidelines for Instructor’s Manual:

Theinstructor'smanualshouldcontainfollowingrelatedtoeverydrawingsheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.

6. Few short questions related to design. 7. A3 size sheet to be used for CAD drawing.
Guidelines for Student's Lab Journal
TheStudent'sLabJournalshouldcontainfollowingrelatedtoeverydrawingsheet- 1. Brief theory related to the concerned sheet. 2. Apparatus with their detail specification as per IS code. 3. Design as per problem statement. 4. Reference tables used for design purpose. 5. Design parameters details in tabular form. 6. Few short questions related to design. 7. A3 size sheet to be used for CAD drawing.
Guidelines for Laboratory conduction
1. There should be continuous assessment for the Lab/TW 2. Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to design as per the problem statement. 3. Timely submission of design report and sheet.

303150: Control System Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**		**OR**	25 Marks
					TW	25 Marks

Prerequisite:

Laplace Transform, Ordinary differential equations.

Course Objectives: The course aims to:-

- To understand basic concepts of the classical control theory.
- To model physical systems mathematically.
- To analyze behavior of system in time and frequency domain.
- To design controller to meet desired specifications.

Course Outcomes: At the end of this course, student will be able to

CO1	Construct mathematical model of Electrical and Mechanical system using differential equations and transfer function and develop analogy between Electrical and Mechanical systems.
CO2	Determine time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.
CO3	Investigate closed loop stability of system in s-plane using Routh Hurwitz stability criteria and root locus.
CO4	Analyze the systems in frequency domain and investigate stability using Nyquist plot and Bode plot
CO5	Design PID controller for a given plant to meet desired time domain specifications.

Unit 01	**Basics of Control System**	**07 hrs**

Basic concepts of control system, classification of control systems, types of control system: feedback, tracking, regulator system, feed forward system, transfer function, concept of pole and zero, modeling of Electrical and Mechanical systems (Only series linear and rotary motion) using differential equations and transfer function , analogy between electrical and mechanical systems, block diagram algebra, signal flow graph, Mason's gain formula.

Unit 02	**Time domain analysis**	**06 hrs**

Concept of transient and steady state response, standard test signals: step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input, time domain specifications of second order systems, derivation of time domain specifications for second-order under-damped system for unit step input, steady state error and static error coefficients.

Unit 03	**Stability analysis and Root Locus**	**05 hrs**

Concept of stability: BIBO, nature of system response for various locations of poles in S-plane. Routh's-Hurwitz criterion. Root Locus: Angle and magnitude condition, Basic properties of root locus. Construction of root locus, Stability analysis using root locus.

Unit 04	**Frequency domain analysis-I**	**06 hrs**

Introduction, Frequency domain specifications, correlation between time and frequency domain specifications, polar Plot, Nyquist plot, stability analysis using Nyquist plot.

Unit	**Frequency domain analysis-II**	**06 hrs**

05		
Introduction to Bode plot, Asymptotic approximation: sketching of Bode plot, stability analysis using Bode plot.		
Unit 06	**PID controllers and Control system components**	**06 hrs**
Basic concept of P, PI, PID controller, design specifications in time domain and frequency domain. design of PID controller by Root Locus, tuning of PID controllers using Ziegler-Nichol Methods Control System Components: Working principle and transfer function of Lag network, lead network, potentiometer, DC servo motors.		

Test Books:

[T1]	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 6th edition, 2017.
[T2]	Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.
[T3]	Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011
[T4]	R. Anandanatrajan and P. Ramesh Babu, "Control Systems Engineering", Scitech Publication,3rd edition, 2011
[T5]	C. D. Johnson, "Process Control Instrumentation Technology, 8th edition, PHI Learning Pvt. Ltd., 2013

Reference Books:

[R1]	B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
[R2]	Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
[R3]	D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.
[R4]	B. Wayne Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2003.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T3	R1,R2
Unit 2	T1,T2,T3	R1,R3
Unit 3	T1,T2,T3	R2,R3
Unit 4	T1,T2,T3	R1,R3
Unit 5	T1,T2,T3	R1,R3
Unit 6	T1,T2,T5	R4

List of Tutorial:

Tutorial (Minimum ten tutorials should be conducted)

1. Reduce the given block diagram and determine overall transfer function.
2. Determine transfer function of the system represented by signal flow graph using Mason's gain formula.
3. Determine time domain specifications of given second order systems.
4. Determine static error constants and steady state error for the given systems.
5. Investigate closed loop stability of a given systems using Routh Hurwitz stability criterion.
6. Sketch the root locus of a given systems and comment on stability.
7. Sketch the polar plot of given systems.
8. Sketch the Nyquist plot of a given system, determine stability margins and comment on stability.
9. Sketch the Bode plot of a given systems, determine stability margins and comment on stability.
10. Determine the tuning parameters of PID controller using open loop step response and closed loop ultimate cycle methods of Ziegler and Nichol.
11. Design the PID controller for desired specifications using root locus approach.

List of Experiment

A) Minimum five experiments should be conducted.

1. Experimental determination of DC servo motor parameters for mathematical modeling and transfer function
2. Experimental study of time response characteristics of R-L-C second order system. Validate the results using software simulation.
3. Experimental determination of frequency response of Lead compensator.
4. Experimental determination of frequency response of Lag compensator.
5. PID control of level/ Temperature/speed control system.
6. Experimental determination of transfer function of any one physical systems (AC Servomotor/ Two Tank System/ Temperature control/ Level control)
7. Experimental analysis of D.C. Motor Position control System.

B) Minimum three experiments should be conducted (perform using software)

1. Stability analysis using a) Bode plot, b) Root locus and c) Nyquist plot.
2. Effect of P, PI and PID controllers on time response of second order system.
3. Analysis of closed loop DC position control system using PID controller.
4. Effect of addition of pole-zero on root locus of second order system.
5. Effect of addition of dominant and non-dominant poles on step response of second order system.
6. PID controller for speed/position control of DC servomotor.

Guidelines for Instructor's Manual:

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram
- Basic MATLAB instructions for control system/ Simulink basics
- Observation table/ Expected simulation results
- Sample calculations for one/two reading
- Result table

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram/Simulink diagram/MATLAB program
- Observation table/ simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Software program and result (if applicable)
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results. Understanding fundamentals and objective of experiment, timely submission of journal

303151A: Elective II: IoT and Its Applications in Electrical Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Basics of Electrical generation, transmission, distribution and utilization, Fundamentals of logic circuits, C, C+.

Course Objectives: The course aims to

1. Understand the architecture of Internet of Things
2. Evaluate the electrical systems for making them IoT enable
3. Assess the automated processes and retrofit it for enhancement is user accessibility.

Course Outcomes: At the end of this course, student will be able to

CO1	Build circuits for signal acquisition and conditioning
CO2	Experiment with sensors and actuators and choose the right sensor for application
CO3	Determine the performance of IoT based automated process
CO4	Design and develop IoT based applications

Unit 01	**Introduction to IoT**	**06 hrs**

Fundamental components of IoT, Evolution of Connected Devices, Basic Architecture of IoT, ISO and IEC Standards, IoT categories, IoT gateways, challenges, Security concerns and hurdles, Overview of applications - home automation, agriculture, Industrial, health care, Smart Grid.

Unit 02	**IoT Development platforms**	**06 hrs**

Basics of Microcontroller and Microprocessor, Introduction to Edge devices e.g. Arduino, Node MCU, Raspberry Pi. Comparative analysis of the Platforms.

Unit 03	**Programming the hardware**	**06 hrs**

Introduction to Integrated Development Environment, Overview of different IDE's, Example of programs using Arduino IDE, Basics of Python, Example of programs using Python.

Unit 04	**Sensing and Actuation**	**06 hrs**

Sensors, Types of sensors – Digital and Analog, characteristics, choosing right sensor for Application, Interfacing Sensor with Node MCU, Reading data from Sensors like LM35, DHT 11, Ultrasonic Sensor, IR Sensor, sound sensor, touch sensor, LDR, Potentiometer, Current and voltage Sensor, Connecting actuators - relay, stepper motor.

Unit 05	**Communication Technologies and Cloud**	**06 hrs**

Introduction to communication Technologies like Wi-Fi, Bluetooth, RFID, Z-Wave, Zigbee, 6LoWPAN, LORA, Wireless HART, MQTT, Introduction to cloud platforms.

Unit 06	**Development of IoT based Application**	**06 hrs**

Reading sensor data and sending it to cloud platform, Visualization and analysis of the data on cloud, actuation and control, case study – Home automation

Test Books:

[T1]	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
[T2]	Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
[T3]	Parikshit N. Mahalle & Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (e-book).
Reference Books:	
[R1]	Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web", ISBN : 978-1-84821-140-7, Willy Publications
[R2]	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2^{nd} Edition, Willy Publications.
[R3]	Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things". Publisher: Lightning Source Inc; 1^{st} edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
[R4]	Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
[R5]	Michael Margolis, Arduino Cookbook, 2^{nd} Edition, O'Reilly Media, Inc, 2011.
[R6]	Alex Bradbury & Ben Everard, Learning Python with Raspberry Pi, 1^{st} Edition, John Wiley & Sons, Feb 2014.
[R7]	Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi, 1^{st} Edition, Apress, 2014.

303151B: Elective-II: Electric Mobility

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Basic concept of Batteries, Electrical Motors, Power Electronics

Course Objectives: This course aims to

1. To make students understand the need & importance of Electric & Hybrid Electric vehicles.
2. To differentiate and analyze the various energy storage devices.
3. To impart the knowledge about architecture and performance of Electric and Hybrid Vehicles
4. To classify the different drives and controls used in electric vehicles.

Course Outcomes: At the end of this course, student will be able to

CO1	Analyze the concepts of Hybrid and Electric vehicles.
CO2	Describe the different types of energy storage systems
CO3	Comprehend the knowledge of the battery charging and management systems.
CO4	Classify the different mode of operation for hybrid vehicle.
CO5	Apply the different Charging standards used for electric vehicles.
CO6	Differentiate between Vehicle to home & Vehicle to grid concepts.

Unit 01	**Introduction to Hybrid and Electric vehicles**	**06 hrs**

Need and importance of Electric Vehicle and Hybrid Electric Vehicles, Environmental importance of Hybrid and Electric vehicles. Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series-parallel). Micro Hybrid, Mild Hybrid, Full Hybrid, Plug-in Hybrid, Electric vehicles: Components, configuration, performance, tractive effort, Advantages and challenges in EV.

Unit 02	**Energy Storage Systems**	**06 hrs**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery specifications, Battery based energy storage and its analysis, Classification of lithium-ion batteries, Aluminum Air and Aluminum ion battery. Fuel Cell based energy storage, Super Capacitor based energy storage, Hybridization of Ultra capacitor and Battery. Selection methodology for the energy storage.

Unit 03	**Battery Charging and Management Systems**	**06 hrs**

introduction: Different Charging algorithms and Charging method, Cell Balancing methods.
Battery Management System: Functions of BMS, Block diagram of BMS. SoC Estimation methods, Thermal Management of Battery.

Unit 04	**Hybrid Power Train and mode of operation**	**06 hrs**

Control Strategies and Design of the Major Components: Series and Parallel Hybrid Electric Drive Train. Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Regenerative braking

Unit 05	**Drives and Charging Infrastructure**	**06 hrs**

Selection of drives for Electric vehicle: PMSM drive and BLDC drive, Sizing of motor, Charging Levels: 01,02 and 03, Charging Standards: CCS, CHAdeMO, SAE J1772, IEC 60309, Bharat DC 001, Bharat AC 001, Electric Vehicle Supply Equipment (EVSE).

Unit 06	**Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid**	**06 hrs**

Vehicle to Home: Introduction, applications, V2H with demand response, Case Study of V2H.
Vehicle to Grid: Introduction of V2G, V2G infrastructure in the smart grid, Role of aggregator for V2G, Case study of V2G, Vehicle to Vehicle: Introduction of V2V, Concept & structure.

Test Books:

[T1]	"Electrical Vehicle", James Larminie and John Lowry, John Wiley & Sons, 2012.

[T2]	"Electric and Hybrid-Electric Vehicles", Ronald K. Jurgen, SAE International Publisher.
[T3]	"Energy Systems for Electric and Hybrid Vehicles", K T Chau, The institution of Engineering and Technology Publication
[T4]	"Batteries for Electric Vehicles", D.A.J Rand, R Woods & R M Dell ,Research studies press Ltd, New York, John Willey & Sons
[T5]	Electric & Hybrid Vehicles-Design Fundamentals, CRC press
Reference Books:	
[R1]	"Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", Mehrdad Ehsani, Yimin Gao and Ali Emadi. CRC Press, 2009.
[R2]	"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", Junwei Lu & Jahangir Hossain et al (eds), IET Digital Library.
[R3]	"Automobile Electrical and Electronic systems", Tom Denton, SAE International publications.
[R4]	"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
[R5]	The Electric Vehicle Conversion handbook –Mark Warner, HP Books, 2011.
Online Resources:	
[O1]	https://www.theiet.org/resources/books/transport/vehicle2grid.cfm?
[O2]	https://www.sae.org/publications/books/content/pt-143.set/
[O3]	http://nptel.ac.in/courses/108103009/

303151C:Elective-II: Cybernetics Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Laplace transform, basics of matrices, computer programming and fundamentals.

Course Objectives: This course aims to

1. Introduce the concept of engineering cybernetics.
2. Give basic knowledge of key topics in cybernetics, such as system theory, control engineering, embedded computer systems, mathematical modeling, simulation, and optimization.

Course Outcomes: At the end of this course, student will be able to

CO1	Define cybernetics in terms of control and how is it used in controlling technical, biological, and other processes.
CO2	Understand various matrix operations.
CO3	Describe different types of control system configurations and their applications.
CO4	Carry out mathematical modeling and simulation of simple processes.
CO5	Appreciate the essential requirements for computers and computer equipment that are intended to operate in dedicated applications and industrial environments.
CO6	Know intelligent optimization techniques.

Unit 01	**Introduction to Cybernetics**	**06 hrs**

History of Cybernetics, various definitions of cybernetics, Control or regulation in machines, Control or regulation in human affairs.

Unit 02	**Linear system theory**	**06 hrs**

Vector Spaces, Bases, Coordinate Transformation, Invariant Subspaces, Inner product, Norms, Rank, Types of Matrices, Eigenvalues, Eigenvectors, Diagonalization, Matrix Factorization.

Unit 03	**Control Engineering**	**06 hrs**

Introduction to control systems, basic terminologies, Linearization. Laplace transform and transfer functions, types of control systems, introduction of nonlinear control system, adaptive control system, optimal control system, multivariable control system and their examples and applications.

Unit 04	**Mathematical Modeling and Simulation**	**06 hrs**

Mathematical modeling of physical processes, Differential equations of physical systems, such as electrical, mechanical, fluid, linear approximation, solution of ordinary differential equations using ODE solvers.

Unit 05	**Embedded computer systems**	**06 hrs**

Design of embedded computer systems. Computer architectures and system components for embedded and industrial applications. Microcontrollers and specialized microprocessors. Parallel and serial bus systems. Data communication in industrial environments. Analog/digital interfaces.

Unit 06	**Modern Optimization Methods**	**06 hrs**

Definition, applications, types of methods for optimization, Introduction to modern optimization techniques, Genetic algorithm, Simulated Annealing method, Particle Swarm Optimization, Ant Colony method.

Test Books:

[T1]	https://asc-cybernetics.org/foundations/history.htm [Online available on 30.05.2021]
[T2]	Dan C. Marinescu, "Complex Systems and Clouds A Self-Organization and Self-Management Perspective", Elsevier, United States, 2017
[T3]	C-T Chen, "Linear System Theory and Design", Oxford University Press, 1999
[T4]	Richard C. Dorf, Robert H. Bishop, "Modern Control System", Pearson Education Limited, 2011
[T5]	Hassan K. Khalil, "Nonlinear Control", Pearson Education Limited, 2011

[T6]	Karl Johan Astrom, Bjorn Wittenmark, “Adaptive Control”, Dover Publications Inc., New York 2008
[T7]	Y. S. Apte, “Linear Multivariable Control Systems”, McGraw-Hill, 1981
[T8]	Nirmala Sharma, “Computer Architecture”, Laxmi Publication, 2009
[T9]	Soliman Abdel- Hady Soliman, Abdel-Aal Hassan Mantawy, “Modern Optimization Techniques with Applications in Electric Power Systems” Springer

303151D:Elective-II Energy Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Various electrical equipment and specifications, Construction and operation of different equipment/process like HVAC, Pumps, Compressors etc.

Course Objectives: The course aims to:-

1. Understand importance of energy Conservation and energy security and impact of energy use on environment.
2. Follow format of energy management, energy policy.
3. Understand demand side management tools and impact of tariff on demand management.
4. Importance of Data Analytics in Energy audit and audit process.
5. Calculate energy consumption and saving options with economic feasibility.
6. Use of appropriate energy conservation measure in field applications or industry.

Course Outcomes: At the end of this course, student will be able to

CO1	Describe BEE Energy policies, Energy ACT.
CO2	List and apply demand side management measures for managing utility systems.
CO3	Explore and use simple data analytic tools.
CO4	Use various energy measurement and audit instruments.
CO5	Evaluate economic feasibility of energy conservation projects.
CO6	Identify appropriate energy conservations methods for electric and thermal utilities.

Unit 01	**Energy Scenario**	**06 hrs**

Classification of Energy resources, Commercial and noncommercial sources, primary and secondary sources, commercial energy production, final energy consumption. Energy needs of growing economy, short terms and long terms policies, energy sector reforms, energy security, importance of energy conservation, energy and environmental impacts, introduction to CDM, UNFCCC, Paris treety, emission check standard, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Latest amendments in Electricity Act. Indian and Global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC).

Unit 02	**Energy Management**	**06 hrs**

Definition and Objective of Energy Management, Principles of Energy management, Energy Management Strategy, Energy Manager Skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy, Organization setup and energy management. Responsibilities and duties of energy manager under the latest Act. Energy Efficiency Programs. Energy monitoring systems.

Unit 03	**Demand Management**	**06 hrs**

Supply side management (SSM), Generation system up gradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM. Use of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control. Apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.) Introduction to ISO 50001- Energy Management.

Unit 04	**Energy Audit**	**06 hrs**

Definition, need of energy audits, types of audit, procedures to follow, data and information analysis, Introduction to Data Analytics, data quality processing, clustering techniques, pattern mining, regression and classification. Relevance of Data Analytics in Audit, energy audit instrumentation,

energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options. Bench- marking energy performance of an industry. Energy Audit reporting format – Executive Summary , Detailing of report.		
Unit 05	**Financial Analysis**	**06 hrs**
Financial appraisals; criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost of energy, cost of generation Energy Audits case studies – Sugar Industry, Steel Industry, Paper and Pulp industry.		
Unit 06	**Energy Conservation**	**06 hrs**
a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and steam systems) d) Ventilation(Fan, Blower and Compressors) and Air Conditioning systems e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T and D Sector) and Performance Assessments.		

Test Books:

[T1]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 1, General Aspects (available on line)
[T2]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities (available on line)
[T3]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities (available on line)
[T4]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 4 (available on line)

Reference Books:

[R1]	Success stories of Energy Conservation by BEE (www. Bee-india.org)
[R2]	Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.
[R3]	Energy Management by W.R. Murphy and Mackay, B.S. Publication.
[R4]	Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication
[R5]	Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.
[R6]	A General Introduction to Data Analytics by Andre Carvalho and Tomáš Horváth Wiley Inc First Edition 2019.

Online Resources:

[O1]	www.energymanaertraining.com
[O2]	www.em-ea.org
[O3]	www.bee-india.org
[O4]	https://www.iso.org/iso-50001-energy-management.html

Unit	**Text Books**	**Reference Books**
Unit 1	T1	O1, O2
Unit 2	T1	O1, O2
Unit 3	T1	R4, O4
Unit 4	T1	R4, R5 and O1 and O2, R6
Unit 5	T1 and T4	R1, R2, R3, R5 O1 and O2
Unit 6	T2, T3 and T4	R1, R5 and O1 and O2

303152: Internship

Teaching Scheme			Credits		Examination Scheme	
IN	04	Hr/Week	IN	04	TW	100 Marks

Preamble

Internship is a short-term industrial working experience for the students. The internship aims at providing entry-level exposure to a particular industry. It is expected that students should spend time working on relevant projects or part of the project and acquire learning about the field, along with developing industry connections, and employability skills.

Course Objectives:

1. Encourage and provide opportunities to the students to acquire professional learning experiences.
2. Empower students to relate and then apply the theoretical knowledge in real-life industrial situations.
3. Provide exposure for handing and using various tools, measuring instruments, meters, and technologies used in industries.
4. Enable students to develop professional and employability skills and expand their professional network.
5. Empower students to apply the internship learnings to the academic courses and project completions.
6. Impart professional and societal ethics in students through the internship.
7. Make students aware of social, economic, and administrative aspects influencing the working environment of the industry.

Course Outcomes: At the end of this course, student will be able to

CO1	Understand the working culture and environment of the Industry and get familiar with various departments and practices in the industry.
CO2	Operate various meters, measuring instruments, tools used in industry efficiently and develop technical competence.
CO3	Apply internship learning in other course completions and final year project management, i.e. topic finalization, project planning, hardware development, result interpretations, report writing, etc.
CO4	Create a professional network and learn about ethical, safety measures, and legal practices.
CO5	Appreciate the responsibility of a professional towards society and the environment.
CO6	Identify career goals and personal aspirations.

Guidelines: The guidelines related to the internship are given below.

Duration: Guidelines related to duration are as follows.

1. The internship should be started after semester 5 and should be completed before the commencement of semester 6.
2. It should be for at least 4 to 6 weeks.
3. It should be assessed and evaluated in semester 6.

2. Internship Identification:

A student may choose to undergo an Internship at Industries, Government organizations, NGOs, Micro-Small-Medium enterprises, startups, Innovation and Incubation Centers, Institutes of National interests, organizations working for rural development, organizations promoting IPR and Entrepreneurship, etc. Approaching various industries for Internships and finalizing the same should be initiated in the 5th semester in consultation with Institute's Training and Placement Cell, Industry-Institute Cell, or Internship Cell. This will help students to start their internship work on time. Also, it will allow students to work in a vacation period after their 5th-semester examination and before the start of the 6th semester. Student can take internship work in the form of Online/Onsite work from any of the following but not limited to:

1. Working for consultancy or the funded research project of the institute/Department.
2. Contributing at Incubation, Innovation, Entrepreneurship Cell, Institutional Innovation Council, Start-up Cell of Institute where students will get learning opportunities on projects.
3. Learning at Departmental Lab leading to lab development and modernization, Tinkering Lab, Institutional workshop for prototyping and model development, etc.
4. Working at Industry or Government Organization on project or part of the project.
5. Internship through Internshala, AICTE, Government initiatives, etc.
6. In-house product or working model development, intercollegiate, inter-department research under research lab or research group, etc.
7. Working at micro-small-medium enterprises on solving their specific problems.
8. Research internship under professors at IISc, IIT's, NIT's, Research organizations, etc.
9. Working with NGOs or Social Internships, Rural Internship, etc.

Further, other internship opportunities should be discussed and finalized in consultation with Department/Institute constituted committees for Internship.

3. Internship Record Book:
Students must maintain an Internship record book. The main purpose of maintaining a record book is to nurture the habit of documenting and keeping records by students. The students should maintain the record of daily activities completed which may include, field visits, important discussions, observations, project work completed, suggestions received, etc. The record book should be signed every day by the supervisor or in-charge where the student is undergoing an internship. The internship record book and well-drafted Internship Report should be submitted by the students to the department faculty coordinator within a week after the completion of the internship.

4. Internship Evaluation:
The evaluation of activities recorded in the Internship Record Book will be done by Program Head, Cell In-charge, Project Head, faculty mentor, or Industry Supervisor based on the overall compilation of internship activities, sub-activities, the level of achievement expected, and the duration for certain activities. Assessment and Evaluation are to be done in consultation with the internship supervisors (Internal from the institute and External from industry).

5. Evaluation and Assessment of Internship:
Internship Record Book – 25 Marks + Internship Report - 25 Marks + Post Internship Internal Evaluation-50 Marks = Total 100 Marks

5.1 Internship Record Book: The attendance record of the student along with the evaluation sheet, duly signed and stamped by the industry should be submitted by the industry Supervisor or Mentor to the Institute/Department after the completion of the internship. The internship record book may be evaluated based on the following criteria:

- Proper and timely documented entries
- Adequacy and quality of information
- Data, observations, discussions recorded
- Thought process and recording techniques used
- Organization of the information

5.2 Internship Report: After completion of the Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the internship period. The report shall be presented covering the following recommended fields but not limited to:

- Title/Cover Page
- Internship certificate with details like company name, location, duration, supervisor, etc.
- Institute Certificate
- Declaration
- Abstract
- Index/Table of Contents
- List of Figures/Tables
- **Chapter 1:** Introduction: Brief about company, industry or organization, objectives, motivation, organization of the report
- **Chapter 2:** Problem Identification/Problem statement/objectives and scope/expected outcomes
- **Chapter 3:** Methodological details
- **Chapter 4:** Results / Analysis /inferences and conclusion
- **Chapter 5:** Suggestions/Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines, and other sources)

5.3 Post Internship Internal Evaluation: The student will give a presentation based on his Internship report before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

1. Internship Identification and Selection
2. Problem Studied with objectives and expected outcomes
3. Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects.
4. Methodology/System/Procedure Q&A
5. Block-diagram, flow-chart, algorithm, system description Q&A
6. Final results, discussions, suggestions, comments, etc. Q&A
7. Presentation and Communication

6. Feedback from internship supervisor (External and Internal)

Post internship, the faculty Internship coordinator should collect feedback about the student on the following suggested parameters from Industry Supervisor.

- Technical knowledge,
- Discipline and Punctuality,
- Work Commitment,
- Willingness to do the work,
- Communication skills, etc.

<table>
<tr><th colspan="8">303153A: Audit Course IV: Ethical Practices for Engineers</th></tr>
<tr><td colspan="3">Teaching Scheme</td><td colspan="2">Credits</td><td colspan="3">Examination Scheme</td></tr>
<tr><td>Theory</td><td>02</td><td>Hr/Week</td><td>TH</td><td>00</td><td>GRADE</td><td colspan="2">PP/NP</td></tr>
<tr><td colspan="8">Prerequisite:</td></tr>
<tr><td colspan="8">Basic understanding of business management</td></tr>
<tr><td colspan="8">Course Objectives: This course aims to</td></tr>
<tr><td colspan="8">Create awareness to serve the public by strictly adhering to codes of conduct and placing paramount the health, safety and welfare of public.</td></tr>
<tr><td colspan="8">Course Outcomes: At the end of this course, student will be able to</td></tr>
<tr><td>CO1</td><td colspan="7">Understand for their professional responsibilities as Engineers.</td></tr>
<tr><td>CO2</td><td colspan="7">Recognize and think through ethically significant problem situations that are common in Engineering.</td></tr>
<tr><td>CO3</td><td colspan="7">Evaluate the existing ethical standards for Engineering Practice.</td></tr>
<tr><td>Unit 01</td><td colspan="6">Introduction: Justice and Moral</td><td>12 hrs</td></tr>
<tr><td colspan="8">Introduction to Ethical Reasoning and Engineer Ethic, Professional Practice in Engineering, Ethics as Design - Doing Justice to Moral Problems, Central Professional Responsibilities of Engineers.</td></tr>
<tr><td>Unit 02</td><td colspan="6">Rights and Responsibility</td><td>12 Hrs</td></tr>
<tr><td colspan="8">Computers, Software, and Digital Information, Rights and Responsibilities Regarding Intellectual Property, Workplace Rights and Responsibilities, Responsibility for the Environment.</td></tr>
<tr><td colspan="8">Test Books:</td></tr>
<tr><td>[T1]</td><td colspan="7">Ethics in Engineering practice and Research (2nd Edition) by Caroline Whitbeck Cambridge</td></tr>
<tr><td>[T2]</td><td colspan="7">Ethics in Engineering MW Martin and R Schinzinger MC Graw Hill</td></tr>
<tr><td>[T3]</td><td colspan="7">Engineering Ethics and Environment P a Vesilind and AS Gunn Cambridge</td></tr>
<tr><td colspan="8">Online Resources:</td></tr>
<tr><td>[O1]</td><td colspan="7">NPTEL course on “Ethics in Engineering Practice”, By Prof. Susmita Mukhopadhyay, IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc19_hs35/preview</td></tr>
</table>

303153B:Audit Course VI: Project Management

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	**PP/NP**

Prerequisite:

Course Objectives: This course aims to

1. Plan a successful project through project management.
2. Select the right members of a team for a project.

Course Outcomes: At the end of this course, student will be able to

CO1	Elaborate importance of project management and its process.
CO2	Learn about the role of high performance teams and leadership in project management.

Unit 01	**Basics of Project Management:**	**12 hrs**

Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

Unit 02	**Project Identification, Selection, planning:**	**12 hrs**

Project Identification, Selection Introduction, Project Identification Process, Project Initiation, Pr-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

Test Books:

[T1]	Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner.
[T2]	Guide to Project Management: Getting it right and achieving lasting benefits by Paul Roberts.

Online Resources:

[O1]	https://www.coursera.org/learn/project-planning?specialization=project-management
[O2]	Project management for managers By Prof. Mukesh Kumar Barua, IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_mg48/preview

SAVITRIBAI PHULE PUNE UNIVERISTY, PUNE

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Final Year Electrical Engineering (2019 Course) (w.e.f. 2022-2023)

BE Electrical (2019 Course)

SEM-I

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403141	Power System Operation & Control	3	2	–	–	30	70	25	–	25	150	3	1	–	–	4
403142	Advanced Control System	3	2	–	–	30	70	–	–	50	150	3	1	–	–	4
403143	Elective-I	3	2	–	–	30	70	–	–	25	125	3	1	–	–	4
403144	Elective-II	3	–	2*	–	30	70	25	–	–	125	3	–	1	–	4
403145	Project Stage-I	–	–	–	4	–	–	50	–	50	100	–	–	–	2	2
403146	MOOCs	–	–	–	–	–	–	50	–	–	50	–	–	–	2	2
403147	Audit Course-VII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		**12**	**6**	**2**	**4**	**120**	**280**	**150**	**–**	**150**	**700**	**12**	**3**	**1**	**4**	**20**

403143: Elective-I	403144: Elective-II	403147: Audit Course-VII
403143A: PLC and SCADA 403143B: Power Quality Management 403143C: High Voltage Engineering 403143D: Robotics and Automation	403144A : Alternate Energy System 403144B : Electrical & Hybrid Vehicle 403144C : Special-purpose Machines 403144D: HVDC & FACTS	403147 A: German Language I 403147B: Engineering Economics I 403147C: Sustainability(IGBC)

SEM-II

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403148	Switchgear and Protection	3	2	–	–	30	70	25	–	50	175	3	1	–	–	4
403149	Advanced Electrical Drives & Control	3	2	–	–	30	70	25	50	–	175	3	1	–	–	4
403150	Elective-III	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403151	Elective-IV	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403152	Project stage II	–	–	–	12	–	–	100	–	50	150	–	–	–	6	6
403153	Audit course VIII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		12	4	–	12	120	280	150	50	100	700	12	2	–	6	20

403150: Elective-III	403151: Elective-IV	403153: Audit Course-VIII
403150 A : Digital Control System 403150 B : Restructuring and Deregulation 403 150 C: Smart Grid 403150 D: SensorTechnology (Open Elective)	403151A: EHV AC Transmission 403151B : Illumination Engineering 403151C: Electromagnetic Fields 403151D: AI and ML (Open Elective)	403153A: German Language II 403153B: Engineering Economics II 403153C: Green Building

*** For the tutorial, one credit is given. # Audit Course: Conduct over and above these lectures.**

403141: Power System Operation and Control

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25
					Term work	25

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Course Objectives:

This course aims to:

1. Study the different types of angle, voltage and frequency stability of the power system and methods to improve the stability of the power system.
2. Impart knowledge about various advanced controllers such as FACTs controllers with its evolution, principle of operation, circuit diagram and applications.
3. Introduce frequency control in a single area and two area system.
4. Understand the formulation of unit commitment and economic load dispatch.
5. Illustrate various ways of interchange of power between interconnected utilities.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Summarize angle, voltage and frequency stability in the power system control (UN).
CO2: Illustrate various ways of interchange of power between interconnected utilities (AP).
CO3: Analyze stability and optimal load dispatch using different techniques (AN).
CO4: Select appropriate FACTS devices for stable operation of the system (EV).
CO5: Evaluate the stability of the system and suggest the methods to improve it (EV).

Unit 01	**Power System Stability (Angle Control):** Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and reclosure), methods to improve steady state and transient stability, numerical based on equal area criteria.	08 hrs
Unit 02	**Reactive Power Control:** The necessity of reactive power control, production and absorption of reactive power, reactive power requirements for power factor control and voltage regulation and the loading capability curve of a synchronous generator, types of FACTS controller. **Series compensation:** reactor and capacitor, TCSC, SSSC. **Shunt compensation:** reactor and capacitor, STATCOM, FC-TCR. **Series and shunt compensation:** UPFC. (FACTS devices: working principle, circuit diagram, VI characteristics, applications)	08 hrs
Unit 03	**Automatic Generation Control (Frequency Control):** Introduction to the concept of AGC; complete block diagram representation of load-frequency control of an isolated power system; steady state and dynamic response;	08 hrs

	control area concept; two-area load-frequency control; Schematic and block diagram of the alternator voltage regulator scheme.	
Unit 04	**Economic Load Dispatch and Unit Commitment (Cost Control):** ● **Part A: Economic load dispatch:** Introduction, revision of cost curve, incremental cost curve of thermal, method of Lagrange multiplier, exact coordinate equation (penalty factor), economic scheduling of thermal plant considering effect of transmission losses using Bmn coefficient. (Numerical on method of Lagrange multiplier, penalty factor, Bmn coefficient) ● **Part B: Unit commitment:** Concept of unit commitment, constraints in unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, Numerical on priority list and dynamic programming method.	08 hrs
Unit 05	**Energy Control:** Interchange of power between interconnected utilities (numerical), economic interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools.	06 hrs
Unit 06	**Voltage Stability:** Basic concepts related to voltage stability: transmission system characteristics (PV curve), generator characteristics (QV curve), and load characteristics. Voltage collapse, classification of voltage stability, static and dynamic stability, analysis techniques for dynamic voltage stability, voltage stability indexing.	07 hrs
Text Books:		
[T1]	I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4^{th} Edition, Tata McGraw Hill Publishing Co. Ltd. (Edition 2)	
[T2]	T. J. E. Miller, "Reactive power control in electric systems," Willey.	
[T3]	Hadi Saadat, "Power System Analysis," Tata McGraw's Hill	
[T4]	S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control," Pearson Education India, 2009.	
[T5]	P. S. R. Murthy, "Power System Operation and Control," Tata McGraw-Hill Publishing Co., Ltd.	
[T6]	Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control," Prentice Hall of India.	
[T7]	Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTs," IEEE Press.	
[T8]	Dr. B.R. Gupta, "Power System-Analysis and Design", S. Chand Publication.	
Reference Books:		
[R1]	Allen J. Wood and Bruce F. Wollenberg, "Power Generation, Operation, and Control," Wiley India Edition.	
[R2]	R. Mohan Mathur, Rajiv K. Varma, "Thyristor based FACTS controller for electrical transmission systems", by John Wiley and Sons, Inc.	

[R3]	Olle I. Elgerd, “Electrical Energy System Theory”, 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd.
[R4]	Dr. K. Uma Rao, “Power System Operation and Control,” Wiley India
[R5]	Prabha Kundur, “Power System Stability and Control,” Tata McGraw’s Hill
[R6]	“Electrical Power System Handbook”, IEEE Press
[R7]	James Momoh, “Smart Grid: Fundamentals of design and analysis,” Wiley, IEEE Press
Online Resources:	
[O1]	https://www.youtube.com/playlist?list=PL86E9AC8CFBA00ADB
[O2]	https://onlinecourses.nptel.ac.in/noc19_ee62/preview
[O3]	https://www.youtube.com/watch?v=uy9lZCdkQIM&list=PLD4ED2FAF3C155625
[O4]	http://nptel.ac.in/courses/108101040/ (PSOC webcourse)
[O5]	https://nptel.ac.in/courses/108101004
[O6]	https://onlinecourses.nptel.ac.in/noc21_ee16/preview

Mapping:

Unit	Text Books	Reference Books
01	T1, T3, T6, T8	R4, R5
02	T2, T4, T7	R2, R4
03	T1, T3, T4, T5	R1, R3, R4, R5
04	T1, T3, T4	R1, R4
05	T1	R1
06	T8	R4, R5, R7

List of Experiments:

A)The following experiments are ***compulsory***:

1. To apply equal area criteria for stability analysis under a fault condition (three-phase fault at the middle point of a parallel transmission line).
2. To study the Lagrange multiplier technique for economic load dispatch (to find the optimal loading of generators).
3. To study load frequency control using an approximate and exact model.
4. To study reactive power compensation using STATCOM.

B) From the following list, perform ***any four*** experiments.

5. To solve the Unit Commitment problem by priority list method/ dynamic programming (DP) approach
6. Plot a swing curve using the point-by-point/4th order Runge-Kutta method.

7. To apply equal area criteria for analysis stability under a sudden rise in mechanical power input.
8. To study load frequency control with proportional and integral control.
9. To study the two area of load frequency control.
10. To study reactive power compensation using simulation of TCR or TCSC.
11. To study the optimum loading of generators considering transmission losses (penalty factor).

Guidelines for the Instructor's Manual:

- The Instructor's Manual should contain the following things related to every experiment:
- Specify prerequisite and objective(s) of experiment
- Include a circuit diagram with specifications (for hardware experiments).
- A related theory of the experiment must be included.
- The circuit diagram of the experiment should be drawn at the beginning.
- For simulation experiments using MATLAB/EMTP, the Simulink diagram with proper details must be included in the write up. For programming, take a printout of the program and the result.
- A conclusion based on calculations, results, and graphs (if any) should be written.

Industrial Visit:

An industrial visit is mandatory to the Load Dispatch Center/Power Station Control Room.

Guidelines for Students' Lab Manual:

- Students should write the journal in their own handwriting, particularly the results, diagrams, conclusions, questions, answers, etc.
- A circuit or connection diagram or construction diagram must be drawn either manually using or using software on graph paper.
- Handwriting and figures must be neat and clean.

Guidelines for Laboratory Conduction:

- Do the continuous assessment. The experiments performed in a particular week must be checked in the next turn in next week.
- During assessment, the teacher should make the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of the experiment and in the index.

403142: Advanced Control System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	50

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Prerequisite:

Control System Engineering, Matrix Algebra, Z-transform, and Laplace transform.

Course Objectives:

This course aims to:

1. Introduce concepts of modern control theory, analysis, and design.
2. Provide an overview of the digital control system and nonlinear control system.
3. Explore advanced control techniques at an introductory level.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Explain compensation networks, common nonlinearities, the concept of state, sampling and reconstruction, and concepts of advanced controls (Understanding)
CO2: Determine transfer function from state model (Applying)
CO3: Test controllability and observability properties of the system (Evaluating)
CO4: Design compensators, state feedback controls, and observers for the system (Creating)

Unit 01	Compensator Design in Frequency Domain	06 hrs

approach to control system design, cascade compensation networks, phase-lead and phase-lag compensator designs using bode plot, physical realization of compensators.

Unit 02	Nonlinear Control Systems	07 hrs

introduction to nonlinear systems, common nonlinearities, describing function method, describing function of an ideal relay, stability analysis with describing function, introduction to Lyapunov stability analysis (basic concepts, definitions, and stability theorem)

Unit 03	Introduction to State-Space	08 hrs

Concept of state, state-space representation of dynamical systems in physical variable form, phase variable forms and Jordon / diagonal canonical form, conversion of the transfer function to state-space model and vice versa, state equation and its solution, state transition matrix and its properties, computation of state transition matrix by Laplace transform and Caley Hamilton method.

Unit 04	State-Space Design	08 hrs

The concept of controllability and observability, Kalman's and Gilbert's tests for controllability and observability, effect of pole-zero cancellation, duality property, control system design using pole-placement using transformation matrix, direct substitution, and Ackermann's formula, State observers, design of a full-order observer.		
Unit 05	Introduction to Digital Control System	08 hrs
Basic block diagram of the digital control system, sampling and reconstruction, Shannon's Sampling theorem, zero-order hold and its transfer function, First-order hold (no derivation), characteristics equation, mapping between s-plane and z-plane, stability analysis in z-plane.		
Unit 06	Advanced control system topics	08 hrs
Concept of sliding mode control, equivalent control, chattering, sliding mode control based on reaching law, Introduction to adaptive control, adaptive schemes, and control problems Optimal control-linear quadratic regulator problem.		

Text Books:

[T1]	Norman S. Nise, *Control System Engineering*, Sixth Edition, John Wily and Sons, Inc. 2011.
[T2]	Richard C. Dorf, Robert H. Bishop, *Modern Control Systems*, Twelfth Edition, Pearson Education.
[T3]	Benjamin C. Kuo, *Digital Control System*, Second Edition, Oxford University Press, 2003.
[T4]	I. J. Nagarath, M. Gopal, *Control System Engineering*, Fourth Edition, New Age International (P) Limited, Publishers
[T5]	A. Nagoor Kani, *Advanced Control Theory*, Third Edition, CBS Publishers and Distributes, 2020.

Reference Books:

[R1]	Katsuhiko Ogata, *Modern Control Engineering*, Fifth Edition, Prentice-Hall, 2010.
[R2]	M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw-Hill.
[R3]	K. Ogata, *Discrete-Time Control System*, Second Edition, PHI Pvt. Ltd. 2006
[R4]	M. Gopal, *Modern Control Systems Theory*, Second Edition, New Age International (P) Limited, Publishers
[R5]	Karl J. Åström, Björn Wittenmark, *Adaptive Control*, Second Edition, Dover Publications, Inc. New Yark
[R6]	C Edwards, Sarah K. Spurgeon, S Spurgeon, *Sliding Mode Control: Theory And Applications*, Taylor and Francis, 1998
[R7]	Jean-Jacques E. Slotine, Jean-Jacques E.. Slotine, Weiping Li, *Applied Nonlinear Control*, Prentice Hall, 1991.

Online Resources:

[O1]	https://nptel.ac.in/courses/108102043
[O2]	https://nptel.ac.in/courses/108102113

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T4, T5	R4
03	T2	R1
04	T2	R1
05	T3	R2,R3
06	T2,T3	R4,R5,R6

List of Experiments:

[Perform any 8 experiments using any simulation software]

1. Simulation of a lead or lag compensator for a given system and comparison of compensated and uncompensated systems responses.
2. Simulation of the closed-loop system with ideal real as a nonlinearity.
3. Software program for determining a state-space model for a given transfer function and vice versa.
4. Software program for determining the state transition matrix.
5. Software program for checking the observability and controllability of a given system.
6. Simulation of state feedback control design using software.
7. Simulation of a full-order observer-based state feedback control system.
8. Effect of sampling and verification of sampling theorem by simulation.
9. Converting a continuous-time system to a discrete-time system and checking the response using the software.
10. Design of a linear quadratic regulator for a given system using simulation.

Industrial Visit:

Industrial visit to a process industry or control and automation industry

Guidelines for the instructor's manual:

Guidelines for the instructor’s manual are given below:

- It should have a title, learning outcomes, aim, software requirement, theory, the problem with the solution, simulation results, comparison (result table, if any), and conclusion.
- All the experiments should have at least one numerical problem, which should be solved analytically, then it should be verified by the simulation. For that matter, theory can be restricted to only definitions and concepts (no detailed explanation).
- Simulation printouts should have readable and self-explanatory block diagrams and figures.
- To develop a proper understanding of all the experiments, it is suggested to take figures with the same physical system (or numerical problem) for all the experiments.

Guidelines for Student’s Lab Manual:

Guidelines for the students' lab manual are given below.

- Students should write the theory, the problem with a solution, and the conclusion on their own in their own handwriting.
- Students should write a program on their own and should compare analytical and simulated results.
- Students should try using different values of the parameters in the numerical problem and should observe the changes in the results.
- Hand writing must be clean and neat.

Guidelines for Laboratory Conduction:

Guidelines for laboratory conduction are as follows:

- At the beginning, the instructor should state the learning outcomes of the experiment and should provide a problem statement to the students.
- Students should solve the problem and then simulate the experiment.
- To have variations in the numerical problem, different parameters can be set for different students.

403143A: PLC and SCADA

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims to:

1. To make the students understand the fundamentals of automation and various automation systems used in the industry, such as PLC.
2. To provide knowledge levels needed for PLC programming and operating.
3. To develop the architecture of SCADA, explaining each unit in detail.
4. To apply knowledge gained about PLCs and SCADA systems to real-life industrial applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Develop and explain the working of a PLC with the help of a block diagram.
CO2:Classify input and output interfacing devices with PLC.
CO3:Design PLC based application by proper selection criteria, developing GUI and ladder program.
CO4:Execute, debug, and test the programs developed for digital and analog operations.
CO5:Develop the architecture of SCADA and explain the importance of SCADA in critical infrastructure.
CO6:Describe the SCADA protocols and digital control systems, along with their architecture for automation.

Unit 01	Introduction to PLC	07 hrs

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition as per NEEMA (National Electrical Engineering Manufacturers' Association), types – fixed/modular/dedicated, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, selection criterion, advantages and disadvantages, specifications, comparison of various PLCs manufactured by Allen Bradley, Siemens, ABB, Mitsubishi, GE, Fanuc and Schneider.

Unit 02	Interfacing of PLC with I/O devices	08 hrs

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices Sensors-temperature, pressure, flow, level Actuators-Electrical, pneumatic, hydraulic Encoders-Incremental, Absolute Transducers, Limit switches, proximity sensors Control Elements- Mechanical, Electrical, Fluid valves

Unit 03	Programming of PLC	08 hrs

Programming languages for PLC, Ladder diagram fundamentals, Rules for proper construction of ladder diagram Timer and counter- types along with timing diagrams, Reset instruction, latch instruction MCR (master control relay) and control zones Developing ladder logic for Sequencing of motors, ON OFF, Tank

level control, ON OFF temperature control, elevator, bottle filling plant, car parking, traffic light controller.		
Unit 04	Advance function and Applications of PLC	08 hrs
Analog PLC operation and PLC analog signal processing, PID principles, typical continuous process control curves, simple closed loop systems, closed loop systems using Proportional, Integral and Derivative (PID), PID modules, PID tuning, tuning methods including the “Adjust and observe” method AC Motor Controls: AC Motor Starter, AC Motor Overload Protection, DC Motor Controller, Variable Speed (Variable Frequency) AC Motor Drive. PLC Applications in developing systems- Tank level controller using analog signals, temperature controller using RTD, speed control of electric motor.		
Unit 05	SCADA Systems	07 hrs
Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system architecture, important definitions HMI, MTU, RTU, communication means, Desirable properties of the SCADA system, advantages, disadvantages, and applications of SCADA. SCADA generations (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, functions and features of SCADA systems, Automatic substation control, Energy management systems (EMS), System operating states, SCADA systems in critical infrastructure: Petroleum Refining Process, Conventional electric power generation, Water Purification System, Chemical Plant.		
Unit 06	SCADA Protocols and Distributed Control Systems	07 hrs
Open systems interconnection (OSI) Model, TCP/IP protocol, Modbus model, DNP3 protocol, IEC 60870-5-101 (IEC101), Control and Information Protocol (CIP), Ether 01111111111111Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Distributed Control System: Introduction to DCS- its working & operation, Architecture , Features, Advantages & Applications of DCS, Comparison between DCS & PLC.		
Text Books:		
[T1]	John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Application”, PHI Learning, New Delhi, 5th Edition	
[T2]	John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications”, PHI Publishers.	
[T3]	Ronald L. Kurtz, “Securing SCADA Systems," Wiley Publishing.	
[T4]	Stuart A. Boyer, “SCADA supervisory control and data acquisition”, ISA, 4th Revised edition.	
[T5]	Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson, 2nd Edition.	
[T6]	Curtis Johnson, “Process Control Instrumentation Technology," Prentice-Hall of India.	
Reference Books:		
[R1]	Gordan Clark, Deem Reynders, “Practical Modern SCADA Protocols," ELSEVIER	
[R2]	Batten G. L., “Programmable Controllers," McGraw Hill Inc., Second Edition	

[R3]	Bennett Stuart, "Real Time Computer Control," Prentice Hall, 1988
[R4]	Krishna Kant, "Computer Based Industrial Control," PHI
[R5]	P. K. Srivstava, "Programmable Logic Controllers with Applications," BPB Publications
[R6]	Distributed Computer Control systems in Industrial Automation, D Popovic & Vijay Bhatkar.

Online Resources:

[O1]	NPTEL Course: Electrical Measurement And Electronic Instruments By Prof. Avishek Chatterjee, Dept. of Electrical Engineering, IIT Kharagpur:- Web link https: // nptel.ac.in /courses /108 /105 / 108105153/
[O2]	NPTEL Course: Industrial Instrumentation By Prof. Alok Barua, IIT Kharagpur:-Web linkhttps://nptel.ac.in/courses/108/105/108105064/

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T1, T2, T6	R3, R4
03	T1, T5	R5
04	T1, T2, T6	R2, R5
05	T3, T4	R1
06	T3	R1, R6

List of Experiments:

Minimum 11 experiments should be conducted. 6 experiments should be on PLC and 5 experiments should be on SCADA.
a) Experiments No. ***1 to 5*** are ***compulsory.***
b) ***Any 1*** experiment should be conducted from experiment number ***6 to 9.***
c) Experiments No. ***10 to 13*** are compulsory.
d) ***Any 1*** experiment should be conducted from experiment number ***14 to 17.***

1. Interfacing of lamp and button with PLC for ON and OFF operation. Verify all logic gates.
2. Set / Reset operation: one push button for ON and other push button for OFF operation.
3. Delayed operation of lamp by using push button.
4. UP/DOWN counter with RESET instruction.
5. Combination of counter and timer for lamp ON/OFF operation.
6. DOL starter and star delta starter operation by using PLC.
7. PLC based thermal ON/OFF control.
8. Interfacing of Encoder with PLC
9. PLC based speed, position, flow, level, pressure measurement system.
10. PLC interfaced with SCADA and status read/command transfer operation.
11. Parameter reading of PLC in SCADA.
12. Alarm annunciation using SCADA.
13. Reporting and trending in the SCADA system.

14. Tank level control by using SCADA.
15. Temperature monitoring by using SCADA.
16. Speed control of Machine by using SCADA.
17. Pressure control by using SCADA.

Guidelines for Instructor's Manual:

- Specify objective(s) of the experiment.
- Include a ladder diagram.
- Related theory of the experiment must be included.
- Include step by step procedure to perform the experiment.
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable.
- Provide space to write conclusions.

Guidelines for Student's Lab Manual:

Students are expected to write the journal in the following sequence:

- Aim –
- Ladder diagram –
- Theory –
- Conclusions
- Students are expected to draw the ladder diagrams on 1mm graph paper.
    - ➢ They should take the print out or draw SCADA HMI.
    - ➢ Students should write conclusions.
    - ➢ Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Laboratory Conduction:

- Give the safety instructions to students.
- Allow 4-5 students per group to perform the experiment.
- Explain theory related to the experiment to be conducted.
- Introduce PLC and SCADA in detail with specifications to students.
- Explain the ladder diagram of the experiment.
- Ladder diagram should be completed by the students.
- Perform the experiment in the presence of an instructor.
- Verify the results obtained.

403143B: Power Quality Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Prerequisite:

Fundamentals of Power Systems and Power Electronics

Course Objectives:

This course aims to:

1. Develop understanding of power quality attributes.
2. Make students describe problems associated with poor power quality.
3. Make students describe mitigation techniques for improving power quality.
4. Learn various equipment of monitoring and assessment.

Course Outcomes:

Student will be able to

CO1: Understand power quality and attribute of power quality

CO2: Describe voltage flicker and mitigation of it

CO3: Analyze the effect of power system events on voltage sag and its characteristics.

CO4: Identify the sources of harmonics and harmonics produced

CO5: Select proper method for harmonic mitigation along with methods of power quality monitoring.

CO6: Carry out power quality monitoring using power quality analyzers.

Unit 01	Basics of Power Quality	07 hrs

Importance of power quality, terms and definitions of power quality as per IEEE std. 1159-2019 such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding, grounding and power quality, recommended grounding practices for noise and power quality control.

Unit 02	RMS Voltage variations, Flickers and Transient Over-Voltages	07 hrs

RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Ferro-resonance Various means to reduce flickers. Flicker meter and monitoring. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Unit 03	Voltage Sag, Swell and Interruption	07 hrs
Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag, Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of type of fault, fault location and fault level on voltage sag. Phase angle jumps. Types of sags (Type 1 to type 7). Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Measurement of voltage sag half cycle RMS, one cycle rms methods. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.		
Unit 04	Harmonics-I	07 hrs
Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effects of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices and other indices for assessing impacts of harmonics. A.C. quantities under non-sinusoidal conditions. Triplen harmonics characteristics and non characteristics harmonics. Power assessment under waveform distortion conditions. Harmonic sources and harmonic generation from lighting loads, Computer and allied load including SMPS, household equipment, Office automation devices, Utility equipment like transformer, synchronous machines and FACTS devices. Industrial equipment – induction machines, AC and Dc drives, Arc Furnaces.		
Unit 05	Harmonics-II	7 hrs
Harmonics resonances - series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Modifying the system frequency response. Harmonic filtering, IEEE 1531 standard for key design criteria for filters. Passive filters, Notch filter, Tuned filters, Broadband filters and active filters. IEEE Standard 519-2014 for Harmonic control.		
Unit 06	Power Quality Monitoring & Assessment	07 hrs
Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality instrumentation. Power quality analyser specification requirement as per EN50160 Standard. Selection of power quality equipment for cost effective power quality monitoring, Selection of power quality monitors, selection of monitoring location and period. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring. Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion.		
Text Books:		
[T1]	R. C. Dugan, Mark F. McGranaghan, Surya Santoso, and H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw-Hill Publication.	
[T2]	C.Sankaran, “Power Quality”, CRC Press.	
[T3]	M. H. J. Bollen, “Understanding Power Quality Problems, Voltage Sag and Interruptions”, New York: IEEE Press, 2000, Series on Power Engineering.	
[T4]	Arrillaga, M. R. Watson, and S. Chan, “Power System Quality Assessment," John Wiley and Sons.	
Reference Books:		

[R1]	Enriques Acha, Manuel Madrigal, “Power System Harmonics: Computer Modeling and Analysis," John Wiley and Sons Ltd.
[R2]	Ewald F. Fuchs, Mohammad A. S. Masoum, “Power Quality in Power Systems and Electrical Machines,” Elsevier Publication.
[R3]	Arrillaga, M. R. Watson, “Power System Harmonics”, John Wiley and Sons.
[R4]	G. J. Heydt, “Electric Power Quality”, Stars in Circle Publications.
[R5]	EN50160 and IEEE 1100, 1346, 519, and 1159 standards.

Mapping:

Unit	Text Books	Reference Books
01	T1,T2, T3,T4	R1,R2,R4, R5
02	T1,T2	R2, R4, R5
03	T1,T2, T3	R2, R4, R5
04	T1,T2	R1, R2, R3, R4, R5
05	T1,T2	R1, R2, R3, R4, R5
06	T1,T2,T5	R1, R2, R3, R4, R5

List of Experiments:

A minimum of 9 experiments are to be performed from the following list:
Compulsory experiments:

1. Study of the power quality analyzer and measurement of various power quality parameters.
2. Measurement of harmonic distortion of various non linear loads.
3. Harmonic analysis of SMPS based Equipment such as UPS /AC/DC drive.
4. Harmonic compliance of institute as per IEEE 519-2014 standard and sizing of hybrid (Active + detuned filter).
5. Power quality audit of institute or department.

Any 4 experiments from following list:

1. Harmonic analysis of transformer for various conditions (no load, inrush, full load etc.)
2. Harmonic analysis of UPS/ DC Drive/AC Drive.
3. Analysis of performance of induction motor/transformer operated with sinusoidal supply and under distorted supply conditions supplied by 3 phase inverter.
4. Measurement of voltage sag magnitude and duration by using digital storage oscilloscope/ power quality analyzer.
5. Design of 7% detuned Passive Filter.
6. Simulation study of transient and/or flicker measurement.
7. Simulation studies of harmonic generation sources such as VFD, SVC, STATCOM and FACTS devices and harmonic measurement (THD) by using professional software like MATLAB.
8. Harmonic load flow analysis by using professional software such as ETAP, PSCAD, ATP.

Guidelines for the Instructor’s Manual:

The Instructor's Manual shall have

- Brief relevant theory.

- Equipment with specifications.
- Connection diagram/methodology.
- Format of observation table and sample results.

Guidelines for Students' Lab Manual:

The Student's Lab Journal should contain the following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram or circuit diagram.
- Observation table/simulation waveforms.
- Sample calculations for one or two readings.
- Result table.
- Graph and conclusions
- Few short questions related to the experiment.

Guidelines for Laboratory Conduction:

- Read and understand the power quality analyzer manual completely.
- Make sure that connections of the power analyzer are done as per manual.
- Follow safety protocols while doing a power quality audit.

403143C: High Voltage Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims:

- To make students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials.
- To make students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
- To enable students to understand the charge formation and separation phenomena in clouds, the causes of overvoltage and lightning phenomena,
- To develop the ability among learners to execute testing on various high-voltage equipment as per standards.
- To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Identify, describe and analyze the breakdown theories of gaseous, solid and liquid materials.
CO2: Analyze the occurrence of over voltage and to provide remedial solutions
CO3: Describe and use of various methods of generation of high AC, DC, impulse voltage and current.
CO4: Demonstrate the methods of measurement of high AC, DC, impulse voltage and current, tests on high voltage equipment and devices
CO5: Study design of high voltage laboratory with all safety measures.

Unit 01	Breakdown in Gas	07hrs

Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, Townsend's breakdown criterion, primary and secondary ionization coefficients, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations, Corona discharges for point plane electrode combination with positive and negative pulse application, time lag for and factors on which time lag depends. (Numerical on Townsend's theory and Paschen's law).

Unit 02	Breakdown in Liquid and Solid Dielectrics	07 hrs

- **Breakdown in Liquid Dielectrics:** Pure and commercial liquids, Different breakdown theories: Breakdown in Pure liquid and breakdown in commercial liquids: Suspended Particle theory, Cavitations and bubble theory, Thermal mechanism of breakdown and Stressed Oil volume theory.
- **Breakdown in Solid Dielectrics:** Intrinsic breakdown: electronic breakdown, avalanche or streamer breakdown, electromechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Chemical and electrochemical breakdown, Partial discharge,Composite dielectric material,

	Properties of composite dielectrics, breakdown in composite dielectrics. (Numerical on theories of liquid and solid dielectric materials)	
Unit 03	Lightning and Switching Over Voltages	07 hrs
Lightning phenomenon, Different types of lightning strokes and mechanisms of lightning strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory. Causes of over voltages and its effects on power systems, Over voltage due to switching surges and methods to minimize switching surges. Statistical approach of insulation coordination.		
Unit 04	Generation of High Voltages and Current	07 hrs
Generation of high ac voltages-Cascading of transformers, series and parallel resonance system, Tesla coil. Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current .		
Unit 05	Measurement of High Voltage and High Currents	07 hrs
Sphere gap voltmeter, electrostatic voltmeter, generating voltmeter, peak reading voltmeter, resistive, capacitive and mixed potential divider, capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, Measurement of dielectric constant and loss factor, partial discharge measurements. Measurement of high power frequency a.c using current transformer with electro-optical signal converter, Radio interference measurements.		
Unit 06	High Voltage Testing of Electrical Apparatus and EHV Laboratories	07 hrs
Testing of insulators and bushings, Power capacitors and cables testing, testing of surge arresters. Design, planning and layout of High Voltage laboratory:-Classification and layouts, earthing and shielding of H.V. laboratories.		
Text Books:		
[T1]	C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers Ltd.	
[T2]	M. S. Naidu, V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill Publication Co. Ltd. New Delhi	
Reference Books:		
[R1]	E. Kuffel, W. S. Zaengl, J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication	
[R2]	Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, “High Voltage Engineering", Khanna Publishers, New Delh	
[R3]	Ravindra Arora, Wolf Gang Mosch, “High Voltage Insulation Engineering”, New Age International	
[R4]	High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York and Basel	
[R5]	Subir Ray, “An Introduction to High voltage Engineering” PHI Pvt. Ltd. New Delhi	

[R6]	IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt
[R7]	Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts
[R8]	Pollution test :IEC 60507-1991 on external and internal insulator
[R9]	High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989)

Online Resources:

[O1]	https://nptel.ac.in/courses/108104048

Mapping:

Unit	Text Books	Reference Books
01	T1,T2	R1,R2,R3,R6
02	T1,T2	R1,R2,R3,R5,R6
03	T1,T2	R1,R2,R3,R5,R6
04	T1,T2	R1,R2,R3,R4,R5,R6
05	T1,T2	R1,R2,R3,R4,R5,R6
06	T1,T2	R1,R2,R3,R7,R8,R9

List of Experiments:

[Minimum eight experiments to be conducted from the given list]

1. To find the constants of the breakdown equation of transformer oil.(Analytical and graphical method)
2. Measurement of unknown high a.c. voltage using sphere gap
3. To obtain breakdown strength of composite insulation systems, and observe the effect of parameters like no. of layers, thickness of layer, effect of interfacing.
4. To find out the breakdown of air in uniform and non uniform fields and compare it.
5. To study surface flashover on corrugated porcelain/polymeric insulation systems.
6. To understand the basic principle of corona and obtain audible and visible corona inception and extinction voltage under non uniform field.
7. To perform an experiment on horn gap arrester and understand arc quenching phenomenon.
8. To observe development of tracks and trees on polymeric insulation systems.
9. Parametric analysis of Impulse current generator using virtual Laboratory.
10. To perform an experiment on rod gap arresters.
11. To Study effect of barrier on breakdown voltage of air/ transformer oil.
12. Simulation of lightning and switching impulse voltage generator using any simulation software.
13. To perform various HV insulation tests on cables as per IS.
14. Study of layout /earthing/safety of HV installation /lab in any industry by visit /virtual lab.

Industrial Visit: Industrial visit to high voltage equipment manufacturing industry/EHV substation/High Voltage Testing Lab.

Guidelines for Instructor's Manual:

The Instructor's Manual should contain following related to every experiment

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Students should be encouraged to visit industries/HV laboratories/HV installations.
- Students should be encouraged to use virtual labs.
- Few short questions related to each practical.
- Assignments based on use of IS and IEC.

Guidelines for Student's Lab Manual:

The Students lab journal should contain:

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Observations, result tables and proper inferences/ conclusions from each experiment conducted.
- Reports on visit to industries/HV laboratories/HV installations.
- Simulations and print outs of use of virtual labs.
- Few short questions and answers related to each practical.
- Assignments based on use of IS and IEC.

Guidelines for Laboratory Conduction:

There should be continuous assessment for the TW.

- Assessment must be based on understanding of theory, attentiveness during practicals.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

403143D: Robotics and Automation

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims to:

- To know the basic parts of a typical industrial robot system with its anatomy similar to the human body.
- To analyze mathematically the kinematic and dynamic modeling of a typical robot manipulator.
- To select an appropriate type of robot with given specifications for different industrial applications.
- To know the basics of actuators, sensors, and control of an industrial robot for different applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1: differentiate between types of robots based on configuration, method of control, types of drives, sensors used, etc.
CO2: apply mathematical modeling of a robot for a specific application with given specifications.
CO3: analyze the robot arm dynamics for calculation of torques and forces required for different joints of robots for control of the robot arm.
C04 : apply knowledge of Robot for their various applications

Unit 01	Robotics fundamentals	07 hrs

historical development of robotics, Definitions of Industrial Robot, Types of Robots, Asimov's Laws of Robotics, robot components, Robot specifications: repeatability, spatial resolution, compliance, degree of freedom, load carrying capacity, speed of response, work volume, work envelope, reach, etc,Robot configurations, Classification of Robots: Control Method: Servo controlled and non-servo controlled, their comparative study, form of motion: P-T-P (point to point), C-P (continuous path), pick and place etc. and their comparative study.

Unit 02	Mathematical Modeling and Dyanamics of Robots	07 hrs

Direct Kinematics, Coordinate and vector transformations using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogeneous Transformations, The Robotic Manipulator Joint Coordinate System, inverse, Jacobian Transformation in Robotic Manipulation. **Robot Dynamics:** Lagrange's Equation, Kinetic and potential energy Equations, and Euler-Lagrange analysis for a single prismatic joint working against gravity and a single revolute joint. equation of motion.

Unit 03	Forward and Inverse Kinematics	07 hrs

Denavit-Hartenberg (D-H) representation of kinematic chains. Rules for establishing link coordinate frames.

Forward solution of robotic manipulator for SCARA Robot and PUMA Robot. Forward 67i solution for simple robot systems. **Inverse Kinematics:** Concept of Inverse Kinematics, general properties of inverse solution such as existence and uniqueness of solution, inverse solution by direct approach, Geometric approach, inverse solution for simple SCARA Robots, numericals for simple three axis robots based on direct approach.		
Unit 04	Robotics Sensors	07hrs
Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Laser Scanners, Position sensors – Piezo Electric Sensor, LVDT, Resolvers. Encoders: Absolute and Incremental: - Optical, Magnetic, Capacitive, pneumatic Position Sensors Range Sensors: Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors. Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches; Machine vision		
Unit 05	Differential motion and control	07 hrs
Manipulator Differential Motion: Concept of linear and angular velocity, Relationship between transformation matrix and angular velocity, manipulator Jacobian, Jacobian for prismatic and revolute joint, Jacobian Inverse, Singularities. **Control of Robot Arm:** Modeling of DC motor and load, closed loop control in position servo, the effect of friction and gravity, control of a robotic joint, position velocity and acceleration profiles for trapezoidal velocity profile. **Control of Robot manipulator:** joint position controls (JPC), resolved motion position controls (RMPC) and resolved motion rate control (RMRC).		
Unit 06	Various applications of Robots	07 hrs
Pick and place the robot, Application of Robots in Arc Welding Robots, assembly and mega-assembly Robots perform continuous arc welding, spot welding, spray painting, and assembly operations. Robots for Inspection: Robotic vision systems, image representation, object recognition and categorization, depth measurement. Other industrial applications: coating, deburring, cleaning, Die Casting, Molding, Material handling, Picking, palletizing, packaging, hospitals and patient care, F&B industry, sports and recreation, defense and surveillance industry, home automation, mining industry. A robot-based manufacturing system, robot cell design considerations and the selection of robots, Robot Economics, Functional Safety in Robotic Applications		
Text Books:		
[T1]	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, and Ashish Dutta, “Industrial Robotics:Technology, Programming and Applications," Tata-McGraw-Hill Education Private Limited, New Delhi, 2012.	
[T2]	Richard D. Klafter, Thomas A. Chemielewski, Michael Neign, “Robotic Engineering – An IntegralApproach”, Prentice Hall of India Pvt. Ltd., New Delhi. Eastern Economic Edition.	
[T3]	Robert J. Schilling, “Fundamentals of Robotics: Analysis and Control”, Prentice Hall of India, New Delhi	
Reference Books:		
[R1]	K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, “Robotics: Control Sensing, Vision, and Intelligence”,	

	International Edition, McGraw-Hill Book Co.
[R2]	John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Education
[R3]	R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
[R4]	Saeed b. Niku, "Introduction to Robotics: Analysis, Control, Applications", Wiley Publication, 2011.

Online Resources:

[O1]	NPTEL Course on "Robotics": https://nptel.ac.in/courses/112/105/112105249/
[O2]	NPTEL Course on "Introduction to Robotics": https://nptel.ac.in/courses/107/106/107106090/

Mapping:

Unit	Text Books	Reference Books
01	T1,T2	R3
02	T1,T2,T3	R1, R2,R3,R4
03	T1,T2,T3	R1,R3,R4
04	T1,T2,T3	R1,R3,R4
05	T2, T3	R1,R2, R3
06	T2	R1

A List of Experiments:

Experiment 9 is compulsory.

List of Laboratory Experiments

1.Identify and selection of Sensors such as IR sensors, Proximity Sensor, Ultrasonic Sensor, White line sensor, Temperature Sensor, Touch sensor, Tilt Sensor, Accelerometer, Gyroscopic Sensor etc. based on given application

2. Identify and selection of Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on application
3. Demonstration of various robotic configurations using industrial robot
4. Design and selection of Gripper / End effector
5. One Programming exercise on lead through programming
6. MATLAB program for simple and inverse kinematics of simple robot configuration
7. To demonstrate simple robotic system using Matlab/ MscAdam / RoboAnalyser software

8.Study of various applications of Robots

9. One Industrial visit for Industrial robotic application

Guidelines for the Instructor's Manual:

The Instructor's Manual should contain the following things related to every experiment:

- Specify prerequisite and objective(s) of experiment.
- A related theory of the experiment must be included.

- The circuit diagram of the experiment should be drawn at the beginning.
- For simulation experiments, the Simulink diagram with proper details must be included in the write up. For programming, take a printout of the program and the result.
- A conclusion based on calculations, results, and graphs (if any) should be written.

Guidelines for Students' Lab Manual:

- Students should write the journal in their own handwriting, particularly the results, diagrams, conclusions, questions, answers, etc.
- A circuit or connection diagram or construction diagram must be drawn either manually using or using software on graph paper.
- Handwriting and figures must be neat and clean.

Guidelines for Laboratory Conduction:

- Do the continuous assessment. The experiments performed in a particular week must be checked in the next turn in next week.
- During assessment, the teacher should make the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of the experiment and in the index.

403144A: Alternate Energy System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:

1. Develop a fundamental understanding of solar thermal and photovoltaic systems.
2. Provide the knowledge of development and operation of wind energy system
3. Discuss bio-energy resource assessment.
4. Introduce different storage systems, Integration and Economics of Renewable Energy Systems.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Analyze the performance of solar thermal and photovoltaic systems.
CO2:Determine wind turbine performance.
CO3:Explain and evaluate biomass resources in an Indian context.
CO4:Illustrate the importance of storage systems.
CO5:Analyze the economics of renewable energy sources.

Unit 01	Solar Energy-I	08 hrs

Solar radiation at the earth's surface, Solar constant, Spectral distribution, Extraterrestrial Radiation, Solar Terrestrial Radiation, Solar radiation geometry, Computation of cosθ for any location having any orientation, Empirical equations for predicting the availability of solar radiation: Monthly average daily and hourly global and diffuse radiation, Beam and Diffuse radiation under cloudless skies, Solar radiation on tilted surfaces : a)Beam radiation, b)Diffuse radiation, c)Reflected radiation, d)Flux on tilted surface.
Instruments for measuring solar radiation, Devices for thermal collection and storage, Thermal applications, Introduction to concentrating solar power (CSP) plants using technologies like a) Parabolic troughs b) Linear Fresnel reflector, c) Parabolic Dish, etc.

Unit 02	Solar Energy-II	06 hrs

Introduction to family of solar film technology, Single c-Si, Poly c-Si PV Cell, Module and Array, Array Design (factors influencing the electrical design of the solar array) : a) Sun Intensity, b)Sun Angle, c) Shadow Effect, d) Temperature Effect, e) Effect of Climate, f) Electrical Load Matching, g) Sun Tracking, Peak Power Point Operation, Electrical characteristics of Silicon PV Cells and Modules, PV System Components, Efficiency of PV system, MPPT of solar system, PV system design for various applications(residential, commercial and industrial)

Unit 03	Wind Energy	08 hrs

Power Contained in Wind, Thermodynamics of Wind Energy, Efficiency Limit for Wind Energy

Conversion, the maximum energy obtained for a Thrust-operated converter (Efficiency limit), Design of Wind Turbine Rotor, Power-Speed Characteristics, Torque-Speed Characteristics, Wind Turbine Control Systems: a) Pitch Angle Control, b) Stall Control, c) Power Electronics Control, d) Yaw Control, Control Strategy, Wind Speed Statistics, Statistical Wind Speed Distributions, Site and Turbine Selection, Extraction of wind energy and wind turbine power. Introduction to Offshore Wind Energy System and its comparison with Wind Energy System,		
Unit 04	Biomass Energy	06 hrs
Biomass Classification, Biomass Resources and their Energy Potential, Biomass Conversion Technologies: Anaerobic Digestion, Ethanol Fermentation, Biomass Gasification: Gasifiers, Fluidized Bed Gasifier, Biogas Technologies and their factor affecting Biogas Production, Biogas Plants: Floating and Fixed Dome type, designing of biogas plant, Introduction to Biodiesel**,** Power Generation from Municipal Solid Waste (MSW), Landfill Gas, Liquid Waste.		
Unit 05	Fuel Cells and Storage Systems	08 hrs
A. Fuel Cells: Operating principles of Fuel Cell, Fuel and Oxidant Consumption, Fuel Cell System Characteristics, Introduction to Fuel Cell Technology and its type, application and limits. B. Storage systems: Hydrogen storage: Hydrogen production, relevant properties, Hydrogen as an Engine Fuel, methods of Hydrogen storage. Batteries: Introduction to Batteries, Elements of Electro-Chemical Cell, Battery classification, Battery Parameters, Factors affecting battery performance. Introduction to other storage technologies: pump storage, SMES, compressed air storage.		
Unit 06	Integration of RES	06 hrs
A. Integration of RES with grid, Grid codes. B. Economics of RES: Simple, Initial rate of return, time value, Net present value, Internal rate of return, Life cycle costing, Effect of fuel Escalation, Annualized and levelized cost of energy.		
Text Books:		
[T1]	S.P. Sukhatme, “Solar Energy”, Tata McGraw Hill	
[T2]	Chetan Singh Solanki, “Solar Photovoltaics-Fundamentals, Technologies and Applications”, PHI Second Edition	
[T3]	Godfrey Boyle, “Renewable Energy”, Third edition, Oxford University Press	
[T4]	H. P. Garg, J. Prakash, “Solar Energy-Fundamentals and Applications”, Tata McGraw hill Publishing Co. ltd., First Revised Edition.	
[T5]	Mukund R. Patel, “Wind and Power Solar System”, CRC Press	
[T6]	Gilbert M. Masters, “Renewable and Efficient Electrical Power Systems”, Wiley - IEEE Press, August 2004	
Reference Books:		
[R1]	D.P.Kothari, K.C.Singal, Rakesh Rajan,“Renewable Energy Sources and Emerging Technologies”, PHI Second Edition	
[R2]	Tapan Bhattacharya, “Terrestrial Solar Photovoltaics”, Narosa Publishing House	
[R3]	Paul Gipe, “Wind Energy Comes of Age”, John Wiley & Sons Inc.	

[R4]	Donald L.Klass, “Biomass for Renewable Energy, Fuels, and Chemicals, Elsevier, Academic Press
[R5]	Thomas Ackermann, “Wind Power in Power Systems”, Wiley Publications.
[R6]	B T.Nijaguna, “Biogas Technology”, New Age International Publishers.
[R7]	Tony Burton, Nick Jenkins, David Sharpe, “Wind Energy HandBook-Second Edition”, John Wiley & Sons, Ltd., Publication

Online Resources:

[O1]	A review on non-edible oil as a potential feedstock for biodiesel: physicochemical properties and production technologies.
[O2]	Fabrication and Design of Solar cooker.

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2
02	T2, T3, T4	R1
03	T5	R3, R5,R7
04	T6	R4, R6
05	T3,T6	R1
06	T6	R1

List of Tutorial:

It is expected to take ***minimum 8 tutorials*** from the following list:

1. Report on Renewable Energy Scenario in India/ across the Globe.
2. Designing of standalone Solar PV systems for various loads(2 numericals).
3. Report on analysis of Indian solar radiation data/ Wind data.
4. Performance analysis of concentrating solar collector/ solar cooker/ solar air heaters
1. Study of Wind Electric Generators with Grid Integration.
2. Performance of Wind generation (2 or 3 numericals).
3. Design of a community biogas plant for a village in India(1 or 2 numericals).
4. Analysis of Non Edible oil as an alternate energy source.
5. Performance of storage devices(3/4 numericals).
6. Economics of renewable energy sources(2 or 3 numericals).
7. Design of Hybrid system using HOMER demo software

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403144B: Electric and Hybrid Vehicle						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:
1. To gain knowledge of Li-ion battery protection.
2. To learn HEV Subsystems and Configurations.
3. To understand Mathematical Model of Li-ion battery.
4. To familiarize with Hybridization of drivetrains.
5. To learn Star Labeling Schemes for Li-ion Packs.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Analyze the Life Cycle Assessment of Li-ion battery.
CO2 : Describe the different types of Li-ion charging methods
CO3 : Comprehend the knowledge of drivetrain hybridization.
CO4 : Evaluate EV motor sizing.
CO5 : Classify Battery Recycling methods.

Unit 01	Li-ion Battery	07 hrs

Materials used for Li-ion battery, Nanostructured Electrode Materials for Li-Ion Batteries, Li-ion battery protection, Wireless charging of EV, Life Cycle Assessment of Li-ion battery, Solid-state Battery, Panasonic 18650 & 2170 cell,

Unit 02	Battery Charging and Modelling	07 hrs

TSCC/CV charging and CVCC/CC charging of Li-Ion battery, BMS standards,
SoC Estimation methods (Kalman Filter, Neural Network, Fuzzy logic), Public EV charging stations, Solar Powered Charging Stations, Modeling of Lithium-ion batteries, Thermal Modeling of Li-ion battery.

Unit 03	Electric Vehicle Technologies	07 hrs

Battery Swapping System, EV Fleet Management, Sensors for Electric Vehicles
Electric bus, Electric trucks, Fuel cell vehicles, Introduction of EV Subsystems and Configurations, Energy management strategies and its general architecture.

Unit 04	Plug-In Hybrid Electric Vehicles	07 hrs

Hybridization of drivetrains in HEVs, Hybridization of energy sources in EVs, Power Flow control in hybrid drive train topologies, Power Management Strategies in HEV, Introduction of HEV Subsystems and Configurations, Vehicle Dynamics Fundamentals and HEV Modeling (Series Hybrid), Fuel

efficiency analysis.		
Unit 05	EV Components Design	07 hrs
Criteria for battery selection , Forces on EV calculation, Power for EV calculation, Sizing the Power Converter, Sizing of Electric Machine for EVs and HEVs, Motor Torque Calculation, Induction motor control, PMSM motor control, Battery pack design, In vehicle networks- CAN		
Unit 06	Electric Vehicle Policies and Startups	07 hrs
FAME-II Policy , Charging Infrastructure for Electric Vehicles - Revised Guidelines and Standards , Star Labeling Schemes for Li-ion Packs- BEE India, EV Tariff, EV Startup examples, Li-ion Battery Recycling Policy and Standards		

Text Books:

[T1]	Energy Systems for Electric and Hybrid Vehicles Edited by K.T. Chau
[T2]	Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011
[T3]	Electric and Hybrid Vehicles by Tom Denton

Reference Books:

[R1]	Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010
[R2]	James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003..

Online Resources:

[O1]	NPTEL Course : Electric Vehicles - Part 1 by Prof. Amit

List of Tutorials:

Any 8 of the following

1. Introduction to battery modeling MATLAB Simulink
2. Introduction to BLDC motor control MATLAB Simulink
3. Introduction to Induction Motor control MATLAB Simulink
4. Power Converter selection in MATLAB Simulink
5. Study of EV subsidies in different states.
6. Visit to the Electric Vehicle Charging Station.
7. Study of Thermal Modeling in Ansys software
8. Study of Harmonics issues of EV charging.
9. Fuel efficiency evaluation of a series HEV in city and high-way.
10. Various strategies for improving vehicle energy/fuel efficiency regenerating braking.
11. Study of various Battery Recycling Methods.

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403144C: Special-Purpose Machines						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

The course aims:-
1. To gain knowledge of operation and performance of synchronous reluctance motors.
2. To learn the operation and performance of stepping motors.
3. To understand operation and performance of switched reluctance motors.
4. To familiarize with operation and performance of permanent magnet brushless D.C. motors.
5. To illustrate operation and performance of permanent magnet synchronous motors.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Reproduce principal of operation of PMSM, Stepper motor, SRM, Switch reluctance and linear motors.
CO2: Develop torque - speed and performance characteristics of above motors.
CO3: Enlist application of above motors.
CO4: Demonstrate various control strategies.

Unit 01	**Generalized Machine Theory**	06 hrs

Energy in singly excited magnetic field systems, determination of magnetic force and torque from energy. Determination of magnetic force and torque from co-energy, Forces and torques in systems with permanent magnets. MMF of distributed winding, Magnetic fields production of EMFs in rotating machines.

Unit 02	**Permanent Magnet Synchronous and brushless D.C. Motor Drives**	06 hrs

Synchronous machines with PMs, machine configurations. Types of PM synchronous machines Sinusoidal and Trapezoidal. EMF and torque equations Torque - speed characteristics, Concept of electronic commutation, Comparative analysis of sinusoidal and trapezoidal motor operations. Applications.

Unit 03	**Control of PMSM Machine**	06 hrs

abc-αβ and αβ-dq transformations, significance in machine modeling, Mathematical Model of PMSM (Sinusoidal), Basics of Field Oriented Control (FOC), Control Strategies: constant torque angle, unity power factor.

Unit 04	**Reluctance Motor**	06 hrs

Principle of operation and construction of Switch Reluctance motor, Selection of poles and pole arcs, Static and dynamics Torque production, Power flow, effects of saturation, Performance, Torque speed characteristics, Synchronous Reluctance, Constructional features; axial and radial air gap motors; operating principle; reluctance torque; phasor diagram; motor characteristics Introduction to control of Reluctance Drive. Applications.		
Unit 05	**Stepper Motor**	06 hrs
Construction and operation of stepper motor, hybrid, Variable Reluctance and Permanent magnet, characteristics of stepper motor, Static and dynamics characteristics, theory of torque production, figures of merit; Concepts of lead angles, micro stepping, Applications selection of motor.		
Unit 06	**Linear Electrical Machines**	06 hrs
Introduction to linear electric machines. Types of linear induction motors, Constructional details of linear induction motor, Operation of linear induction motor. Performance specifications and characteristics Applications.		

Text Books:

[T1]	K. Venkatratnam, 'Special Electrical Machines', University Press
[T2]	A.E. Fitzgerald Charles Kingsley, Stephen Umans, 'Electric Machinery', Tata McGraw Hill Publication
[T3]	T.J.E. Miller, 'Brushless Permanent magnet and Reluctance Motor Drives' Clarendon Press, Oxford 1989
[T4]	V. V. Athani, 'Stepper Motors: Fundamentals, Applications and Design', New age International, 1997.
[T5]	P.S. Bhimbra, Generalized Theory Of Electrical Machines

Reference Books:

[R1]	R Krishnan, 'Permanent Magnet Synchronous and Brushless D.C. Motor Drives' CRC Press.
[R2]	Ion Boldea, 'Linear Electric Machines, Drives and maglevs' CRC press.
[R3]	Ion Boldea S. Nasar, 'Linear Electrical Actuators and Generators', Cambridge University Press.

Online Resources:

[O1]	NPTEL video lectures on all the special purpose machines can be observed.

Mapping:

Unit	**Text Books**	**Reference Books**
01	T2	R1

02	T1, T3	R1
03	T1, T5	R1
04	T1	R1
05	T1, T4	R1
06	T5	R2,R3

List of Tutorials: Minimum eight tutorials are to be performed out of the list mentioned as below:

1. Experimental analysis of PMSM motor drive
2. Experimental analysis of BLDC (Trapezoidal Motor) Drive
3. Experimental analysis of Switched Reluctance Motor Drive.
4. Experimental analysis of Synchronous Reluctance Motor Drive
5. Experimental analysis of Stepper Motor Drive.
6. Laboratory demonstration of Linear Induction Motor.
7. Simulation for the performance analysis of PMSM/BLDC drive. (Any software can be used)
8. Simulation of Switched Reluctance Drive.
9. Software programming for abc-αβ and αβ-dq transformations

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.
- Prepare tutorial assessment sheet which may be used for the term work marks.

403144D: HVDC and FACTs						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:

1. To develop understanding of modern trends in power transmission.
2. To make students describe the operation of HVDC System and Control.
3. To make students describe applications of power electronics in the control of power transmission.
4. To understand fundamentals of FACTS Controllers.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Choose a proper FACTS controller for the specific application based on system requirements.
CO2:Analyze shunt, series, and combined controllers to explore different benefits.
CO3:Compare EHVAC and HVDC systems and to describe various types of DC links.
CO4:Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems.

Unit 01	HVDC -I	07 hrs

EHVAC versus HVDC transmission, power flow through HVDC link, Graetz circuit, equation for HVDC power flow bridge connection, control of DC voltage and power flow, effects of angle of delay and angle of advance commutation, CIA, CC and CEA control.

Unit 02	HVDC – II	07 hrs

Twelve pulse converter operation, Harmonics in HVDC systems. HVDC system layout and placement of components, HVDC protection, grounding, multi terminal HVDC systems, configurations and types.

Unit 03	VSC based HVDC System	07 hrs

Introduction to VSC transmission, power transfer characteristics, structure of VSC link, VSC DC system control, HVDC light technology. HVDC plus, introduction, construction, operation and applications to renewable energy sources Principles of DC Link Control in a VSC based HVDC system: Power flow and dc voltage control. Reactive Power Control / AC voltage regulation using VSC. Real and Reactive power control using a VSC.

Unit 04	Fundamentals of FACTS Controllers	08 hrs

Basics, Challenges and needs of Power Electronic Controllers, Review of rectifiers and inverters, back to back converter, dc link converter, static Power converter structures, AC controller based structures, DC link converter topologies, converter output and harmonic control, power converter control. Reactive power

control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.		
Unit 05	Shunt and Series Controllers	08 hrs
Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM comparison. Series compensation – objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes. Comparison between STATCOM and SVC, V –I and V –Q Characteristics, Transient stability, Response Time. Comparison between TSCS and SSSC		
Unit 06	Unified Power Flow Controller and advanced controllers	08 hrs
Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.		
Text Books:		
[T1]	S Kamakshaiah and V Kamaraju, “HVDC Transmission,” TMH Publications, 2011.	
[T2]	K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International Publishers, 2011	
[T3]	Hingorani ,L.Gyugyi, “Concepts and Technology of Flexible AC Transmission System”, IEEE Press, New York, 2000, ISBN –0780334588.	
[T4]	Padiyar K.R., “FACTS Controllers for Transmission and Distribution systems”, New Age International Publishers, 1st Edition, 2007.	
Reference Books:		
[R1]	Jos Arrillaga, “High Voltage Direct Current Transmission”, IET Power and Energy Series 29	
[R2]	Erich Uhlmann, “Power Transmission by Direct Current,” Springer International	
[R3]	Song, Y.H. and Allan T. Johns, ‘Flexible AC Transmission Systems (FACTS)’, Institution of Electrical Engineers Press, London, 1999.	
[R4]	Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho ‘FACTS" —Modeling and simulation in Power Networks, John Wiley & Sons, 2002.	
[R5]	J. Arrillaga, “High Voltage Direct Current Transmission,” Peter Peregrinus Ltd., London, UK	

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2, R5
02	T1, T2	R1, R2, R5

03	T1, T2	R1, R2, R5
04	T3, T4	R3, R4
05	T3, T4	R3, R4
06	T3, T4	R3, R4

List of Tutorials:

1. Study of various HVDC transmission system components and its applications.
2. Study of AC/DC side voltage and current waveforms of a six-pulse converter system under variable RL load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow, etc.).
3. Study of AC/DC side voltage and current waveforms of a twelve-pulse converter system under variable R-L load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow, etc.).
4. Study of Reactive Power Control in an HVDC Transmission system
5. Study of various types of multi-terminal HVDC transmission systems
6. Study of DC link control in VSC-based HVDC transmission systems.
7. Study of various passive filters used in LCC-based HVDC transmission systems
8. Operation of VSC for power factor correction at AC side of HVDC system using sinusoidal pulse width modulation.

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403145: Project Stage I

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	4	Hrs./Week	SEM/PW/IN	2	ORAL	50
					Term work	50

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Preamble:

Project is an important part of the engineering curriculum covered in the final year. It is divided into Project Stage I and Project Stage II at Semesters I and II of the Final Year. This project is a substantial piece of work that will require creative activity and original thinking. The project aims to provide students with a transitional experience from the academic world to the professional world. The objectives, outcomes, and guidelines for Project Stage I are given below.

Course Objectives:

The objectives of this course are to:

1. Provide an opportunity to learn new software, interdisciplinary theory, concepts, technology, etc. not covered in earlier subjects.
2. Empower students to use engineering knowledge and skills learned in previous courses to deliver a product that has passed through the design, analysis, testing, and evaluation.
3. Encourage multidisciplinary project work through the integration of knowledge.
4. Allow students to develop problem-solving, analysis, synthesis, and evaluation skills.
5. Encourage teamwork.
6. Improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

Course Outcomes:

Course outcomes can be different for the different projects undertaken by the student groups. However, in general, the course outcomes for Project Stage-I can be stated as follows.
At the end of this course, students should be able to:
CO1:Define the project problem statement and identify the scope of the project.
CO2:Search the appropriate research papers, standards and e-resources and write a literature survey.
CO3:Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project.
CO4:Justify the selection of electrical, electronic and mechanical components for the project prototyping
CO5:Simulate or develop a system for software or hardware verification.
CO6:Write a project report with proper interpretation of results.

Guidelines for students:

1. Form a group of 3-4 students.
2. Select a project problem statement based on an industrial or societal issue and ideate on it.
3. Research on the project topic through existing theories, literature, technology, patents, etc.
4. Define objectives, scope, and outcomes of the project in the 1st presentation.
5. Maintain a notebook to keep records of all the meetings, discussions, notes, etc. This is to be done by the individual student.
6. Some of the parameters mentioned in the above table will be evaluated and assessed at the group

level and some at an individual level.

Guidelines:

Term work evaluation guidelines are given below.

Sr. No.	Activity	Deadline (Semester I)	Parameters for Evaluation
1.	Topic Approval Presentations	Up to 3rd Week	• Problem definition clearly stated (YES/NO) • Objectives clearly defined (YES/NO) • The overall project idea is feasible (YES/NO)
2.	Progress Review-1 Presentation	Up to 8th Week	• Problem Definition (5) • Scope & Objectives (10) • Literature Review (10) • Methodology (10) • Block Diagram / Architecture (10) • Project Planning (5) • **Total Marks (50)**
3.	Progress Review-2 Presentation	Up to 12th Week	• Requirement Specification (10) • Literature Review (revised) (5) • Detailed Design (10) • Experimental Setup/Simulation (10) • Performance Parameters (10) • Partial Conclusion (5) • **Total Marks (50)**
4.	Submission of Project Stage –I Report	Up to 14th Week	• Timely submission (5) • Formatting and Report Writing Style (5) • Abstract, Literature Survey, Conclusion (5) • Refereed References (5) • Grammatical correctness in the report (5) • **Total Marks (25)** **(Review 1+ Review 2) conversion to 25 marks +Report (25 marks) = 50 Marks**

403146: MOOCs

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	–	Hrs./Week	SEM/PW/IN	2	ORAL	–
					Termwork	50

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Preamble:

Massive Open Online Courses (MOOCs) is essentially an asynchronous teaching learning platform. To enhance the students learning and to motivate self learning, MOOCs have been added in the BE Electrical 2019 course. It is advised to students that they have to registers MOOCs courses thorough SWAYAM-NPTEL platform.

Course Objectives:

The objectives of this course are to:

1. Provide an opportunity to learn new software, interdisciplinary theory, concepts, technology, etc. not covered in earlier subjects.
2. Make students employable in the industry or pursue a suitable higher education program.
3. Exposure to relevant tools and technologies.
4. Enrich the learning experience by using audio video and multimedia and state of the are pedagogy.

Course Outcomes:

At the end of this course, students should be able to:
CO1:Enables the students to directly engage and learn from the best faculty in the country in order to strengthen the fundamentals.
CO2:Explore new areas of interest in a relevant field.
CO3:Enable self learning initiative in learners..
CO4:Develop critical thinking to solve complex problems in engineering, science and humanities.
CO5:Improve communication skills by interacting with peers and course teachers.

Guidelines:

Guidelines for students:

1. Students have to register on the SWAYAM portal.
2. Through the SWAYAM portal, explore the courses available by NPTEL coordinator.
3. The minimum duration of the NPTEL course to be registered by the students has to be 8/12 weeks. (as per the course offered in the semester.)
4. Students can register the courses of engineering, science, humanities, management, and multidisciplinary in the NPTEL portal.
5. Students have to submit the assignments as per schedule given by NPTEL course structure and take part in a self assessment test.
6. Students have to register for the certificate examination of NPTEL by paying the required fees.
7. Students will be awarded credits of MOOCs only when they earn the certificate of the registered course.

7. Students have to submit proof (certificate) to the department in order to get credits.

Guidelines for institute:

1. It is advised that the institute should register for the NPTEL local chapter.
2. Keep the track of student registration in SWAYAM-NPTEL course.
3. Check the certificate authenticity submitted by student through online portal

Guidelines for Assessment:

1. The NPTEL will give percentage grades in certificates out of 100.
2. The percentage obtained needs to be converted to 50 marks and submitted as term work marks to university. (if someone got 75% marks then TW calculation will be 75/2=37.5=38 (out of 50) and round up the nearest integer.)
3. External examiner appointed by the university will assess certificates and marks obtained physically at the institute.

403147A: German Language-I

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Get introduced to the Culture, Routine of the German Society through language.
2. Meet the needs of ever growing German industry with respect to language support.

Course Outcomes:

At the end of this course, students:
CO1: Will have the ability of basic communication.
CO2: Will have the knowledge of German script.
CO3: Will get introduced to reading ,writing and listening skills
CO4: Will develop interest to pursue profession in Indo-German Industry.

Unit 01	Introduction to the German Language-I	06 hrs

Introduction of German Alphabets, Spell the names, Addresses, Numbers, Telephone numbers, Ordinal Numbers, Pin code Numbers, Dates, Birthdates, Age, days of the week, Months.

Unit 02	Introduction to the German Language-II	06 hrs

Basic Greetings, Personal Pronouns, Possessive Pronouns.

Unit 03	Introduction to the German Language-III	06 hrs

Self-Introduction, Introducing other people, about family, friends, course mates, seasons, and seasons in Germany and in neighboring countries.

Text Books:

[T1]	Netzwerk A-1 (Deutsch als Fremdsprache) Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

[R1]	Tipps und Uebungen A1

Online Resources:

[O1]	Practice Material like Listening Module, reading Texts

403147B: Engineering Economics-I

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Describe basics of economics and its application in engineering.
2. Explain the concept of Time value of Money and Cash flow

Course Outcomes:

At the end of this course, students will be able to:
CO1:Discuss concepts related to business and its impact on enterprise.
CO2:Illustrate time value of money in economic analysis.

Unit 01	Engineering Economics	10 hrs

Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product, Design selection for a product, Process planning.

Unit 02	Time Value of Money and Cash flow analysis	10 hrs

Time value of money: Simple and compound interest, Nominal Interest rate, Effective Interest rate, Principle of economic equivalence.
Cash Flow – Diagrams, Categories & Computation
Depreciation: Meaning Causes, Factors affecting depreciation, Methods of providing depreciation, Straight Line Method & Diminishing Balance Method

Text Books:

[T1]	Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
[T2]	D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books:

[R1]	Sasmita Mishra, “Engineering Economics & Costing “, PHI
[R2]	Sullivan and Wicks, “ Engineering Economy”, Pearson
[R3]	R. Paneer Seelvan, “ Engineering Economics”, PHI

403147C: Sustainability

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

- Increase awareness among students about sustainability.
- Understand role of engineering and technology within sustainable development.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Understand different types of environmental pollution problem.
CO2: Suggest solutions for sustainable development.
CO3: Develop a broader perspective in thinking for sustainable practices by utilizing engineering principle and knowledge

Unit 01	Sustainability Introduction		11 hrs

Introduction, need and concept of sustainability, social, environmental and economical sustainability concepts, sustainable development, 17 goals defined by UN, Nexus between technology and sustainable development and its challenges, multilateral environmental agreements and protocols-CDM, Environmental legislations in India-Water Act, Air Act.
Air, water and solid waste pollution sources and impacts, Sustainable water treatment. Zero waste concept. Global environmental issues, climate change, global warming, ozon layer depletion.

Unit 02	Sustainable Solution		11 hrs

Carbon credits and trading, carbon foot print, Green engineering, sustainable urbanization, industrialization and poverty reduction, Industrial process: Material selection, pollution preventions, industrial ecology and symbiosis, Global institutions: UNEP, IPCC, UNDP, WHO, Kyoto protocols. Certification and labelling in energy and carbon: Energy Star, Compliance and voluntary carbon credits, Green-e. Tools and techniques: ISO 14001, ISO26000, ABCD planning method.Assessment measurement: Indicators, F2B2, LCA, LCC, ROI.

Text Books:

[T1]	Allen D. T. and Shonnard D. R. "Sustainable Engineering: Concept design and case studies", Prentice hall
[T2]	Environmental Impact Assessment Guidelines, Notification of Government of India 2006
[T3]	Mackenthun K. M. "Basic Concept of Environmental Management", Lewis publication London 1998
[T4]	ECBC code 2007, BEE, New Delhi, BEE publication, TERI publication

[T5]	Ni Bin Chang, “Systems Analysis for sustainable engineering: Theory and Applications ”, Mc-Graw-Hill Professional
Reference Books:	
[R1]	“Sustainable Excellence Associate: Study Guide” International society of sustainability professional, https://community.sustainabilityprofessionals.org/store/viewproduct.aspx?id=13043928
Online Resources:	
[O1]	https://www.globalgoals.org/goals/

403148: Switchgear and Protection

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	50
					Termwork	25

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Course Objectives:

This course aims to:

- Acquaint about construction and working principles of different types of HVCBs.
- Elaborate the need for protective relaying and the operating principles of different types of relays.
- Explain the different types of faults in the transformer, alternator, and 3-phase induction motor and the various protective schemes related to them.
- Impart knowledge about transmission line protection schemes and the characteristics of different types of distance relays.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Understand the fundamentals of protective relaying.
CO2:Demonstrate the arc interruption and analyze the RRRV in circuit breakers
CO3:Demonstrate the construction and working principle of air brake circuit breakers, SF6 circuit breakers, and a vacuum circuit breaker.
CO4:Explain the characteristics of static and digital relays and their applications in power systems.
CO5:Apply the differential protection scheme to large transformers, alternators, and induction motors.
CO6:Apply distance protection, three stepped protection for transmission line.

Unit 01	Fundamentals of protective relaying	08hrs

Need for protective system, nature and causes of fault, types of faults, effects of faults, evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Trip circuit of circuit breaker, zone of protection. Various basic operating principles of protection- over current, (current graded and time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, current and time setting in induction relay, Numericals on TSM , PSM and operating time of relay.

Unit 02	Fundamentals of arc interruption	07 hrs

Ionization of gasses, deionization, Electric arc formation , Current interruption in AC circuit breaker, high and low resistance principles, arc interruption theories, arc voltage, recovery voltage, derivation and definition of restriking voltage and RRRV, current chopping, interruption of capacitive current, resistance switching, Numerical on RRRV, current chopping and resistance switching.

Unit 03	Circuit Breaker	08 hrs

Different ratings of circuit breaker (like rated voltage, rated current, rated frequency, rated breaking capacity – symmetrical and unsymmetrical breaking, making capacity, rated interrupting duties, rated operating sequence, short time rating). Classification of high voltage circuit breakers. Working and constructional features of ACB, SF6 , VCB- advantages, disadvantages and applications. Auto reclosing, Testing of circuit breakers. Introduction to GIS , its advantages over conventional substation		
Unit 04	Static and Digital Relaying	06 hrs
Overview of Static relay, block diagram, operating principle, merits and demerits of static relay. Numerical Relays :-Introduction and block diagram of numerical relay, Sampling theorem, Anti –Aliasing Filter, Block diagram of PMU and its application.		
Unit 05	Equipment protection	08 hrs
I. Power Transformer Protection: Types of faults in transformer, Percentage differential protection in transformers, Restricted E/F protection, incipient faults, Buchholz relay, protection against over fluxing, protection against inrush current. II. 3 Phase Induction Motor Protection: Abnormal conditions and causes of failures in 3 phase Induction motor, single phasing protection, Overload protection, Short circuit protection. III. Synchronous Generator (Alternator) Protection: Various faults in Alternator, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.		
Unit 06	Transmission line protection	08 hrs
Over current protection for feeder using directional and non directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, three stepped distance protection, Effect of arc resistance, and power swing on performance of distance relay. Realization of distance relays(impedance, reactance, and mho relay) using numerical relaying algorithm(flowchart, block diagram), Introduction to PLCC, block diagram, advantages, disadvantages, Introduction to Wide Area Measurement (WAM) system.		
Text Books:		
[T1]	Badri Ram, D. N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill Publishing Co. Ltd.	
[T2]	Y. G. Paithankar, S. R. Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India	
[T3]	Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani,” Protection and Switchgear”, Oxford University Press, 2011 Edition.	
[T4]	J.B.Gupta “ Switchgear and Protection”, S.K. Kataria and Sons.	
[T5]	Power system protection and switchgear by Oza, Nair, Mehta, Makwana	
Reference Books:		
[R1]	S. Rao, “Switchgear Protection and Power Systems”, Khanna Publications	

[R2]	J Lewis Blackburn , “Protective Relaying- Principles and Applications”, Dekker Publications.
[R3]	A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(John Willy and Sons Inc New York)
[R4]	Mason C.R., “Art and Science of Protective Relaying”, Wiley Eastern Limited.
[R5]	Arun Ingole, “Switchgear and Protection”, Pearson.
[R6]	Bhuvanesh Oza, “Power System Protection and Switchgear”, McGraw Hill Education.

Online Resources:

[O1]	Prof. Dr S.A. Soman, IIT Mumbai, A Web course on “Digital Protection of power System” http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html
[O2]	NPTEL Course on power system protection.

Mapping:

Unit	Text Books	Reference Books
01	T1,T2,T4	R1, R2, R6
02	T1,T3,T4	R1, R6
03	T1,T4	R1, R6
04	T2,T3,T4	R3, R4, R6
05	T1 , T5	R1 ,R5, R6
06	T1,T4	R1,R2, R5, R6

List of Experiments:

A) Compulsory Experiments

1. Study of switchgear testing kit.
2. Protection of Transmission line using Impedance relay

B) Minimum 6 Experiments to be performed from the following list:

1. Study and testing of fuse , MCB.
2. Study and testing of contactors.
3. Study and testing of ACB.
4. Study and testing of MCCB.
5. Study and testing of thermal overload relay for Induction Motor protection.
6. Study and plot Characteristics of IDMT type Induction over current relay
7. Study and plot Characteristics of digital over current relay
8. Percentage differential protection of transformer (Merz Price Protection).
9. Protection of alternators.

Guidelines for Instructor's Manual:

Lab manual must contain;

- Title of the experiment
- Aim
- Apparatus.
- Theory: Brief theory explaining the experiment
- Circuit / connection diagram or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
- Detailed constructional diagram with nomenclature:
- Procedure: Write down step by step procedure to perform the experiment.
- Specifications of Switchgear:
- Observation table:
- Graph:
- Conclusion:

Guidelines for Student's Lab Manual:

- Students should write the journal in his own handwriting using A4 size both side ruled paper.
- Circuit / Connection diagram or construction diagram must be drawn either manually or using software. [Do not use Photocopy of standard journal] on A4 size blank/graph paper.
- Hand writing must be neat and clean.
- Journal must contain a certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
- Index must contain Sr. number, title of the experiment, page number, and the signature of staff along with date.
- Use black or blue ink pen for writing.

Guidelines for Laboratory Conduction:

- Check whether the MCB / main switch is off.
- Make connections as per circuit diagram. Do not keep loose connections. Get it checked by the teacher / Lab Assistant.
- Perform the experiment only in the presence of a teacher or Lab Assistant.
- After completion of the experiment, switch off the MCB / main switch.
- Write the experiment in the journal and get it checked within a week.

Industrial Visit:

Industrial visit to switchgear training center /or switchgear/relay manufacturing unit/ or 220 kV substation visit and report to be submitted.

Assignments:

Minimum 2 assignments (at least 4 to 6 questions in each) to be submitted as a part of term-work.

403149: Advanced Electrical Drives and Control

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Practical	50
					Termwork	25

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Course Objectives:

This course aims to:

- Understand motor load dynamics. ·
- Study and analyze the operation of the converter fed and chopper fed dc drives. ·
- Study and understand braking methods of D.C. and Induction motor drive.
- Study vector control of induction motors. ·
- Study synchronous and BLDC motor drive. ·
- Study classes and duty of motor. ·
- Understands the modes of operation of drive in various applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Explain motor load dynamics and multi quadrant operation of drives.
CO2: Analyze operation of converter fed and chopper fed DC drives.
CO3: Apply different braking methods of D.C. and induction motor drive.
CO4: Elaborate vector control for induction motor and BLDC drives.
CO5: Elaborate synchronous motor, reluctance motor drive.
CO6: Differentiate between classes and duty cycles of motors and select suitable drives in various industrial applications.

Unit 01	Electrical Drives	07 hrs

A. Definition, components of electric drive system, types of electrical drives (DC and AC), selection of drive parameters, List of Industrial Applications
B. Motor-Load dynamics, speed-torque conventions and multi-quadrant operation, equivalent values of drive parameters, load torque components, nature and classification of load, constant power operation of a drive, steady-state stability.

Unit 02	DC Motor Drives:	08 hrs

A. Single-phase and three-phase fully controlled converter drives and performance of converter fed separately excited DC Motor for speed control operations, 12 pulse converter drives.
B. Chopper controlled drives for separately excited and series DC Motor operations. Closed-loop speed control of DC motor below and above base speed for starting, speed control and braking

Unit 03	Induction Motor Drives:	08 hrs

Regenerative braking, dynamic braking, Plugging, Numerical based on braking and speed control, voltage source inverter (VSI) control, Steady State Analysis. Current source inverter (CSI) control-open and closed loop, Regenerative braking and multi quadrant operation of Induction motor drives, Principle of vector control, Block diagram of Vector control of induction motor, Failure modes of Drives.		
Unit 04	BLDC drive:	07 hrs
Construction (Block diagram) and working for motoring and regenerative braking, Speed and torque Characteristics, closed loop control of BLDC drive (PI controller) , vector control of BLDC drive, Applications in EV (descriptive treatment)		
Unit 05	Synchronous Motor drives:	08 hrs
A. PMSM Drive: Construction (Block diagram) and working for motoring and regenerative braking, Speed and torque Characteristics, closed loop control of PMSM drive (PI controller) , vector control of PMSM drive. B. Synchronous Reluctance Motor -Introduction, working of SRM , application in EV (descriptive treatment)		
Unit 06	Drive Application	07 hrs
A. Classes of motor duty, types of enclosures for motor. B. Specific requirement and choice of drives for following applications: Machine tools , Textile mills, Steel rolling mills, Sugar mills, Traction drives, Crane and hoist drives, Solar and battery powered drives		
Text Books:		
[T1]	G. K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House	
[T2]	N. K. De, P. K. Sen, "Electric Drives", Prentice Hall of India Eastern Economy Edition	
[T3]	S. K. Pillai, "Analysis of Thyristor Power Conditioned Motors", University Press	
[T4]	G.K. Dubey, "Power Semiconductor controlled drives", PHI publication	
[T5]	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education	
Reference Books:		
[R1]	R. Krishnan, "Electric Motor Drives – Modeling Analysis and Control", PHI India	
[R2]	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education	
[R3]	V. Subrahmanyam, "Electric Drives: Concepts and Application", Tata Mc-Graw Hill (An imprint of Elsevier)	
[R4]	M.D. Singh and Khanchandani "Power Electronics", Tata Mc-Graw Hill	
[R5]	Austin Huges, "Electrical motor and drives: Fundamental, types and applications", Heinemann Newnes, London	

[R6]	Tyagi MATLAB for engineers oxford (Indian Edition)
[R7]	Malcolm Barnes, "Practical Variable Speed Drives and Power Electronics", Elsevier Newnes Publications

Online Resources:

[O1]	NPTEL online course on Fundamentals of Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
[O2]	NPTEL online course on advanced Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
[O3]	Allen Bradley Powerflex 700 AC Drives User manual.

Mapping:

Unit	Text Books	Reference Books
01	T1	R3
02	T1,T5	R2,R4
03	T1,T4	R1,R5
04	T1,T2,T5	R1,R2
05	T1,T3,T5	R1,R6
06	T1,T2	R3,R5,R7

List of Experiments:

Total 9 experiments to be conducted from the following list of practical.

A) Following 5 experiments are compulsory (Hardware based)

1. Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).
2. Speed control characteristics of single phase fully converter fed separately excited D.C. motor
3. VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics.
4. Chopper fed D.C. series/separately motor speed control characteristics.
5. Electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging, Regenerative Braking).

B) Any 4 experiments from following (Hardware/software)

6. Speed control characteristics of 3-ph fully converter fed separately excited D.C. motor.
7. Simulation of Induction Motor Vector Control.
8. Study of constant torque and constant power characteristic of induction motor.
9. Study of speed control of BLDC / PMSM drive.
10. Simulation of closed loop control of BLDC / PMSM drive.
11. Simulation of vector control of PMSM/BLDC motor

Guidelines for Instructor's Manual:

- Title and circuit diagram of power electronic controlled drives/ electrical machine circuit. ·
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit used to control the electric motor.
- Procedure to carry out the experiment

Guidelines for Student's Lab Manual:

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit and expected machine performance with speed torque characteristics.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on the left side of the journal and aim, theory related to experiment and procedure must be written on the right side.
- Analyze and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory Conduction:

- Each group in the lab should have not more than three students. ·
- All the students in the group must do the connections and perform the practical under the guidance of the staff member. ·
- Staff member has to check the results of all the groups.

403150A: Digital Control System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Make students elaborate basic concepts of discrete signals and systems.
- Educate students to analyze the stability of discrete systems.
- Explain formulation of state space discrete model and design the digital controllers.
- Elaborate digitize analog controllers using various numerical methods.
- Explore application of the theory of digital control to practical problems.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Analyze digital control system and its stability.
CO2: Differentiate between various control systems
CO3: Present system in state space format.
CO4: Design observer for system.
CO5: Understand digital controllers
CO6: Elaborate applications such as digital temperature control and position control

Unit 01	Discrete systems and Signals	07 hrs

Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing and quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

Unit 02	State - Space analysis	07 hrs

Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete – time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation

Unit 03	Design using state space	07 hrs

Controllability and observability of linear time invariant discrete-data system, Tests for Controllability and observability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback.

Unit 04	Design of State Observers	07 hrs

Full order state observer, reduced order state observer, State estimation and full order observer design. Ackermann's formula. Compensator design by the separation principle, State feedback with integral control, State regulator design.		
Unit 05	State space model and digitizing analog controllers	07 hrs
State space model of digital systems: Transformation of state-space model to various forms (controllable, observable, diagonal and Jordan canonical forms). Numerical approximation of differential equations, Euler's forward and backward method, Trapezoidal method, Bilinear transformation with frequency warping. Numerical differentiation, Matching step and other response. Pole-zero matching		
Unit 06	Digital control system applications	07 hrs
Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.		

Text Books:

[T1]	K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009
[T2]	B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press
[T3]	M. Gopal, "Digital Control Engineering", New Age International Publishers
[T4]	M. Gopal, "Digital Control and State Variable Methods", 3rd Edition The McGraw Hill Co.

Reference Books:

[R1]	Load D. Landau, Gianluca Zito, 'Digital Control Systems: design, Identification and Implementation' Springer.
[R2]	Mohammed Santina, Allen Stubberud, Gene Hostetter 'Digital control System Design', Sanders College publishing
[R3]	K.J. Astrom, B Wittenmark 'Computer Controlled Systems: Theory and Design' Prentice-Hall Inc New Jersey, 2011 Dover.

Mapping:

Unit	Text Books	Reference Books
01	T2, T2	R3
02	T2	R3
03	T1, T2	R3
04	T1,T2	R1, R2
05	T1,T3	R1, R2
06	T2,T4	R3

403150B: Restructuring and Deregulation

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Give brief introductions about the various institutions and their roles in the Indian Power sector and introduce the restructured power system .
- Introduce Fundamentals of Power Sector economics.
- Educate about the process and operation of restructuring of power systems and tariff setting principles.
- Explain Power Sector Restructuring Models and to introduction concept of energy trading
- Introduce the concept of electricity markets and various operations involved in the market .
- Explain the fundamental concept of congestion, its management and transmission pricing and concept of transmission pricing.

Course Outcomes:

At the end of this course, students will be able to:

CO1: Identify the various institutions in the Indian power sector and explain their role in the Indian power sector .

CO2: Explain the various fundamentals of power sector economics

CO3: Describe the regulatory process in India and list the steps involved in tariff determination and explain the phases of tariff determination

CO4: Describe and explain different power sector restructuring models and explain the concept of energy trading

CO5: Explain the types of electricity markets and compare the types of electricity markets .

CO6: State different transmission pricing methods and describe and compare various congestion management methods.

Unit 01	Power Sector in India	07hrs

Introduction to various institutions in the Indian Power sector such as the Ministry of Power ,MNRE, CEA, Planning Commissions, PGCIL, PFC, CERC, SERC, Load dispatch centers (National, regional and state) and their roles. Critical issues / challenges before the Indian power sector, Need of regulation and deregulation of the power industry. Conditions favoring deregulation in the power sector. An overview of the restructured power system, Difference between integrated power system and restructured power system

Unit 02	Fundamentals of Power Sector Economics	07hrs

Introduction, Consumer behaviour, Supplier behaviour, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Typical cost components and cost structure of the power sector, Concept of life cycle cost, annual rate of return .Elasticity of demand and

supply curve, Market equilibrium, Consumer and supplier surplus. Perfectly competitive market. Key Indices for assessment of utility performances.(Generation, transmission and distribution).Financial tools to compare investment options.		
Unit 03	Power Sector Regulation	07hrs
Regulatory process in India, types and methods of Regulation - rate of return regulation, benchmarking or yardstick regulation, performance-based regulation. Role of regulatory commission. Considerations of socio economic aspects in regulation. Principles of Tariff setting, Phases of Tariff determination. Consumer tariff structures and considerations, different consumer categories. Comparison of different tariff structures for different load patterns. The Electricity Act 2003, The Electricity Act 2010, National Electricity policy. Recently Amended Electrical policy.		
Unit 04	Introduction to Power Sector Restructuring Models and Introduction to energy trading	07hrs
Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Introduction to energy exchange , Day ahead market (DAM) and Term ahead market (TAM), procedure adopted in energy exchanges and trading of Renewable energy credits and carbon credits.		
Unit 05	Electricity markets	07hrs
Rules that govern electricity markets, peculiarity of electricity as a commodity. Various electricity markets such as spot markets, forward contracts and forward markets , future contracts and future markets .Market operation – settlement process , market clearing price (MCP) , Market efficiency . Market power Electricity markets under imperfect competition Sources of market power, Effect of market power, Identifying market power, HHI Index, Entropy coefficient, Lerner index, Market power mitigation, Effects of contract for differences.		
Unit 06	Transmission Pricing and Congestion Management	07hrs
Cost components of transmission system, cost allocation of transmission system, Transmission pricing methods, physical transmission rights, Open access. Congestion in power networks, reasons for congestion, congestion management methods . Non-market methods, Market based methods. Definition of terms - Total transfer capability (TTC), Available transfer capability (ATC), Transmission Reliability Margin (TRM), Capacity Benefit Margin (CBM), Existing Transmission Commitments (ETC). Locational marginal Pricing (LMR), Firm Transmission Right (FTR)		
Text Books:		
[T1]	Know Your Power: A citizen Primer on the electricity Sector, Prayas Energy Group, Pune	
[T2]	Daniel S. Kirschen, Goran Strbac, “Power System Economics” John Wiely and Sons Publication Ltd. August 2006	
[T3]	Mohammad Shahidehpour, Muwaffaq Alomoush, “Restructured Electrical Power Systems: Operation Trading and Volatility” CRC Press, 06-J	
Reference Books:		
[R1]	Steven Stoft, “Power System Economics: Designing Markets for Electricity”, John Wiley and Sons, 2002	

[R2]	Sally Hunt, “Making Competition Work in Electricity”, 2002, John Wiley Inc
[R3]	Geoffrey Rothwell, Tomas Gomez, “Electricity Economics Regulation and Deregulation” A John Wiley and Sons Publication 2003
[R4]	Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, “Market operations in Electric Power System” A John Wiley and Sons Publication
[R5]	Deregulation in Power Industry – A course under continuing Education Program, Department of Electrical Engineering , IIT Bombay
Online Resources:	
[O1]	http://www.cercind.gov.in/Function.html
[O2]	www.cercind.gov.in/serc.html
[O3]	http://www.power.gov.ng/index.php/about-us/our-functions
[O4]	http://planningcommission.nic.in/reports/genrep/arep9920/ar9920role.htm
[O5]	http://www.cea.nic.in/functions.html
[O6]	https://nptel.ac.in/courses/108101005
[O7]	https://posoco.in/
[08]	https://www.iexindia.com/

Mapping:

Unit	Text Books	Reference Books
01	T1	[O1]-[O6]
02	T1	R3
03	T1	R1
04	T2	R5,[O8]
05	T2	R5,R2,R4
06	T3	R1

403150C: Smart Grid

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Explain the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
- Describe the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors, Home and Building Automation, Phase Shifting Transformers.
- Elaborate the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System, Phase Measurement Unit.
- Elaborate the concept of microgrid.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Apply the knowledge to differentiate between Conventional and Smart Grid
CO2: Describe importance of Supercapacitors.
CO3: Identify the need of Smart metering.
CO4: Apply the communication technology in smart grid.
CO5: Comprehend the issues of micro grid.

Unit 01	Introduction to Smart Grid	07 hrs

Concept of Smart Grid, Need of Smart Grid, Functions of Smart Grid, Opportunities and Barriers of Smart Grid, Drivers of SG in India, Functionalities and key components of smart grid, Difference between conventional and smart grid, Smart Grid Vision and Roadmap for India, Concept of Resilient and Self-Healing Grid, Smart Grid National Policies, Smart Cities, Pilot projects in India

Unit 02	Smart Grid Technologies	07 hrs

Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid (V2G), Energy Storage Technologies and applications – Battery (flow and advanced), SMES, Super Capacitors, Compressed Air Energy Storage (CAES) and its comparison.

Unit 03	Smart Meters and Advanced Metering Infrastructure	07 hrs

Introduction to Smart Meters, Prepaid meters, Net Metering, Advanced Metering Infrastructure (AMI), Real Time Pricing, Automatic Meter Reading (AMR), Outage Management System (OMS), Smart Substation , IEC 61850, Smart Sensors, Geographic Information System (GIS), IS 16444, LowPAN RF meter

Unit 04	Communication Technology for Smart Grid	07 hrs
Communication Architecture of SG, Wide Area Measurement Protection and Control (WAMPAC), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN)., ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing and Cyber Security for Smart Grid, LORaWAN, NB-IoT, SigFox.		
Unit 05	Microgrids	07 hrs
Concept of Microgrid, need and applications of Microgrid, Microgrid Architecture, DC Microgrid, Hybrid Microgrid, Formation of Microgrid, Issues of interconnection, protection and control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Renewable Energy based Microgrid system		
Unit 06	Power Quality issues and Challenges	07 hrs
Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources , Smart Grid data analytics, Distributed Generation, Reliability Indices (CAIDI, CAIFI, MAIDI, MAIFI), Load Forecasting Methods, Smart Appliances, Home and Building Automation.		

Text Books:	
[T1]	Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”,CRC Press
[T2]	Stuart Borlase, “Smart Grids-Infrastructure, Technology and Solutions”, CRC Press, Taylor and Francis group
[T3]	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley Publications.
[T4]	Nikos Ziargyriour, “Micro grid, Architecture and Control”, IEEE Press, Wiley Publications.

Reference Books:	
[R1]	Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press, Taylor and Francis group

Online Resources:

403150D: Sensor Technology (Open Elective)						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

Course Outcomes:

At the end of this course, students will be able to:
CO1: Understand the characteristics of sensors used for system monitoring and protection.
CO2: Interface the various position sensors to microcontrollers.
CO3: Demonstrate the characteristics of sensors used for light and image sensing.

Unit 01	Sensor fundamentals and characteristics	06 hrs

Sensor Classification, Performance and Types, Error Analysis characteristics

Unit 02	Optical Sources and Detectors	06 hrs

Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

Unit 03	Light & image sensing	06 hrs

Sensors and sensing AFEs for capturing a broad range of wavelengths introduction, 3D Depth Sensor, Near Infrared spectroscopy, OPT3007 Light Sensor, Optical Isolators.

Unit 04	System monitoring & protection sensing	06 hrs

Principle of operation and application of following sensors for Real-time system protection, feedback control and high-accuracy system monitoring: LM35 Temperature Sensor, INA240 current sense amplifier, DRV5053 Hall Effect based current sensor, HDC1080 / HDC1010 / HDC2010 Humidity Sensor.

Unit 05	Position Sensing	06 hrs

Absolute and relative position sensing solutions including: angular, presence, proximity, distance, flow, level, and velocity basics, DRV 5032 Hall Effect Sensor, mmWave Sensor, AFE5805 Ultrasonic sensor, Encoder, Resolver, Inductive position sensor, Capacitive Position Sensor, LVDT.

Unit 06	Special Sensors -	06 hrs

GPS, Bluetooth, smart sensor - film sensor, MEMS and nano sensors, laser sensors, touch screen sensors, heading sensors - compass gyroscope inclinometer, application of sensors in drone.

Text Books:

[T1]	Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York. 2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.
[T2]	Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

Reference Books:

[R1]	Gerd Keiser,"Optical Fiber Communications", 2012, 4th edition, McGraw-Hill Science, Delhi.
[R2]	John G Webster, "Measurement, Instrumentation and sensor Handbook", 2014, 2nd edition, CRC Press, Florida.
[R3]	Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.
[R4]	Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Online Resources:

[O1]	https://www.ti.com
[O2]	https://www.mouser.in/

Mapping:

Unit	Text Books	Reference Books
01	[01]	[R1]
02	[02]	[R2],[R4]
03	[01],[02]	[R3]
04	[01],[02]	[01] Online
05	[01],[02]	[02] online
06	[01],[02]	[R2],[R4]

403151A: EHV AC Transmission						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Explain the need of EHV and UHV systems.
- Describe the impact of such voltage levels on the environment.
- Identify problems encountered with EHV and UHV transmissions.
- Describe methods of governance on the line conductor design, line height and phase etc.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Highlight need for EHV ac transmission.
CO2:Calculate line and ground parameters.
CO3:Enlist problems encountered in EHV transmission.
CO4:Describe the effect of electric and magnetic fields on human beings.

Unit 01	EHVAC Transmission	07 hrs

Need for EHV transmission lines, Power handling capacity and line loss, Mechanical considerations in line performance, Vibrations. Traveling wave equations, transmission reflection attenuation and distortion of traveling waves, transmission and reflection coefficients and examples.

Unit 02	Calculation of line and ground parameters	07 hrs

Resistance of conductors, effect of temperature on overhead conductors, temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of current carrying single conductor, Inductance of EHV line configurations, Line capacitance calculations

Unit 03	Voltage Gradient of Conductor	07 hrs

Electrostatic Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, charge potential relations for multi-conductor lines, Maximum charge condition on three phase line.
Surface voltage gradient on conductors-single conductor, two conductors and multi-conductor bundle, Maximum surface voltage gradient, Mangoldt formula, design of cylindrical cage for corona gradients.

Unit 04	Electrostatic and magnetic fields of EHV lines	07hrs

Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level.
Electrostatic induction on an un-energized circuit of a double circuit line. Insulated ground wire and induced voltage in insulated ground wires. Magnetic field calculation of horizontal configuration of single circuit of

three phase lines, Effects of power frequency magnetic fields on human health.		
Unit 05	Corona and its effects	07 hrs
Corona formation, corona inception voltage, visual corona voltage, critical field for corona inception and for visual corona under standard operating condition and conditions other than standard operating conditions. Power loss due to corona, corona loss formulae, corona current waveform, charge-voltage diagram and corona loss. Audible noise operation and characteristics limits for audible noise, AN measurement and meters, microphone, weighting networks.		
Unit 06		07 hrs
A. Design of EHV line: Design of EHV lines based upon steady state limits and transient over voltages, design factors under state. Design examples: steady state limits. Line insulation design based on transient over voltages. B. Extra high voltage cable transmission: Classification of cables, Electrical characteristics of EHV Cables, Properties of cable insulation materials.		
Text Books:		
[T1]	Rakosh das Begamudre "Extra high voltage transmission", New Age International publishers.	
Reference Books:		
[R1]	S. Rao , "EHV AC and DC Transmission" Khanna publication.	

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T1	–
03	T1	–
04	T1	R1
05	T1	R1
06	T1	R1

403151B: Illumination Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- To explain conventional and modern lamps and their accessories.
- To get detailed insight of indoor and outdoor illumination system components, control and design aspects.
- To know the requirements of energy efficient lighting.
- To introduce the modern trends in the lighting

Course Outcomes:

At the end of this course, students will be able to:
CO1: Define and reproduce various terms in illumination.
CO2: Identify various parameters for illumination system design.
CO3: Design indoor and outdoor lighting systems.
CO4: Enlist state of the art illumination systems.

Unit 01	Importance of Lighting in Human Life	07 hrs

Optical systems of human eye, Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting and perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification and Measurement of light.

Unit 02	Light Sources and Electrical Control of Light Sources	08 hrs

Light Sources- Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high pressure mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps - Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL)
High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.
Ballast, ignitors and dimmers for different types of lamps
Control of Light Sources
Photometric Control of Light Sources and their Quantification: Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures. Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).

Unit 03	Design Considerations for illumination schemes	07 hrs
Zonal cavity method for general lighting design, determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization), beam angles and polar diagrams. Factors to be considered for design of indoor illumination scheme		
Unit 04	Design of lighting schemes-I	07 hrs
Indoor illumination design for following installations Residential (Numerical) Educational institute Commercial installation Hospitals Industrial lighting Special purpose lighting schemes Decorative lighting Theatre lighting Aquarium, swimming pool lighting		
Unit 05	Design of lighting schemes-II	07 hrs
Factors to be considered for design of outdoor illumination scheme Outdoor Lighting Design: Road classifications according to BIS, pole arrangement, terminology, lamp and luminaries' selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method. Outdoor illumination design for following installations: Road lighting (Numerical) Flood lighting (Numerical) Stadium and sports complex Lighting for advertisement/hoardings		
Unit 06	Modern trends in illumination	07 hrs
LED luminary designs Intelligent LED fixtures Natural light conduiting Organic lighting system LASERS, characteristics, features and applications, non-lighting lamps Optical fiber, its construction as a light guide, features and applications		

Text Books:

[T1]	H. S. Mamak, "Book on Lighting", Publisher International lighting Academy.
[T2]	Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications
[T3]	M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-Butterworth Heinemann (ISBN 978-0-415-50308-2)

[T4]	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
Reference Books:	
[R1]	"BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi.
[R2]	D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0.
[R3]	"IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society of North America.
[R4]	"IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society of North America
[R5]	IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition 2000
[R6]	Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.
[R7]	IS 3646: Part I: 1992, Code of practice for interior illumination.
[R8]	Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4

Mapping:

Unit	Text Books	Reference Books
01	T1, T4	R6
02	T3, T4	R1, R3, R4, R8
03	T2, T4	R2, R3, R7
04	T3, T4	R2,R3, R4, R5, R7
05	T2, T3, T4	R3, R4, R6, R7
06	T1, T2, T4	R2, R3, R5, R8

403151C: Electromagnetic Fields

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- To impart knowledge on the basics of electric and magnetic fields and their applications for utilization in the development of the theory for power transmission lines and electrical machines.
- To describe how materials affect electric and magnetic fields
- To discuss the boundary conditions
- To analyze the relation between the fields under time varying situations
- To give insight to Maxwell's equations in different form and media

Course Outcomes:

At the end of this course, students will be able to:
CO1: Describe time varying Maxwell's equations and their applications in electromagnetic problems
CO2: Interpret electric and magnetic field with the help of associated laws
CO3: Solve simple electrostatic and magnetic boundary conditions
CO4: Determine the relationship between time varying electric and magnetic fields and electromotive force
CO5: Solve electromagnetic problems with the help of mathematical tools.

Unit 01	Introduction	07 hrs

Sources and effects of Electro-Magnetic Fields, Scalar and vector, Unit vector, Mathematical operations of Vector, Scalar and vector fields, Different Coordinate System, Operator Del, Physical interpretation of gradient, divergence and curl, Conversion between coordinate system, Expression for gradient, divergence and curl in three coordinate system.

Unit 02	Basic Electrostatics	07 hrs

Coulomb's law, Electric field, Electric Field Intensity (EFI), EFI due to - point charge, line charge, surface charge and volume charge, Electric displacement, Electric flux density, Gauss's law (scalar and vector form), Applications of Gauss law, Electric field due to – point charge, infinite long straight conductor and infinite plane sheet of charge, Divergence theorem, Stoke's theorem

Unit 03	Applied Electrostatics	07 hrs

Electric Potential, Relationship between E and V, Equipotential surfaces, Electric dipole and flux lines, Electric field due to dipole, Energy density in electrostatic field, Energy stored in terms of D and E, Convection and Conduction currents, Current and current density, Continuity equation for current, Poisson's and Laplace's equations, Capacitor and its capacitance, Parallel plate capacitor, Capacitors with multiple dielectrics, Spherical capacitor, Coaxial capacitor.

Unit 04	Magnetostatics and Applications	07 hrs

Magnetic flux density, Magnetic field intensity (MFI), Magnetic permeability, Biot-Savart's law, Applications of Biot-Savart's law, MFI due to - infinite long straight filament, finite length element, on the axis of circular loop, Ampere's Circuital law, Field due to – infinite line current, coaxial cable, uniform current sheet density, Magnetic flux density, Scalar magnetic potential, Vector magnetic potential, Poisson's Equations for Magnetostatic field, Derivations of BiotSavart law and Ampere's law based on magnetic potential, Forces due to magnetic field, Magnetic dipole.

Unit 05	Boundary Conditions and Analysis	07 hrs

Conductors, Ohm's law employing mobility, Dielectrics, Polarization in Dielectrics, Dielectric constants and strength, Relaxation time, Boundary conditions : Dielectric-Dielectric boundary conditions, Conductor – Dielectric boundary conditions, Conductor – Free space boundary conditions, Boundary conditions for Magnetostatic fields

Unit 06	Time Varying Fields and Maxwell's equations	07 hrs

Faraday's law, Transformer and motional EMFs – stationary loop in time varying B field, moving loop in static B field and moving loop in time varying field, Displacement current, Maxwell's equations in point form and integral form, Power and Poynting theorem, Time varying potentials, Time Harmonic Field, Maxwell's equations in point form and integral form for harmonic field, Concept of uniform plane wave.

Text Books:

[T1]	W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", Tata McGraw Hill.
[T2]	Mathew Sadiku, "Elements of Electromagnetics", Oxford University Press

Reference Books:

[R1]	R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill.
[R2]	Liang Chi Shen, Jin Au Kong, Amalendu Patnaik, "Engineering Electromagnetics", CENGAGE Learning
[R3]	K. B. Madhu Sahu, "Electromagnetic Fields", SciTech Publication.
[R4]	N. N. Rao, " Elements of Engineering Electromagnetics", Pearson Education.
[R5]	Edminister J. A., " Electromagnetics", Tata McGraw Hill.

Mapping:

Unit	Text Books	Reference Books
01	T2	R2, R3, R4
02	T1, T2	R1, R2, R3
03	T1, T2	R2, R3, R4, R5
04	T1, T2	R2, R3
05	T2	R1, R4, R5
06	T1, T2	R2, R3, R4

403151D: Artificial Intelligence and Machine Learning

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Understand the basic concept of AI, strength and weakness of problem solving and search.
- Know about various Expert System tools and applications.
- Understand the basic concepts of machine Learning and apply different dimensionality reduction techniques.
- Optimize the different linear methods of regression and classification.
- Interpret the different supervised classification methods of support vector machine.
- Acquire the knowledge of different generative models through unsupervised learning.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Evaluate Artificial Intelligence (AI) and Machine Learning(ML) methods and describe their foundations.
CO2: Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
CO3: Illustrate the construction of learning and expert system Discuss current scope and limitations of AI and societal implications
CO4: Distinguish between different types of learning types.
CO5: Apply the different supervised, unsupervised and reinforcement learning methods.

Unit 01	Introduction to AI	07 hrs

Definitions – Foundation and History of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment. Artificial Intelligence vs Machine learning, Statistical Analysis: Relationship between attributes: Covariance, Correlation Coefficient, Chi Square. Intelligent Agent: Concept of Rationality, nature of environment, structure of agents.

Unit 02	Problem Solving	07 hrs

Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm, Bestfirst Search; Problem Reduction. Constraint Satisfaction problem: Interference in CSPs; Back tracking search for CSPs; Local Search for CSPs; structure of CSP Problem. Beyond Classical Search: Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments.

Unit 03	Knowledge and Reasoning	07 hrs

Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks. Probabilistic reasoning over time: time and uncertainty, hidden Markova models, Kalman filter, dynamic bayesian network, keeping track of many objects

Unit 04	Introduction to ML and Supervised Learning	07 hrs
Introduction to Machine Learning, Examples of Machine Learning Applications, Learning Types **Supervised Learning** -Learning a Class from Examples, Vapnik-Chervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning,Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, **Dimensions of a Supervised Machine Learning** Algorithm Dimensionality Reduction-Introduction,Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis,Isomap, Locally Linear Embedding		
Unit 05	Linear Regression	08 hrs
Introduction, Linear Regression Models and Least Squares, Subset Selection, Shrinkage Methods-Ridge Regression, Lasso Regression, Least Angle Regression, Methods Using Derived Input Directions-Principal Components Regression, Partial Least Squares, A Comparison of the Selection and Shrinkage Methods , Multiple Outcome Shrinkage and Selection, More on the Lasso and Related Path Algorithms, Logistic Regression-Fitting Logistic Regression Models, Quadratic Approximations and Inference, L1 Regularized Logistic Regression		
Unit 06	Unsupervised and reinforcement learning	08 hrs
Introduction, Association Rules-Market Basket Analysis, The Apriori Algorithm, Unsupervised as Supervised Learning,Generalized Association Rules, Cluster Analysis. Proximity Matrices, Clustering Algorithms-K-mean, Gaussian Mixtures as Soft K-means Clustering. **Reinforcement Learning:** Introduction, Single state case, elements of reinforcement learning, model based learning, Temporal difference learning		

Text Books:

[T1]	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall
[T2]	J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016
[T3]	Introduction to Machine Learning Edition 2, by Ethem Alpaydin
[T4]	The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
[T5]	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997

Reference Books:

[R1]	Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010 2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011
[R2]	Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill
[R3]	Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson
[R4]	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT

[R5]	Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
[R6]	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
[R7]	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
Online Resources:	
[O1]	https://nptel.ac.in/courses/106/106/106106139/
[O2]	https://nptel.ac.in/courses/106/106/106106202/
[O3]	https://nptel.ac.in/courses/106/106/106106198/
[O4]	https://nptel.ac.in/courses/106/105/106105152/
[O5]	https://nptel.ac.in/courses/106/106/106106213/
[O6]	https://www.coursera.org/learn/machine-learning

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2, R3
02	T1, T2	R1, R2, R3
03	T1, T2	R1, R2, R3
04	T3, T4, T5	R4, R5, R6, R7
05	T3, T4, T5	R4, R5, R6, R7
06	T3, T4, T5	R4, R5, R6, R7

403152: Project Stage II

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	12	Hrs./Week	SEM/PW/IN	6	ORAL	50
					Termwork	100

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Preamble:

Project is an important part of the engineering curriculum covered in the final year. It is divided into Project Stage I and Project Stage II in Semesters I and II of the Final Year. This project is a substantial piece of work that will require creative activity and original thinking. The project aims to provide students with a transitional experience from the academic world to the professional world. The objectives, outcomes, and guidelines for Project Stage II are given below.

Course Objectives:

The objectives of this course are to:

1. Provide an opportunity to learn new software, interdisciplinary theory, concept, technology, etc. not covered in earlier subjects
2. Empower students to use engineering knowledge and skills learned in previous courses to deliver a product that has passed through the design, analysis, testing, and evaluation
3. Encourage multidisciplinary project work through the integration of knowledge
4. Allow students to develop problem-solving, analysis, synthesis, and evaluation skills.
5. Encourage teamwork.
6. Improve students' communication skills by asking them to produce both a professional report and to give an oral presentation
7. Exposed to the project management skills and ethical practices in project

Course Outcomes:

Course outcomes can be different for the different projects undertaken by the student groups. However, in general, the course outcomes for Project Stage-II can be stated as follows.

At the end of this course, students should be able to:

CO1: Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project

CO2: Justify the selection of electrical, electronic and mechanical components for the project prototyping

CO3: Select the appropriate testing method for system performance evaluation

CO4: Interpret results obtained by simulation, and hardware implementation and decide on further action or write a conclusion

CO5: Write a project report and research paper on the project work

Guidelines:

Termwork evaluation guidelines are given below.

Sr. No.	Activity	Deadline (Semester II)	Parameters for Evaluation
1	Progress Review-3 Presentation	Up to 6th Week	Revised Final Design (10) Tools and Techniques Used with justification (10) Partial Implementation/ development (15) Partial Results (15)

			Total Marks (50)
2	Progress Review-4 Presentation	Up to 12^{th} Week	Implementation Status of project (10) Testing and Evaluation (10) Intermediate Results (15) Conclusion (10) Future Scope (5) **Total Marks (50)**
3	Submission of Project Stage –II Report	Up to 14^{th} Week	Timely submission (5) Formatting and Report Writing Style (5) Abstract, Literature Survey, Conclusion (10) Grammatical correctness in the report (5) Publication/participation in project exhibition (20) **Total Marks (50)** **Review 3+ Review 4+ Final Project Report = 150 Rounded to 100 Marks**

Guidelines to students:

1. Continue with the same group and identify opportunities for self-learning and upgrading skills.
2. Actively participate in all the activities related to the project.
3. Document the project in the form of a hard-bound report at the end and submit it to the department.
4. Attempt to make a prototype, working model, and demonstration of the project to display during the final presentation.
5. Participate in project competitions, paper presentations, etc.
6. Maintain an institutional culture of authentic collaboration, self-motivation, peer learning, and personal responsibility.
7. Maintain a notebook to keep records of all the meetings, discussions, notes, etc. This is to be done by the individual student and submitted at the end to the supervisor or guide.
8. Some parameters, mentioned in the above table, will be evaluated and assessed at a group level and some at an individual level.

403153A: German Language-II							
Teaching Scheme			**Credits**		**Examination Scheme**		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

- Get introduced to the Culture, Routine of the German Society through language.
- Meet the needs of ever growing German industry with respect to language support.

Course Outcomes:

At the end of this course, students:
CO1: Will have the ability of advanced communication.
CO2: Will develop reading, writing and listening skills.
CO3: Will understand tenses in German Language.
CO4: Will develop interest to pursue a German language course.

Unit 01	Introduction of Cases:	06 hrs

Introduction of Cases: Nominative, Akkusative, Dative.
Personal & Possessive Pronouns in Nominative, Akkusative, Dative.

Unit 02	Prepositions:-	06 hrs

Prepositions:- Akkusative & Dative.

Unit 03	Tenses:-	06 hrs

Tenses:-
Past tense of sein & haben Verbs, Perfect tense

Text Books:

[T1]	Netzwerk A-1 (Deutsch als Fremdsprache), Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

[R1]	Tipps und Uebungen A1

Online Resources:

[O1]	Practice Material like online Worksheets regarding the Grammar, listening Module, reading Texts.

403153B: Engineering Economics-II

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Describe basics methods of Engineering Economic Analysis
2. Explain inflation and its impact on business decisions.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Apply various techniques for evaluation of engineering projects.
CO2:Assess cash flow under risk with varying parameters.

Unit 01	Engineering Economic Analysis	10 hrs

Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Public Sector Economic Analysis (Benefit Cost Ratio Method).Introduction to Lifecycle Costing, Introduction to Financial and Economic Analysis.Case Study – Tata Motors

Unit 02	Inflation and Risk Analysis	10 hrs

Concept of Inflation., Measuring Inflation, Equivalence Calculation Under Inflation, Impact of Inflation on Economic Evaluation.
Sources of Project Risks, Methods of Describing Project Risks, Sensitivity Analysis, Break Even Analysis, Scenario Analysis, Probability Concept of Economic Analysis, Decision Tree and Sequential Investment Decisions

Text Books:

[T1]	Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
[T2]	D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books:

[R1]	Sasmita Mishra, “Engineering Economics & Costing “, PHI
[R2]	Sullivan and Wicks, “ Engineering Economy”, Pearson
[R3]	R. Paneer Seelvan, “ Engineering Economics”, PHI
[R4]	Chan S. Park, Contemporary Engineering Economics, Prentice Hall, Inc.

403153C: GREEN BUILDING

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	--	ISE		--

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Course Objectives:

This course aims to:

- To learn the principles of planning and orientation of buildings.
- To acquire knowledge on various aspects of green buildings.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Design green and sustainable techniques for both commercial and residential buildings.
CO2:Design water, lighting, energy efficiency plan using renewable energy sources.
CO3:Explain the principles of building planning, its bylaws and provide facilities for rainwater harvesting
CO4:Understand the concepts of green buildings

Unit 01	Sustainability and Building design	06 hrs

Sustainability, objectives of sustainable development, Sustainable aspects of habitat design, sustainable buildings, principles, approaches and characteristics, climate data, climate parameters and zones, comparative analysis of various climatic zones, site planning recommended checklist for identifying site characteristics, site development and layout. Efficient water management and waste water treatment, solid waste management.

Unit 02	Energy efficiency	06 hrs

Solar passive techniques in building design to minimize load on conventional systems i.e. heating, cooling, ventilation and lighting. Designing Energy efficient lighting and HVAC systems. Use of renewable energy systems to meet part of building load. Green building certification. Overview of various green buildings in India. Policy and regulatory mechanisms.

Text Books:

[T1]	Seven Wonders of Green Building Technology: Karen Sirvaitis, Twenty-First Century Books.
[T2]	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[T3]	Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[T4]	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

Reference Books:

[R1]	Sustainable Building Design Manual, Volume 2, TERI, New Delhi
[R2]	Energy Efficient Buildings in India, TERI, New Delhi
[R3]	Sustainable Building Design Manual, Volume 1 TERI, New Delhi
[R4]	Mili Majumdar, “Energy-efficient buildings in India” Tata Energy Research Institute, 2002.
[R5]	TERI “Sustainable Building Design Manual- Volume I & II” Tata Energy Research Institute, 2009.
Online Resources:	
[O1]	https://nptel.ac.in/courses/105102175
[O2]	https://theect.org/energy-efficiency-buildings-distance-learning/
[O3]	https://www.udemy.com/topic/energy-management/
[O4]	https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-ce13/
[O5]	https://beeindia.gov.in/content/certification
[O6]	https://elearning.iea.org/
[O7]	https://onlinecourses.nptel.ac.in/noc20_ce08/preview

JSPM's Bhivarabai Sawant Institute of Technology &Research, Wagholi, Pune (412207)

CRITERION 1 - CURRICULAR ASPECTS

1.2

Academic Flexibility

1.2.1

Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

DEPARTMENT OF MECHANICAL ENGINEERING

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
for

Second Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering and Automobile Engineering
(2019 Course)

Board of Studies - Automobile and Mechanical Engineering
(With Effect from Academic Year 2020-21)

Savitribai Phule Pune University

Board of Studies - Automobile and Mechanical Engineering

Undergraduate Program - Automobile Engineering & Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hours/ Week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-III														
202041	Solid Mechanics	4	2	-	30	70	-	50	-	150	4	1	-	5
202042	Solid Modeling and Drafting	3	2	-	30	70	-	50	-	150	3	1	-	4
202043	Engineering Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202044	Engineering Materials and Metallurgy	3	2	-	30	70	25	-	-	125	3	1	-	4
203156	Electrical and Electronics Engineering	3	2	-	30	70	25	-	-	125	3	1	-	4
202045	Geometric Dimensioning and Tolerancing Lab	-	2	-	-	-	25	-	-	25	-	1	-	1
202046	Audit Course - III	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**16**	**12**	**-**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**6**	**-**	**22**
Semester-IV														
207002	Engineering Mathematics - III	3	-	1	30	70	25	-	-	125	3	-	1	4
202047	Kinematics of Machinery	3	2	-	30	70	-	-	25	125	3	1	-	4
202048	Applied Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202049	Fluid Mechanics	3	2	-	30	70	-	-	25	125	3	1	-	4
202050	Manufacturing Processes	3	-	-	30	70	-	-	-	100	3	-	-	3
202051	Machine Shop	-	2	-	-	-	50	-	-	50	-	1	-	1
202052	Project Based Learning - II	-	4	-	-	-	50	-	-	50	-	2		2
202053	Audit Course - IV	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**12**	**1**	**150**	**350**	**125**	**-**	**75**	**700**	**15**	**6**	**1**	**22**

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam,**TW**: Term Work, OR: Oral

Note: Interested students of SE (Automobile Engineering and Mechanical Engineering) can opt for any one of the audit course from the list of audit courses prescribed by BoS (Automobile and Mechanical Engineering)

Instructions

- Practical/Tutorial must be conducted in three batches per division only.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Assessment of tutorial work has to be carried out as a term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.
- Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.
- Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

202041 - Solid Mechanics

Teaching Scheme	Credits	Examination Scheme
Theory : 04 Hr./Week Practical : 02 Hr./Week	**05** Theory : 04 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Engineering Mathematics- I and II, Systems in Mechanical Engineering, Engineering Mechanics

Course Objectives

1. To acquire basic knowledge of stress, strain due to various types of loading.
2. To draw Shear Force and Bending Moment Diagram for transverse loading.
3. To determine Bending, Shear stress, Slope and Deflection on Beam.
4. To solve problems of Torsional shear stress for shaft and Buckling for the column.
5. To apply the concept of Principal Stresses and Theories of Failure.
6. To utilize the concepts of Solid Mechanics on application based combined mode of loading.

Course Outcomes

On completion of the course, learner will be able to

CO1. DEFINE various types of stresses and strain developed on determinate and indeterminate members.

CO2. DRAW Shear force and bending moment diagram for various types of transverse loading and support.

CO3. COMPUTE the slope & deflection, bending stresses and shear stresses on a beam.

CO4. CALCULATE torsional shear stress in shaft and buckling on the column.

CO5. APPLY the concept of principal stresses and theories of failure to determine stresses on a 2-D element.

CO6. UTILIZE the concepts of SFD & BMD, torsion and principal stresses to solve combined loading application based problems.

Course Contents

Unit I — Simple stresses & strains — [10 Hr.]

Simple Stress & Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads and self-weight, Thermal stresses in plain and composite members

Unit II — Shear Force & Bending Moment Diagrams — [08 Hr.]

SFD & BMD: Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure

Unit III — Stresses, Slope & Deflection on Beams — [12 Hr.]

Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section

Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section

Slope & Deflection on a Beam: Introduction to slope & deflection on a beam with application, slope, deflection and Radius of Curvature, Macaulay's Method, Slope and Deflection for all standard beams

Unit IV	Torsion, Buckling	[08 Hr.]

Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience

Torsion on Thin-Walled Tubes: Introduction of Torsion on Thin-Walled Tubes Shaft and its application

Buckling of columns: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory

Unit V	Principal Stresses, Theories of Failure	[08 Hr.]

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses

Theories of Elastic failure: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory

Unit VI	Application based combined loading & stresses (Based on load and stress condition studied in Unit I to Unit V)	[08 Hr.]

Introduction to the Combined Loading and various stresses with application, Free Body Diagram and condition of Equilibrium for determining internal reaction forces, couples for 2-D system, Combined stresses at any cross-section or at any particular point for Industrial and Real life example for the following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined problem of Normal and Shear type of Stresses

Books & Other Resources

Text Books

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication
3. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
4. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
5. Singer and Pytel, "Strength of materials", Harper and row Publication
6. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication

Reference Books

1. Egor. P. Popov, "Introduction to Mechanics of Solids",Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore
6. Prof. S.K. Bhattacharyya, IIT Kharagpur , "NPTEL Web course material"
   https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

The Termwork shall consist of completion of Practicals, Self-learning Study Assignments and Presentations. Practical examination shall be based on the Termwork undertaken during the semester.

Practical *(Any 6 experiments out of experiment no 1 to 8 from the following list whereas experiment no. 9 and 10 are mandatory. Minimum One experiment must be performed on IoT platform- Virtual Lab)*:

1. Tension test for Ductile material using extensometer on Universal Testing Machine.
2. Compression test for Brittle material on Universal Testing Machine.
3. Shear test of ductile material on Universal Testing Machine.
4. Tension test of Plastic/Composite material on low load capacity Tensile Testing Machine.
5. Measurement of stresses and strains using strain gauges.

6. Experimental verification of flexural formula in bending for cantilever, Simple supported beam.
7. Study and interpretations of stress distribution pattern using Polariscope for Plastic/Acrylic.
8. Experimental verification of torsion formula for circular bar.
9. Verification of results of any two from experiments no 1-8 using any FEA software tools.
10. **Self-learning study practical**: *Following topics are distributed among the group of 3-5 Students and groups need to present and also submit the slides/poster on TW file*.
    a. Experimental stress analysis, Strain Gauges rosette with case study.
    b. Residual stresses and Fatigue life with case study.
    c. Effect of heat treatment on the mechanical properties of a metal with case study.
    d. Mechanical properties of materials, Stresses and Design of components with case study.
    e. Failure Mode Analysis and Stresses with case study.

202042 - Solid Modeling and Drafting

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Graphics, Engineering Mathematics - I and II

Course Objectives

1. To understand basic structure of CAD systems and their use to create geometric models of simple engineering parts
2. To introduce the curves and surfaces and their implement in geometric modeling
3. To apply basic concepts of 3D modeling, viewing and evaluate mass properties of components and assemblies
4. To apply geometrical transformations in CAD models
5. To understand data exchange standards and translators for various applications
6. To create engineering drawings, design documentation and use in manufacturing activities

Course Outcomes

On completion of the course, learner will be able to

CO1. UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management

CO2. UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry

CO3. CONSTRUCT solid models, assemblies using various modeling techniques & PERFORM mass property analysis, including creating and using a coordinate system

CO4. APPLY geometric transformations to simple 2D geometries

CO5. USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.

CO6. USE PMI & MBD approach for communication

Course Contents

Unit I — Fundamentals of 3D Modeling — [08 Hr.]

Introduction, Product Life Cycle, CAD tools in the design process of Product Cycle, Scope of CAD, Software Modules - Operating System (OS) module, Geometric module, application module, programming module, communication module, Computer Aided Design - Features, requirements and applications

3D Modeling approach - Primitive, Features and Sketching, Types of Geometric models - 2½ extrusions, axisymmetric, composite, 3D objects, difference between wireframe, surface & solid modeling, Modeling strategies

Model viewing: VRML web-based viewing

Unit II — Curves & Surfaces — [08 Hr.]

Curves: Methods of defining Point, Line and Circle, Curve representation - Cartesian and Parametric space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity (C^0, C^1 & C^2), Synthetic Curves - Hermit Cubic Spline, Bezier, B-Spline Curve, Non-Uniform Rational B-Spline curves (NURBS)

Surfaces: Surface representation, Types of Surfaces, Bezier, B-Spline, NURBS Surface, Coons patch surface, Surface Modeling

Reverse Engineering: Introduction, Point Cloud Data (PCD), PCD file formats, Quality issues in PCD, Requirements for conversion of surface models into solid models, Applications of PCD

Unit III — Solid Modeling — [08 Hr.]

Introduction, Geometry and Topology, Solid entities, Solid representation, Fundamentals of Solid modeling, Half spaces, Boundary representation (B-Rep), Constructive Solid Geometry (CSG), Sweep representation, Analytical solid modeling, Parametric solid modeling, feature based modeling, etc., Euler Equation (Validity of 3D solids), Mass Property Calculations

Introduction to Assembly Modeling, Assemblies (Top-down and Bottom-up approach), Design for Manufacturing [DFM], Design for Easy Assembly & Disassembly [DFA], Design for Safety

Unit IV **Geometric Transformation** **[08 Hr.]**

Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear, Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D objects with maximum 3 points only), Coordinate systems - Model (MCS), Working (WCS), Screen (SCS) coordinate system, Mapping of coordinate systems

Projections of geometric models - Orthographic and Perspective projections, Design and Engineering applications

Unit V **CAD Data Exchange** **[08 Hr.]**

Introduction, CAD Kernels, CAD Data File, Data interoperability, CAD Data Conversions, challenges in CAD data conversions/remedies, Direct Data Translators, Neutral 3D CAD file formats (DXF, IGES, PDES, STEP, ACIS, Parasolid, STL, etc.), Data Quality

Requirements of CAD file format for 3D Printing (Additive Manufacturing), CAE, FEA, CFD, CAM (Subtractive Manufacturing), Multi-Body Dynamics (Motion Simulations), Computer Aided Inspection (CAI), Computer Aided Technologies (CAx), AR/VR applications, etc., Introduction to CAD Geometry Clean-up for different applications

Unit VI **CAD Customization & Automation** **[08 Hr.]**

Introduction, Limitations of 2D drawings, Introduction to Product and Manufacturing Information (PMI), Model Based Definitions (MBD), Applications of PMI & MBD

CAD Customization: Introduction, advantages and disadvantages, Applications of Customization Interfaces, Product Customization Approaches - Part Modeling Customization, Assembly Modeling Customization, Drawing sheets & PMI Customization, CAD Automation

Introduction to Application Programming Interface (API), Structures of APIs, Coding/Scripting for customization, Introduction to CAD API Development, CAD Files & application handling

Books & Other Resources

Text Books

1. Zeid, I and Sivasubramania, R., (2009), “CAD/CAM : Theory and Practice”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
2. Rao, P. N., (2017), “CAD/CAM: Principles and Applications”, 3rd edition, McGraw Hill Education, ISBN-13: 978-0070681934
3. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design", Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
2. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
3. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980
4. Um, Dugan, (2018), "Solid Modeling and Applications: Rapid Prototyping, CAD and CAE Theory", 2nd edition, Springer, ISBN-13: 978-3319745930
5. Rogers, D. and Adams, J. A., (2017), “Mathematical Elements for Computer Graphics”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070486775
6. Hearn, D. D. and Baker, M. P., (2013), "Computer Graphics with OpenGL", 4th edition, Pearson Education India, ISBN-13: 978-9332518711
7. Gokhale, N. S., Deshpande, S. S., Bedekar, S. V. and Thite, A. N., (2008), “Practical Finite Element Analysis”, Finite to Infinite, Pune, India, ISBN-13: 978-8190619509
8. Lee Ambrosius, (2015), “AutoCAD® Platform Customization: User Interface, AutoLISP®, VBA, and Beyond”, John Wiley & Sons, Inc., IN, ISBN-13: 978-1118798904

9. Bucalo, Joe and Bucalo, Neil, (2007), “Customizing SolidWorks for Greater Productivity”, Sheet Metal Guy, LLC, ISBN-13: 978-0979566608
10. Ziethen, Dieter R. (2012), “CATIA V5: Macro Programming with Visual Basic Script”, McGraw-Hill Companies, Inc./Carl Hanser Verlag München, ISBN-13: 978-0071800020, ISBN: 978-007180003-7
11. Programming Manuals of Softwares

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Practical

The student shall complete the following Practical in laboratory using suitable CAD modeling software. Learner will demonstrate skills to communicate drawings as per industry standards.

1. 2-D sketching with geometrical and dimensional constraints
2. Solid & Surface modeling for simple mechanical components (Output file as Production drawing and Model Based Definition (MBD)
   (a) Sheet-Metal (b) Machining
   (c) Fabrication (d) Casting
   (e) Forgings (f) Plastic Molding
3. Assembly modeling (Output file as Assembly drawing and detailing) of the parts modeled in Practical assignment-2 using proper assembly constraint conditions and generation of exploded view for assemblies like Couplings, Clutches, Gear Assemblies, Engine/Pump/Turbine Components, Valves, Machine Tools, Automobile Components, Gear-Box, Pressure Vessels, etc.
4. Reverse Engineering of surface/solid modeling using Point Cloud Data.
5. Assembly Modeling by importing parts/components from free online resources like CAD and Product development software websites, forums, blogs, etc.
6. Demonstration on CAD Customization (with introduction to programming languages, interfacing)

202043 - Engineering Thermodynamics		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry

Course Objectives

1. To introduce the fundamentals of thermodynamics.
2. To understand the concepts of laws of thermodynamics.
3. To apply the concepts of thermodynamics towards open and closed systems.
4. To be acquainted with Entropy generation and Exergy Analysis.
5. To understand the behaviour of a Pure substance and to analyze Vapour power cycles.
6. To undertake the performance analysis of a steam generator.

Course Outcomes

On completion of the course, learner will be able to

CO1. DESCRIBE the basics of thermodynamics with heat and work interactions.

CO2. APPLY laws of thermodynamics to steady flow and non-flow processes.

CO3. APPLY entropy, available and non available energy for an Open and Closed System,

CO4. DETERMINE the properties of steam and their effect on performance of vapour power cycle.

CO5. ANALYSE the fuel combustion process and products of combustion.

CO6. SELECT various instrumentations required for safe and efficient operation of steam generator.

Course Contents

Unit I — Fundamentals of Thermodynamics — [07 Hr.]

Introduction, Review of basic definitions, Zeroth law of Thermodynamics, Macro and Microscopic Approach, State Postulate, State, Path, Process and Cycles, Point function and Path function, quasi static process, Equilibrium, **Temperature** (concepts, scales, international fixed points and measurement of temperature), Constant volume gas thermometer and constant pressure gas thermometer, mercury in glass thermometer.

First Law of Thermodynamics: Concept of heat and work, Sign convention and its conversion. First law of thermodynamics, Joules experiments, Equivalence of heat and work. Application of first law to flow and non-flow Processes and Cycles. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Compressors, Boilers etc. PMM-I kind.

Unit II — Ideal Gas and Second law of Thermodynamics — [08 Hr.]

Properties and Processes of Ideal Gas: Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes (Open and Closed systems), Calculations of Heat transfer, Work done, Internal Energy.

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, Heat Engine, Refrigerator and Heat pump: Schematic representation, Efficiency and Coefficient of Performance (COP), Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics; PMM-II kind, Equivalence of the two statements; Clausius Inequality, Concept of Reversibility and Irreversibility, Carnot Theorem/Principles, Carnot Cycle.

Unit III — Entropy and Availability — [08 Hr.]

Entropy: Entropy as a property, Clausius Inequality, Principle of increase of Entropy Principle, Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas and Pure Substance, Concept of Entropy generation. Entropy - a measure of Disorder.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems.

Unit IV **Properties of Pure substances & Thermodynamics of Vapour Cycle** **[07 Hr.]**

Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow Vapour Processes, Change of Properties, Work and Heat transfer.

Thermodynamics of Vapour Cycle: Rankine Cycle, Comparison of Carnot cycle and Rankine cycle, Introduction to Steam power Plant, Efficiency of Rankine Cycle, Relative Efficiency, Effect of Varying operating parameters like Superheat, Boiler and Condenser Pressure on performance of Rankine cycle, Modified Rankine Cycle.

Unit V **Fuels and Combustion** **[07 Hr.]**

Types of fuels, Proximate and ultimate analysis of fuel, Combustion theory, Combustion Equations, Theoretical and Excess air requirements, Equivalence ratio, Analysis of products of combustion, Calorific value - HCV & LCV. Bomb and Boys gas Calorimeters. Flue Gas Analysis using Orsat Apparatus, Exhaust Gas analyser, Enthalpy of formation, Adiabatic flame temperature.

Unit VI **Steam Generators & Boiler Draught** **[08 Hr.]**

Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features of high pressure (Power) boilers, Location, Construction and working principle of boiler, Boiler mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to IBR Act, Boiler performance Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.

Boiler Draught: Classification, Necessity of Draught, Natural draught, Determination of Height of chimney, Diameter of chimney, condition for maximum discharge, Forced draught, Induced draught, Balanced draught, Draught losses.

Books & Other Resources

Text Books

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications
2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications
3. P. L Ballaney, "Thermal Engineering", Khanna Publishers
4. C.P. Arora, "Thermodynamics", Tata McGraw Hill
5. Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers
6. M M Rathore, "Thermal Engineering", Tata McGraw-Hill

Reference Books

1. Rayner Joel, "Basic Engineering Thermodynamics", AWL-Addison Wesley
2. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill
3. G.VanWylen, R.Sonntag and C.Borgnakke, "Fundamentals of Classical Thermodynamics", John Wiley & Sons
4. Holman J.P, "Thermodynamics", McGraw Hill
5. M Achuthan, "Engineering Thermodynamics", PHI
6. Steam Tables/Data book

Guidelines for Laboratory Conduction

The student shall complete the following activity as Term Work

The Term work shall consist of successful completion of Practicals, and Industrial Visits. Oral Examination shall be based on the term work.

Practical

1. Joule's experiment to validate, first law of thermodynamics.
2. Survey of temperature sensors used in various thermal systems.
3. Determination of dryness fraction of steam using combined separating and throttling calorimeter.
4. Determination of HCV of solid or gaseous fuel using Bomb or Junker's calorimeter respectively.

5. Demonstration on Orsat Apparatus.
6. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
7. Thermodynamic Analysis of any System / Model by using any Computer Software.
8. Energy and Exergy analysis of contemporary steam generator.

Industrial Visits

Visit to any Process Industry/Plant having Boiler equipped with Accessories.

The visit report consists of

- Details about the Industry/Process Plant.
- Operational description of the Equipment with specification, its use, capacity, application etc.

202044 - Engineering Materials and Metallurgy		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Physics, Engineering Chemistry, Systems in Mechanical Engineering

Course Objectives

1. To impart fundamental knowledge of material science and engineering.
2. To establish significance of structure property relationship.
3. To explain various characterization techniques.
4. To indicate the importance of heat treatment on structure and properties of materials.
5. To explain the material selection process.

Course Outcomes

On completion of the course, learner will be able to

CO1. COMPARE crystal structures and ASSESS different lattice parameters.

CO2. CORRELATE crystal structures and imperfections in crystals with mechanical behaviour of materials.

CO3. DIFFERENTIATE and DETERMINE mechanical properties using destructive and non-destructive testing of materials.

CO4. IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.

CO5. ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.

CO6. SELECT appropriate materials for various applications.

Course Contents

Unit I — Crystal Structures and Deformation of Materials — [08 Hr.]

Crystal Structures: Study of Crystal structures BCC, FCC, HCP and lattice parameters & properties, Miller indices, Crystal imperfections, and Diffusion Mechanisms

Material Properties: Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic properties

Deformation of Materials: Elastic deformation, Plastic deformation: slip, twinning, work hardening, baushinger effect, recovery, re-crystallization and grain growth, Fracture: Types of fractures (brittle, ductile), Creep & Fatigue failures

Unit II — Material Testing and Characterization Techniques — [06 Hr.]

Destructive Testing: Impact test, Cupping test and Hardness test

Non-Destructive Testing: Eddy current test, Sonic & Ultrasonic testing, X-ray Radiography testing (Principle and Applications only)

Microscopic Techniques: Sample Preparation and etching procedure, optical microscopy, Electronic microscopy - only SEM, TEM and X-ray diffraction (Principle and Applications only)

Macroscopy: Sulphur printing, flow line observation, spark test

Unit III — Phase Diagrams and Iron-Carbon Diagram — [09 Hr.]

Solid solutions: Introduction, Types, Humerothery rule for substitutional solid solutions

Solidification: Nucleation & crystal growth, solidification of pure metals, solidification of alloys.

Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules

Iron-Carbon Diagram: Iron-carbon equilibrium diagrams in detail with emphasis in the invariant reactions

Unit IV	Heat Treatments	[08 Hr.]

Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling transformation diagrams. Retained austenite and its effect

Steps in Heat treatment and Cooling Medium

Heat Treatment Processes: Introduction, Annealing (Full annealing, Process annealing, Spheroidise annealing, isothermal annealing, stress relief annealing), Normalising, Hardening, Tempering, Austempering, Martempering, Sub-Zero Treatment, Hardenability

Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding, Carbonitriding

Unit V	Ferrous Materials	[07 Hr.]

Carbon Steel: Classification, types & their composition, properties and Industrial application

Alloy Steels: Classification of alloy steels & Effect of alloying elements, examples of alloy steels, (Stainless steel, Tool steel) sensitization of stainless steel

Designation of carbon steel and alloy steels as per IS, AISI, SAE Standards

Cast Iron: Classification, types & their composition, properties and Industrial application of (White CI, Gray CI, SG CI, Malleable Cast and alloy Cast Iron)

Microstructure and property relationship of various ferrous Materials

Unit VI	Non-Ferrous Materials	[07 Hr.]

Classification of Non-Ferrous Metals: Study of Non-ferrous alloys with Designation, Composition, Microstructure

Mechanical & other properties for Industrial Applications: Copper and its Alloys (Gilding Metal, Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze), Aluminium and its Alloy (LM5, Duralumin, Y-Alloy, Hinduminum), Nickel and its Alloys (Invar, Inconel), Titanium and its Alloys (α Alloys, α-β Alloys), Cobalt and its Alloys (Stellite Alloys, Alnico), Bearing Alloys (Classification, lead based alloys, tin based alloys), Age Hardening

Microstructure and Property relationship of various Non-ferrous Materials

Recent Material used in Additive Manufacturing: Properties, Composition and Application only

Books & Other Resources

Text Books

1. Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication.
2. William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley & Sons, Inc.

Reference Books

1. A. K. Bhargava, C.P. Sharma, "Mechanical Behaviour & Testing of Materials", P H I Learning Private Ltd.
2. Raghvan V., "Material Science & Engineering",Prentice Hall of India, New Delhi. 2003
3. Avner, S.H., "Introduction to Physical Metallurgy", Tata McGraw-Hill, 1997.
4. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd.
5. George Ellwood Dieter, "Mechanical Metallurgy", McGraw-Hill 1988
6. Smith, W.F, Hashemi, J., and Prakash, R., "Materials Science and Engineering in SI Units", Tata McGraw Hill Education Pvt. Ltd.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments, and Industrial Visits.

Practical *(Any Seven)*

1. Destructive testing - Hardness testing (Rockwell/Vickers) Hardness conversion number
2. Brinell and Poldi hardness Test

3. Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)
4. Non Destructive testing - Dye Penetrant Test/ Magnetic Particle test/ Ultrasonic Test
5. Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope
6. Observation and Drawing of Microstructure of Steels, Cast Iron of various compositions
7. Observation and Drawing of Microstructure of Non Ferrous Metals of various compositions
8. Heat Treatment of steels based on relative hardness
9. Jominy End Quench Test for hardenability

Miniature commitment or Assignments *(Any Two)*

1. Exploration of engineering Alloy (Name, composition, properties, microstructure, Heat treatment, Designation & specific applications)- One student one Alloy or material
2. Examine aspects of component form material and manufacturing process point of view (Name, Material, Drawing, Manufacturing Process, properties, microstructure, Heat treatment, & specific applications) - For example spur gear, Needle etc. One student one component
3. Creep and Fatigue Test (Virtual Lab IIT Bombay)
4. Fluorescence Microscope (Virtual Lab IIT Bombay)

Industrial Visits

To provide awareness and understanding of the course, Compulsory Industrial Visit must be arranged for the students.

The Industrial Visit must be preferably to

- Material & Metallurgy related like Engineering Cluster, NDT Lab, and Nearby NABL lab or
- Any manufacturing unit with material orientation

Student must submit a properly documented Industrial Visit Report.

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment
2. Apparatus with their detailed specifications
3. Standard ASME/ IS numbers of test procedure
4. Schematic, Layout/diagram
5. Observation table/graphs.
6. Sample calculations for one/two reading
7. Result table, Graph and Conclusions.
8. 3/4 questions related to the experiment
9. Relevance of practical in industry with recent software of image analysis

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment:

1. Theory related to the experiment
2. Apparatus with their detailed specifications
3. Schematic, Layout/diagram
4. Observation table/simulation plots/graphs
5. Sample calculations for one/two reading
6. Result table. Graph and Conclusions
7. 3/4 questions related to the experiment
8. Attach Photo of experiment or image related to Experiment

Guidelines for Lab/TW Assessment

1. There should be continuous assessment for the TW
2. Assessment must be based on understanding of theory, attentiveness during practical, and understanding
3. Session, how efficiently the student is able to do connections and get the results
4. Online evolutions of practical with objective type of Questions
5. Timely submission of journal

203156 - Electrical and Electronics Engineering

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Basic Electrical Engineering, Basic Electronics Engineering, Systems in Mechanical Engineering

Course Objectives

1. To understand Arduino IDE; an open source platform and its basic programming features
2. To interface Atmega328 based Arduino board with different devices and sensors
3. To study principle of operation of DC machines and speed control of DC motors
4. To know about three phase induction motor working and its applications
5. To get acquainted with Electric Vehicle (EV) technology and subsystems
6. To get familiar with various energy storage devices and electrical drives

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY programming concepts to UNDERSTAND role of Microprocessor and Microcontroller in embedded systems

CO2. DEVELOP interfacing of different types of sensors and other hardware devices with Atmega328 based Arduino Board

CO3. UNDERSTAND the operation of DC motor, its speed control methods and braking

CO4. DISTINGUISH between types of three phase induction motor and its characteristic features

CO5. EXPLAIN about emerging technology of Electric Vehicle (EV) and its modular subsystems

CO6. CHOOSE energy storage devices and electrical drives for EVs

Course Contents

Unit I — Introduction to Arduino — [08 Hr.]

Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Introduction to Arduino IDE- features, IDE overview, Programming concepts: variables, functions, conditional statements, Concept of GPIO in Atmega328 based Arduino board, digital input and output

Unit II — Peripheral Interface — [07 Hr.]

Interfacing of Atmega328 based Arduino board with LED and LCD/serial monitor, serial communication using Arduino IDE, Concept of ADC in Atmega328 based Arduino board, interfacing of Atmega328 based Arduino board with temperature sensor (LM35), LVDT, strain gauge

Unit III — DC Machines — [08 Hr.]

Generating and motoring action, Constructional features of a DC machine, EMF equation of DC machine and its significance in motor

Concept of torque developed by motor and it's equation, Concept of load torque, Types of loads and dynamics of motor and load combination, Characteristics of DC shunt motor, Speed control methods of DC shunt motor, Reversal of direction of rotation of DC motor, Braking in DC motor and its types, Regenerative braking in DC shunt motor

Unit IV — Three Phase Induction Motors — [07 Hr.]

Constructional features, working principle of three phase induction motor, types, torque equation, torque-slip characteristics, effect of rotor resistance on characteristics, modification in squirrel cage motor with deep bar rotor construction

Power stages, efficiency, starters (DOL starter and Star Delta starter), Methods of speed control-voltage and frequency control, variable frequency drive, applications

Unit V **Electric Vehicle (EV) Technology** **[08 Hr.]**

Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV

Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison, Challenges faced by EV technology

Subsystems and configurations of EV, Subsystems of Hybrid EV, Configurations of series, parallel and series-parallel Hybrid EV

Impact of EV on grid, Vehicle to grid technology- block diagram

Unit VI **Energy Storage Devices and Electric Drives** **[07 Hr.]**

Storage Devices: Cell construction and working of batteries like Lithium- Iron Phosphate (LFP), Lithium Nickel-Manganese-Cobalt (NMC) and Lithium- Manganese Oxide (LMO), Voltage, Impedance, Ah and Wh Capacity, Cycle Life, Energy density, Power, C-rate and safety aspects

Use of supercapacitor and hydrogen fuel cell in EVs- necessity, advantages and specifications

Factors used in selection of energy storage device in case of EVs, Vehicle Battery Management System - block diagram

Electric Drives: Factors used for selection of the electric motor in EVs

BLDC hub motor drive for EVs, characteristics and speed control of BLDC motor, three phase induction motor drive for EVs

Books & Other Resources

Text Books

1. Barret Steven F, “Arduino Microcontroller Processing for Everyone!”, 3^{rd} Ed, Morgan and Claypool Publishers
2. Michael Margolis, “Arduino Cookbook”, 2^{nd} Ed, O'Reilly Media
3. Hughes Edward, “Electrical and Electronic Technology”, Pearson Education
4. Ashfaq Husain, “Electric Machines”, 3^{rd} Ed, Dhanpat Rai & Sons
5. Bhattacharya S. K., “Electrical Machine”, 3^{rd} Ed, Tata McGraw Hill
6. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill
7. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press
8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2^{nd} Ed, CRC Press

Reference Books

1. Deshmukh Ajay, “Microcontrollers Theory and Applications”, Tata McGraw Hill
2. Massimo Banzi, “Getting Started with Arduino”, 2^{nd} Ed, Maker Media, Inc.
3. Brad Kendall, “Getting Started With Arduino: A Beginner's Guide”, Justin Pot and Angela Alcorn (Editors)
4. Lowe, “Electrical Machines”, Nelson Publications
5. [A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, 5^{th} Ed, Tata McGraw Hill
6. Pillai S. K., “A First Course on Electrical Drives”, New Age International (P) Ltd.
7. James Larminie, John Lowry, , “Electric Vehicle Technology Explained”, Wiley
8. Dhameja Sandeep, “Electric Vehicle Battery Systems”, Newnes
9. R. Krishnan,“Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press

Web References

1. www.arduino.cc *(for downloading Arduino IDE and information)*
2. www.alldatasheet.com *(for datasheets of components)*
3. https://spoken-tutorial.org/tutorial-search/ *(for video tutorials on Arduino)*
4. https://swayam.gov.in/NPTEL *(for e-learning courses and video lectures)*

Guidelines for Laboratory Conduction
The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Virtual Laboratory & Detailed Industrial Visit Report and Group Assignment using Case Study/Product Survey.

Practical - Electronics Engineering Laboratory *(Any four experiments to be performed)*

Atmega328 based Arduino board can be used for following interfaces:

1. Interfacing of LED to blink after every 1 sec
2. Display data using serial communication with PC
3. Interfacing of LCD to display given message
4. Interfacing of temperature sensor (LM35) and display output on LCD/serial monitor
5. Interfacing of strain gauge sensor to measure parameters like pressure, weight, etc., and display the measured value
6. Interfacing of LVDT sensor to measure the displacement and display the measured value

Practical - Electrical Engineering Laboratory *(Any four experiments to be performed)*

7. Demonstration of use of starters for DC motor and three phase induction motor along with understanding of specifications on name plates of these machines
8. Brake test on DC shunt motor
9. Study of power electronic converter based DC motor drive
10. Study of electrical braking of DC shunt motor (Rheostatic/ Plugging/regenerative)
11. Load test on three phase induction motor
12. Torque- speed characteristics of three phase induction motor

Assignments using Virtual Laboratory

Virtual Labs project is an initiative of the Ministry of Human Resource Development (MHRD), Government of India under the aegis of National Mission on Education through Information and Communication Technology (NMEICT). Please visit the following link for exploring experiments on Electrical Machines: http://www.vlab.co.in/broad-area-electrical-engineering

Assign following experiments by applying Virtual Labs:

1. Speed control of DC shunt motor by armature and field resistance control
2. Speed control of slip ring induction motor by rotor resistance control

Please refer http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html

Assignments using Case Study/Product Survey

Each group consisting of maximum five number of students should carry out a case study/product survey focused on various EVs available in Indian market. *Forming groups and allotment of specific task to the students group should be done at the beginning of semester so that students get sufficient time to carry out the survey and prepare a presentation.*

Students must

- Compare various models in each class.
- Study various main components of EVs
- A formal presentation on case study/product survey must be arranged before class/batch.

Industrial Visits

An industrial visit must be arranged to one of the following establishments during the semester.

The Industrial Visit must be preferably to

- Automation/Manufacturing industries
- Battery/EV Charging Stations
- Retro-fitting Workshops of ICE vehicle to EVs
- EV Service Stations

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Instructions for Laboratory Conduction

Electronics Engineering Laboratory

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.

2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them different experiments.
3. Each student in the group is supposed to execute the program.
4. The faculty should check the result of all the groups.

Electrical Engineering Laboratory

1. Check whether the MCB / ELCB / main switch is off while preparing the set-up.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For the rest of the connections, use thick wires. Do not keep the connections loose. Get it checked by the faculty / Lab Assistant.
3. Perform the experiment only in presence of faculty or Lab Assistant.
4. Do the calculations and get these checked from the faculty.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked regularly after conducting

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment.
2. Connection diagram /circuit diagram
3. Observation table
4. Sample calculations for one reading
5. Result table
6. Graph and Conclusions.
7. Data sheets of the ICs used(if any)

Guidelines for Student's Lab Journal

Electronics Engineering Laboratory

1. Title of the program should be mentioned
2. The algorithm of the program must be written
3. Flow Chart for each program has to be drawn on separate page
4. Input data has to be specified
5. Result of the program should be highlighted

Electrical Engineering Laboratory

1. Lab journal should be hand written
2. Circuit diagrams can be drawn on graph paper
3. Specifications of the instruments/machines used for conduction of practical should be mentioned in respective write-up
4. Conclusion of each experiment should be written by student at the end

Guidelines for Lab/TW/PR Assessment

1. Continuous assessment should be carried out time to time.
2. During assessment, faculty should put the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of experiment and also in the index.
3. Assess each laboratory experiment/virtual lab assignment/report of industrial visit/case study for 10 marks each as per following details:
   Attendance in practical - 02 marks
   Timely completion of journal -03 marks
   Presentation of write-up and results - 02 marks
   Depth of understanding - 03 marks
4. Maintain a continuous assessment sheet on the basis of which final TW marks can be offered.

202045 - Geometric Dimensioning and Tolerancing Lab

Teaching Scheme	Credits	Examination Scheme
Practical : 02 Hr./Week	**01** Practical : 01	Term Work : 25 Marks

Prerequisite Courses
Systems in Mechanical Engineering, Project Based Learning - I, Workshop Practise, Engineering Graphics

Course Objectives
1. To understand requirements of industrial drawings
2. To read, understand and explain basic Geometric Dimensioning & Tolerancing concepts
3. To apply various geometric and dimension tolerances based on type of fit
4. To include surface roughness symbols based on manufacturing process
5. To measure and verify position tolerances with applied material conditions
6. To understand requirements for manufacturing and assembly

Course Outcomes
On completion of the course, learner will be able to
CO1. SELECT appropriate IS and ASME standards for drawing
CO2. READ & ANALYSE variety of industrial drawings
CO3. APPLY geometric and dimensional tolerance, surface finish symbols in drawing
CO4. EVALUATE dimensional tolerance based on type of fit, etc.
CO5. SELECT an appropriate manufacturing process using DFM, DFA, etc.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 9 Practical Assignments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Industrial Visit Report and Group Assignment.

Practical *(Assignment # 1 to 6 & 10 are compulsory; Select any Two from Assignment # 7 to 9)*
The student shall complete the following Practical in laboratory. Learner will demonstrate skills to communicate drawings as per industry standards:

1. Study of drawing sheet layout, Principles of Drawing and various IS Standards & Conventions in Machine Drawing, Dimensioning practices - Terminology & Basic Rules, Styles, Conventions [02 Hr.]
2. GD&T -
   (a) Terminology, Maximum and Minimum Material conditions, Features, Rules for GD&T, Datum Control [02 Hr.]
   (b) Adding GD&T to a Design, Form Tolerances [02 Hr.]
   (c) Orientation Tolerances, Profile Tolerances [02 Hr.]
   (d) Location Tolerances, Run out Tolerances [02 Hr.]
3. Surface finish, Welding symbols [02 Hr.]
4. Study and reading of Industrial Drawings to understand standard industrial practices viz. Dimensioning, GD&T, Surface finish, welding symbols, etc. [04 Hr.]
   (a) Machine Drawing, (b) Production Drawing, (c) Part Drawing,
   (d) Assembly Drawing - (i) Assembly Drawing for Design, (ii) Assembly Drawing for Instruction Manuals, (iii) Exploded Assembly Drawing, (iv) Schematic Assembly Drawing, (v) Patent Drawing, etc.
5. Calculation of Tolerances based on Type of Fits in Assembly [02 Hr.]
6. Tolerance Stacks-Up with suitable examples [02 Hr.]
7. Design for Manufacturing (DFM) with suitable examples [02 Hr.]
8. Design for Assembly and Dis-assembly with suitable examples [02 Hr.]
9. Design for Safety with suitable examples [02 Hr.]
10. Industrial visit / Case study

Books & Other Resources
Text Books 1. Standards: ASME Y14.5 – 2018 2. Narayana, K. L., Kannaiah, P., Venkata Reddy, K., (2016), “Machine Drawing”, 2nd edition, New Age International Publishers, New Delhi, India, ISBN-13: 978-8122440546 3. Bhatt, N. D. and Panchal, V. M., (2014), “Machine Drawing”, Charotar Publishing House Pvt. Ltd, Anand, India, ISBN-13: 978-9385039232
Reference Books 1. Cogorno, G. R., (2020), "Geometric Dimensioning and Tolerancing for Mechanical Design", 3rd edition, McGraw-Hill Education 2. Blokdyk, Gerardus, (2019), "Geometric Dimensioning and Tolerancing: A Complete Guide - 2020 Edition", 5STARCooks 3. Standards: ISO/TR 23605:2018, ISO 1101:2017, SP 46, IS 15054(2001)

202046 - Audit Course - III		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course III

- Technical English For Engineers
- Entrepreneurship Development
- Developing soft skills and personality
- Design Thinking
- Foreign Language (preferably German/ Japanese)
- Science, Technology and Society

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

207002 - Engineering Mathematics - III

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Tutorial : 01Hr/Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Differential & Integral calculus, Differential equations of first order & first degree, Fourier series, Collection, classification and representation of data and Vector algebra.

Course Objectives

1. To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Laplace transform & Fourier transform, Statistical methods, Probability theory and Vector calculus.
2. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes

On completion of the course, learner will be able to

CO1. SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.

CO2. APPLY Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.

CO3. APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.

CO4. PERFORM Vector differentiation & integration, analyze the vector fields and APPLY to fluid flow problems.

CO5. SOLVE Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents

Unit I — Linear Differential Equations (LDE) and Applications — [08 Hr.]

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modelling of Mass-spring systems, Free &Forced damped and undamped systems.

Unit II — Transforms — [08 Hr.]

Laplace Transform **(LT):** LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform **(FT):** Fourier integral theorem, Fourier transform, Fourier sine & cosine transforms, Inverse Fourier Transforms.

Unit III — Statistics — [07 Hr.]

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV — Probability and Probability Distributions — [07 Hr.]

Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis: Chi-Square test, t-test.

UnitV — Vector Calculus — [08 Hr.]

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal & Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI	**Applications of Partial Differential Equations (PDE)**	**[08 Hr.]**
Basic concepts, modelling of Vibrating String, Solution of Wave equation, One and two dimensional Heat flow equations, Method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier transforms.		

Books & Other Resources

Text Books

1. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw-Hill
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, Delhi

Reference Books

1. Erwin Kreyszig, “Advanced Engineering Mathematics’, 10e, by Wiley India.
2. M. D. Greenberg, “Advanced Engineering Mathematics”, 2e, by Pearson Education.
3. Peter V. O'Neil , “Advanced Engineering Mathematics”, 7e, by Cengage Learning
4. S. L. Ross, “Differential Equations”, 3e by Wiley India.
5. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, 5e, by Elsevier Academic Press

Guidelines for Tutorial and term Work

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.The student shall complete the following activity as a Term Work Journal.

202047 - Kinematics of Machinery		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Geometric Modeling & Drafting

Course Objectives

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY kinematic analysis to simple mechanisms

CO2. ANALYZE velocity and acceleration in mechanisms by vector and graphical method

CO3. SYNTHESIZE a four bar mechanism with analytical and graphical methods

CO4. APPLY fundamentals of gear theory as a prerequisite for gear design

CO5. CONSTRUCT cam profile for given follower motion

Course Contents

Unit I — Fundamentals of Mechanism — [07 Hr.]

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and its Inversions, Double slider crank Chain and its Conversions, Mechanisms with Higher pairs, Equivalent Linkages and its Cases - Sliding Pairs in Place of Turning Pairs, Spring in Place of Turning Pairs, Cam Pair in Place of Turning Pairs

Unit II — Kinematic Analysis of Mechanisms: Analytical Method — [07 Hr.]

Analytical methods for displacement, velocity and acceleration analysis of slider crank Mechanism, Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Vector and Complex Algebra Methods. Computer-aided Kinematic Analysis of Mechanism like Slider crank and Four-Bar mechanism, Analysis of Single and Double Hook's joint

Unit III — Kinematic Analysis of Mechanisms: Graphical Method — [08 Hr.]

Displacement, velocity and acceleration analysis mechanisms by Relative Velocity Method (Mechanisms up to 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links), Coriolis component of Acceleration (Theoretical treatment only)

Unit IV — Synthesis of Mechanisms — [07 Hr.]

Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors

Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar and Single Slider Crank Mechanisms

Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's equation, Blotch synthesis

Unit V **Kinematics of Gears** **[08 Hr.]**

Gear: Classification

Spur Gear: Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis (theoretical treatment only)

Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears

Bevel Gear & Worm and Worm Wheel: Terminology, Geometrical Relationships

Gear Train: Types, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and Epicyclic gear Trains, Torque on Sun and Planetary gear Train, compound Epicyclic gear Train

Unit VI **Mechanisms in Automation Systems** **[08 Hr.]**

Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon

Automation: Introductions, Types of Automation

Method of Work Part Transport: Continuous transfer, Intermittent or Synchronous Transfer, Asynchronous transfer, Different type of transfer mechanisms - Linear transfer mechanisms and Rotary transfer mechanisms

Automated Assembly-Line: Types, Assembly line balancing Buffer Storages, Automated assembly line for car manufacturing, Artificial intelligence in automation

Books & Other Resources

Text Books

1. S. S. Rattan, “Theory of Machines”, Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Bevan T, “Theory of Machines”, Third Edition, Longman Publication
3. G. Ambekar, “Mechanism and Machine Theory”, PHI
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, “Theory of Machines and Mechanisms”, Fifth Edition, International Student Edition, Oxford

Reference Books

1. Paul E. Sandin, “Robot Mechanisms and Mechanical Devices Illustrated”, Tata McGraw Hill Publication
2. Stephen J. Derby, “Design of Automatic Machinery”, 2005, Marcel Dekker, New York
3. Neil Sclater, “Mechanisms and Mechanical Devices Sourcebook”, Fifth Edition, Tata McGraw Hill Publication
4. Ghosh Malik, “Theory of Mechanism and Machines”, East-West Pvt. Ltd.
5. Hannah and Stephans, “Mechanics of Machines”, Edward Arnolde Publication
6. R. L. Norton, “Kinematics and Dynamics of Machinery”, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, “Theory of Machines”, Pearson
8. Dr. V. P. Singh, “Theory of Machine”, Dhanpatrai and Sons
9. C. S. Sharma & Kamlesh Purohit, “Theory of Machine and Mechanism”, PHI
10. M.P. Groover, “Automation, production systems and computer-integrated manufacturing”, Prentice-Hall of India Pvt. Ltd, New Delhi

Web References

1. https://nptel.ac.in/courses/112104121/ (NPTEL1, Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur)
2. https://nptel.ac.in/courses/112/106/112106270/ (NPTEL2, Theory of Mechanism, Prof. Sujatha Srinivasan, IIT Madras)
3. https://nptel.ac.in/courses/112/105/112105268/ (NPTEL3, Kinematics of Mechanisms and Machines, Prof. Anirvan DasGupta, IIT Kharagpur)

4. https://nptel.ac.in/courses/112/105/112105236/ (NPTEL4, Mechanism and Robot Kinematics, Prof.Anirvan DasGupta, IIT Kharagpur)
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Robotics Course/Course_home_lect1.html (NPTEL5, Introduction to Robotics and Automation, IIT Bombay)

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Drawing Aids, Assignments using Software & Programming Languages, Assignments using Virtual Laboratory and Detailed Industrial Visit Report.

Practical *(Experiment # 1 is compulsory and Select any Two from Experiment # 2 to 4)*

1. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give a presentation using PPTs.
2. Speed and torque analysis of epicyclic gear train to determine holding torque.
3. To study and verify cam jump phenomenon.
4. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.

Assignments using Drawing Aids *(Experiment #1 to 3 and 6 are compulsory and Select any One from Experiment #4-5)*

Do following graphical assignments on Half Imperial drawing sheet:

1. Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom. Submit the sheet and working video of the mechanism.
2. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.
3. To solve two problems on velocity analysis using the ICR method.
4. To draw conjugate profile for any general type of gear tooth.
5. To study various types of gearboxes.
6. To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam.

Assignments using Software *(Any Three Assignments - Minimum one computer programming based and Minimum one based on use of software)*

Do following assignments by using Software or by using Coding/Programming Languages:

1. To design a simple Planer Mechanism by using any software (Geogebra, SAM, Working Model, any 3D Modelling Software, etc.)
2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Slider Crank Mechanism using Analytical Method
3. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke’s joint Mechanism using Analytical Method
4. To generate a Cam Profile using any Modelling Software (Mech Analyser, any 3D Modelling Software)
5. To synthesize the Four-Bar and Slider Crank Mechanism (Geogebra, SAM, any 2D/3D Modelling Software)
6. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for the Synthesis of Mechanism using Chebychevs spacing, Freudensteins equation and function generation

Assignments using Virtual Laboratory *(minimum Two experiments)*

Please visit the links given below for exploring experiments on Kinematics of Machinery using Virtual Laboratory. Write a Brief Reports of using Virtual Laboratory to perform following assignment:

1. Mechanics-of-Machines Lab (All Experiments), http://mm-nitk.vlabs.ac.in/index.html
2. Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
3. Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

4. Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

Industrial Visits

A Compulsory industrial visit must be arranged to industries/ establishments consisting automation and mechanization during semester to provide awareness and understanding of the course.

The Industrial Visit must be preferably to

- Manufacturing industries with Assembly-line Automation
- Sugar factory
- Bottle filling plants

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Assignments on Content beyond syllabus

Following assignments can be attempted:

1. Forward and Inverse Kinematics of 2R/2P/RP/PR Manipulators using Software (Geogebra, RoboAnalyser, Vlab, etc.)
2. Kinematic Analysis of 6 DOF Industrial Robot using Software (RoboAnalyzer, Vlab, etc.)

202048 - Applied Thermodynamics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Thermodynamics, Systems in Mechanical Engineering, Engineering Mathematics - I, Engineering Mathematics - II

Course Objectives

1. To determine COP of refrigeration cycle and study Psychrometric properties and processes.
2. To study working of engine, Actual, Fuel-Air and Air standard cycle and its Performance.
3. To understand Combustion in SI and CI engines and factors affecting performance parameters
4. To study emission from IC Engines and its controlling method, various emission norms.
5. To estimate performance parameters by conducting a test on I. C. Engines.
6. To determine performance parameters of Positive displacement compressor.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE COP of refrigeration system and ANALYZE psychrometric processes.
CO2. DISCUSS basics of engine terminology,air standard, fuel air and actual cycles.
CO3. IDENTIFY factors affecting the combustion performance of SI and CI engines.
CO4. DETERMINE performance parameters of IC Engines and emission control.
CO5. EXPLAIN working of various IC Engine systems and use of alternative fuels.
CO6. CALCULATE performance of single and multi stage reciprocating compressors and DISCUSS rotary positive displacement compressors

Course Contents

Unit I — Basics of Refrigeration and Psychrometry — [07 Hr.]

Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle (VCC), Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle (VAC), Comparison between VCC & VAC.

Psychrometry: Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.

Unit II — Introduction to Internal Combustion (IC) Engine — [06 Hr.]

IC Engine: Components and Construction details, Terminology, Classification, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.

Fuel, Air and Actual Cycle: Air-standard cycles, fuel air cycles, and actual cycles, Effects of variables on performance, various losses, and Comparison of Air standard with Fuel and Actual cycle.

Unit III — SI and CI Engines — [09 Hr.]

SI Engines: Theory of Carburetion and Types of Carburetor, Working of Simple Carburetor, Electronic Fuel Injection System, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations, Rating of fuels in SI engines, Combustion Chambers used in SI Engine.

CI Engines: Fuel Injection system, Construction and Working of Fuel Pump, Fuel Injector and Various types of Nozzle, Combustion stages in CI engines, Theory of knocking and Parameters affecting knocking, Rating of fuels in CI engines, Combustion Chambers used in CI Engines.

Unit IV — IC Engine Testing and Emission — [09 Hr.]

Engine Testing: Engine Testing Procedure, Measurement of indicated power, Brake power, fuel consumption, Air Consumption, Measurement of friction power by Willan's Line Method and Morse Test, calculation of mean effective pressure, various efficiencies, specific fuel consumption, heat balance sheet of IC Engines and performance Characteristic curves.

Emission & Control: Introduction to Indian Driving Cycle (IDC), European Driving Cycle (EDC), SI and CI Engines Emission and controlling methods, Methods to measure emission such as (Non Dispersive Infrared Red (NDIR), Flame Ionization Detector (FID), Chemiluminescent Analyzer, Smoke meter), Euro Norms and Bharat Stage Norms.

Unit V **Engine Systems and Alternative Fuels** **[07 Hr.]**

Cooling system: Air Cooling, Liquid cooling, **Lubrication system**: Objectives of lubrication system, properties of lubricant, Methods of lubrication system, **Ignition system**: battery coil ignition system, magneto ignition system, Electronics Ignition (CDI, TCI), Maximum Brake Torque (MBT) & spark advance. Supercharging and Turbo-charging.

Alternative Fuels: Bio-diesel, Ethanol, LPG, CNG and Hydrogen.

Unit VI **Compressor** **[07 Hr.]**

Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors.

Rotary Compressors: Roots blower, Vane type, Screw compressor and Scroll compressor.

Books & Other Resources

Text Books

1. Arora C. P., "Refrigeration and Air Conditioning", Tata McGraw-Hill
2. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill
3. M. L. Mathur and R.P. Sharma, "A course in Internal combustion engines", Dhanpat Rai & Co.
4. H.N. Gupta, "Fundamentals of Internal Combustion Engines", PHI Learning Pvt. Ltd.

Reference Books

1. Dossat Ray J, "Principles of refrigeration, S.I. version", Willey Eastern Ltd, 2000
2. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill
3. Domkundwar & Domkundwar, "Internal Combustion Engine", Dhanpat Rai & Co.
4. R. Yadav, "Internal Combustion Engine", Central Book Depot, Ahmedabad.
5. S.Domkundwar,C.P. Kothandaraman,A.Domkundwar,"Thermal Engineering",DhanpatRai & Co.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 of the following list must be performed. During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations and Detailed Industrial Visit Report.

Practical *(Minimum 6 Practical must be performed)*

1. Trial on Vapour Compression System
2. Trial on Vapour Absorption System
3. Trial on Air-Conditioning Test Rig.
4. Morse Test on Petrol engine.
5. Trial on Diesel engine.
6. Trial on Petrol engine.
7. Trial on variable compression ratio engine.
8. Trial on Positive Displacement Air Compressor.
9. Demonstration on Exhaust Gas Analyser and Smoke meter.

Survey *(Minimum one)*

1. Practical Survey of various fuel supply systems.
2. Practical Survey of supercharged and turbocharged engines.

Activity: *Presentation based*

Compulsory study of following topics must be done by students during semester to gain awareness and further understanding of the course and a presentation of the same should be included in the TW:

1. **Engines**:(any one) Homogeneous charge compression ignition (HCCI)/ Stratified charge

engine/Variable valve timing (VVT)/Variable geometry turbocharger (VGT), etc.

2. **Automotive Field**: (any one) Hydrogen CNG vehicles/Adaptive cruise control system/On-board diagnostic system (OBD) / Electric Battery classification/Fuel Cell vehicle/Rear driving emission (RDE) system

Industrial Visit

A Compulsory industrial visit must be arranged to automobile manufacturing or servicing.
Students must submit properly documented Detailed Industrial Visit Report in his/her own words.

202049 - Fluid Mechanics		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mechanics, Engineering Physics

Course Objectives

1. To understand basic properties of fluids.
2. To learn fluid statics and dynamics
3. To study basics of flow visualization
4. To understand Bernoulli's theorem and its applications.
5. To understand losses in flow, drag and lift forces
6. To learn to establish relation between flow parameters.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE various properties of fluid

CO2. APPLY the laws of fluid statics and concepts of buoyancy

CO3. IDENTIFY types of fluid flow and terms associated in fluid kinematics

CO4. APPLY principles of fluid dynamics to laminar flow

CO5. ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface

CO6. CONSTRUCT mathematical correlation considering dimensionless parameters, also ABLE to predict the performance of prototype using model laws

Course Contents

Unit I — Properties of Fluid — [06 Hr.]

Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, measurement of viscosity, application based numerical on viscosity-flow through pipe, lubrication, bearing, brake fluids, parallel plates, rotating shafts etc., vapor pressure surface tension, capillarity, compressibility

Unit II — Fluid Statics — [07 Hr.]

Laws of fluid statics: forces acting on fluid element, pascal’s law, hydrostatics law, hydraulic ram Pressure measurement: pressure scale, piezometer, barometer, manometer - simple, inclined, differential, micro manometer, inverted

Forces acting on surfaces immersed in fluid: total pressure and center of pressure on submerged plane surfaces, curved surface submerged in liquid including numerical on dam gate

Buoyancy: flotation, stability of bodies

Unit III — Fluid Kinematics — [08 Hr.]

Flow description methods, types of flows, velocity and acceleration fields, continuity equation in 1D & 3D flow, flow visualization (path line, stream line and streak line), stream tube, angularity, vorticity, stream function and velocity potential function, flow net

Unit IV — Fluid Dynamics — [10 Hr.]

Euler’s equation of motion differential form and Navier Stokes equation, Euler’s equation of motion along streamline, Bernoulli’s theorem and modified Bernoulli’s theorem, stagnation pressure, HGL, TEL

Flow measurement: venturimeter, orifice meter, pitot tubes, static pitot tube, introduction to coriolis flow meter, introduction to orifices, notches & weirs

Laminar flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, fixed parallel plates and Couette flow, velocity profile of turbulent flow

Unit V	Internal & External Flow	[09 Hr.]

Internal Flow: Losses - major & minor losses, hydro dynamically smooth and rough boundaries, Moody's chart, compounding of pipes & equivalent pipe, siphons, transmission of power

External Flow: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation, drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body

Unit VI	Dimensional Analysis & Similitude	[08 Hr.]

Dimensional Analysis: Introduction, system of dimensions, Dimensional homogeneity, Buckingham-Pi Theorem, repeating variables, dimensionless numbers and their physical significance

Similitude & Model Testing: Model & prototype, similarity, scaling parameters , model laws, objectives , importance and application of model studies.

Books & Other Resources

Text Books

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Potter Wiggert, "Fluid Mechanics", Cengage Learning
4. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
5. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics",Standard Book House.
6. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
7. F. M. White, "Fluid Mechanics", TATA McGraw-Hill
8. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publication

Reference Books

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press.
3. Edward Shaughnessy, Ira Katz James Schaffer, "Introduction to Fluid Mechanics",Oxford University Press

Web References

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/104/112104118/
3. https://nptel.ac.in/courses/112/105/112105269/
4. http://www.efluids.com/efluids/books/efluids_books.htm
5. http://web.mit.edu/hml/ncfmf.html
6. http://www.efluids.com/efluids/pages/edu_tools.htm
7. https://spoken-tutorial.org/tutorial-search/?search_foss=OpenFOAM&search_language=

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. During Oral, the Student is evaluated based on the completion of Practical, Assignments using Virtual Lab and Detailed Mini project / Industrial Visit Report/ Simulation of fluid flow / Programming using any suitable software.

Practical *(Experiment # 3 & 9 are compulsory; Select any One Simulation of Experiments from Experiment # 4 & 6; Perform any Eight experiments)*

1. Determination of pressure using manometers (minimum two)
2. Determination of fluid viscosity and its variation with temperature.
3. Determination of Metacentric height of floating object.
4. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
5. Draw flow net using electrical analogy apparatus to calculate discharge for rectangular / enlargement / contraction channel.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter/Notch.
8. Determination of minor/major losses through metal/non-metal pipes.

9. Mini project/Industrial visit/Simulation of fluid flow/Programming using any suitable software

Assignments using Virtual Laboratory *(Any Two Virtual Lab experiments from experiment # 1,2,5,7,8 mentioned above)*

Please visit the links given below for exploring and performing experiments on Fluid Mechanics using Virtual Laboratory. Write brief Reports using Virtual Laboratories:

1. https://eerc03-iiith.vlabs.ac.in/
2. http://fm-nitk.vlabs.ac.in/

202050 - Manufacturing Processes		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week	**03** Theory : 03	In-Semester : 30 Marks End-Semester : 70 Marks

Prerequisite Courses

Material Science and Metallurgy, Engineering Physics, Systems in Mechanical Enginering

Course Objectives

1. Describe various sand and permanent mould casting methods, procedure and mould design aspects.
2. Understand basics of metal forming processes, equipment and tooling.
3. Understand sheet metal forming operations and die design procedure.
4. Classify, describe and configure the principles of various welding techniques.
5. Understand plastic processing techniques.
6. To know about composites, its fabrication processes.

Course Outcomes

On completion of the course, learner will be able to

CO1. SELECT appropriate moulding, core making and melting practice and estimate pouring time, solidification rate and DESIGN riser size and location for sand casting process

CO2. UNDERSTAND mechanism of metal forming techniques and CALCULATE load required for flat rolling

CO3. DEMONSTRATE press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations

CO4. CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics

CO5. DIFFERENTIATE thermoplastics and thermosetting and EXPLAIN polymer processing techniques

CO6. UNDERSTAND the principle of manufacturing of fibre-reinforce composites and metal matrix composites

Course Contents

Unit I — **Casting Processes** — **[07 Hr.]**

Introduction to casting processes, Patterns: Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting

Unit II — **Metal Forming Processes** — **[08 Hr.]**

Plastic deformation. Stress-strain diagram for different types of material, Hot and Cold working, Factors affecting plastic deformation, Yield criteria, Concept of flow stress, Forming Limit diagram

Rolling Process: Rolling terminology, Friction in rolling, Calculation of rolling load

Forging: Open and closed die forging, Forging operations

Extrusion: Types, Process parameter

Wire and Tube Drawing: Wire and tube drawing process, Die profile

Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes

Unit III — **Sheet Metal Forming** — **[07 Hr.]**

Types of sheet metal operations, Press working equipment and terminology, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Bending dies, Methods of reducing forces, Formability and forming limit diagrams

Unit IV **Welding Processes** **[08 Hr.]**

Classification of joining processes, Welding terminology and types of joints

Arc Welding Processes: Principles and equipments of Single carbon arc welding, FCAW, TIG, MIG, SAW

Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding

Gas Welding and Cutting, Soldering, brazing and braze welding

Welding Metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies

Unit V **Processing of polymers** **[07 Hr.]**

Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion

Moulding: Compression moulding, Transfer moulding, Blow moulding, Rotation moulding, Injection moulding - Process and equipment

Extrusion of Plastic: Type of extruder, extrusion of film, pipe, Cable and Sheet – Principle

Pressure forming and Vacuum forming

Unit VI **Manufacturing of Composites** **[08 Hr.]**

Introduction to composites, Composite properties, Matrices, Fiber reinforcement

Composite Manufacturing Processes: Hand lay-up Process, Spray lay-up, Filament winding process, Resin transfer moulding, Pultrusion, and Compression moulding process, Vacuum impregnation process, Processing of metal matrix composites, Fabrication of ceramic matrix composites, Carbon-carbon composites, Polymer matrix and nano-composites

Books & Other Resources

Text Books

1. P. N. Rao, "Manufacturing Technology Vol. I & II" , Tata McGraw Hill Publishers
2. P. C. Sharma, "Production Engineering", Khanna Publishers

Reference Books

1. R. K. Jain, "Production Technology", Khanna Publishers
2. K. C. Chawala, "Composite Materials", Springer, ISBN 978-0387743646, ISBN 978-0387743653
3. Brent Strong, "Fundamentals of Composites Manufacturing: Materials, Methods", SME Book series

202051 - Machine Shop		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 02 Hr./Week	**01** Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 50 Marks

Prerequisite Courses

Workshop Practice

Course Objectives

1. To understand the basic procedures, types of equipment, tooling used for sand casting and metal forming processes through demonstrations and/(or) Industry visits..
2. To understand TIG/ MIG/ Resistance/Gas welding welding techniques.
3. To acquire skills to handle grinding and milling machine and to produce gear by milling.
4. To acquire skills to produce a composite part by manual process.

Course Outcomes

On completion of the course, learner will be able to

CO1. PERFORM welding using TIG/ MIG/ Resistance/Gas welding technique

CO2. MAKE Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques

CO3. PERFORM cylindrical/surface grinding operation and CALCULATE its machining time

CO4. DETERMINE number of indexing movements required and acquire skills to PRODUCE a spur gear on a horizontal milling machine

CO5. PREPARE industry visit report

CO6. UNDERSTAND procedure of plastic processing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Practical *(Select any One Practical from Practical # 1 & 2; Select any Five Practical from Practical # 3 to 8; Perform Total Six Practicals)*

1. To study and observe various stages of casting through demonstration of sand casting process from pattern making, sand mould preparation and melting and pouring of metal.
2. Visit to any foundry/ permanent mould casting industry to demonstrate various stages of casting and make a report on it.
3. A compulsory visit to any one metal forming industry out of: Rolling mill, Forging plant, Wire/Tube drawing unit and prepare a report on it.
4. A demonstration of any one welding technique out of TIG/ MIG/Resistance/Gas welding. A job drawing to be prepared by an individual institute with details of welding process parameters with weld joint design such as edge preparation, type and size of electrode used, welding current, voltage etc.
5. Manufacturing of Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques.
6. Demonstration on any one plastic component like bottle, bottle caps, machine handles etc. by injection moulding process/ by additive manufacturing process.
7. Demonstration on cylindrical grinding/surface grinding operations, measurement of surface roughness produced and estimation of machining time.
8. Demonstration on indexing mechanism. Calculation of index crank and index plate movement by simple/compound/differential indexing and manufacture of spur gear on a milling machine using indexing head.

Instructions for Laboratory Conduction

Please note following instructions regarding Laboratory Conduction:

1. Industrial Visits to be conducted by the Teaching **Faculty** (subject Teacher).
2. Demonstration of Welding machines, Surface/Cylindrical Grinding, Milling machine, Indexing head and calculation of indexing to be taught by a **subject Teacher in Practical slot**.

202052 - Project Based Learning - II

Teaching Scheme	Credits	Examination Scheme
Practical : 04 Hr./Week	**02** Practical : 02	Term Work : 50 Marks

Preamble

Currently, engineering education is undergoing significant structural changes worldwide. The rapidly evolving technological landscape forces educators to constantly reassess the content of engineering curricula in the context of emerging fields and with a multidisciplinary focus. In this process, it is necessary to devise, implement and evaluate innovative pedagogical approaches for the incorporation of these novel subjects into the educational programs without compromising the cultivation of the traditional skills. In this context, the educational community is showing rapidly rising interest in project-based learning approaches.

The mainstream engineering education follows traditional classroom teaching, in which the major focus is mainly on the lecture and the student has very little (if any) choice on the learning process. However rapid development in engineering and technology requires adopting a teaching approach that would assist students not only in developing a core set of industry relevant skills, but also enable them to adapt to changes in their professional career.

Course Objectives

1. To emphasize project based learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent and group learning by solving real world problems with the help of available resources.
3. To be able to develop applications based on the fundamentals of mechanical engineering by possibly applying previously acquired knowledge.
4. To get practical experience in all steps in the life cycle of the development of mechanical systems: specification, design, implementation, and testing.
5. To be able to select and utilize appropriate concepts of mechanical engineering to design and analyze selected mechanical system.

Course Outcomes

On completion of the course, learner will be able to

CO1. IDENTIFY the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aims and objectives.

CO2. ANALYZE the results and arrive at valid conclusions.

CO3. PROPOSE a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.

CO4. CONTRIBUTE to society through proposed solutions by strictly following professional ethics and safety measures.

CO5. USE of technology in proposed work and demonstrate learning in oral and written form.

CO6. DEVELOP ability to work as an individual and as a team member.

Group Structure

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 5 (five) to 6 (six) students in each class
2. A supervisor/mentor teacher is assigned to 3-4 groups or one batch

Project Selection

The project can be selected by undertaking a survey of journal papers, patents or field visit (A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific). The problem shall consist of following facets: feasibility of arriving at a solution, analyzing the problem, design and development of the system (hardware or virtual).

There are no commonly shared criteria/ guidelines for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity undertaken.

Solution to problem-based projects through ***"learning by doing"*** is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students" wandering within different disciplines and professional environments. As stated in the preamble as the world has adapted and propagated multidisciplinary approach, hence the proposed project activity preferably should not be restricted to only mechanical domain specific projects rather should be Interdisciplinary in nature. However the chosen problem should be integration of other streams of engineering with Mechanical engineering.

Although in a genuine case 100% software/ virtual project topic may be allowed.

Ethical Practices, teamwork and project management:

Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation

In order to make our engineering graduates capable of preparing effective documentation, it is required for the students to learn the effective writing skills. The PBL final report is expected to consist of the Literature Survey, Problem Statement, Aim and Objectives, System Block Diagram, System Implementation Details, Discussion and Analysis of Results, Conclusion, System Limitations and Future Scope. Many freely available software tools (for instance Mendley (Elsevier), Grammarly) are expected to be used during the preparation of PBL synopsis and final report. It is expected that the PBL guides/mentors shall teach students about utilizing valid sources of information (such as reference papers, books, magazines, etc) related to their PBL topic.

Evaluation & Continuous Assessment

The institution/head shall be committed to ensuring the effective and rigorous implementation of the idea of project based learning. Progress of PBL shall be monitored regularly on a weekly basis. Weekly review of the work shall be necessary. During the process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

The effectiveness of the concept PBL lies in rigorous and continuous assessment and evaluation of the student performance. It is recommended that all activities are required to be recorded regularly. A regular assessment of PBL work is required to be maintained at the department in PBL log book by students. It is expected that the PBL log book must include following:

1. Information of students and guide
2. Weekly monitoring by the PBL guide,
3. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC).

The PEC structure shall consist of Head of the department, 1/2 senior faculties of the department and one industry expert (optional). Continuous Assessment Sheet (CAS) is to be maintained by the department.

Recommended parameters for assessment, evaluation and weightage

1. Idea Inception (kind of survey). (10%)
2. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
3. Attended reviews, poster presentation and model exhibition. (10%)

4. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
5. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
6. Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small applications using Arduino, design of control systems, development of various systems/ subsystems of BAJA/SUPRA/Robots/GoKart/ Sunrisers/Hackathon/ application development and similar activities/ System performance and analysis) (40%)
7. Participation in various competitions/ publication/ copyright/ patent) (10%)

Learning Resources

Reference Books / Research Articles

1. John Larmer, John R. Mergendoller, and Suzie Boss, “Setting the Standard for Project Based Learning”
2. John Larmer and Suzie Boss, “Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences”
3. Erin M. Murphy and Ross Cooper, “Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry”

Web resources

1. https://www.edutopia.org/project-based-learning
2. www.howstuffworks.com
3. https://www.pblworks.org/
4. www.wikipedia.org

202053 - Audit Course - IV		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course IV

- Language & Mind Emotional Intelligence
- Advanced Foreign Language (preferably German/ Japanese)
- Human Behaviour
- Speaking Effectively
- Business Ethics
- Technical writing/ Research writing

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the mark sheet.

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
For
Third Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering
(2019 Course)
Board of Studies – Mechanical and Automobile Engineering
(With Effect from Academic Year 2021-22)

Savitribai Phule Pune University

Board of Studies - Automobile and Mechanical Engineering

Undergraduate Program - Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
Semester-V														
302041	Numerical & Statistical Methods	3	-	1	30	70	25	-	-	125	3	-	1	4
302042	Heat & Mass Transfer	3	2	-	30	70	-	50	-	150	3	1	-	4
302043	Design of Machine Elements	3	2	-	30	70	-	-	25	125	3	1	-	4
302044	Mechatronics	3	2	-	30	70	-	-	25	125	3	1	-	4
302045	Elective I	3	-	-	30	70	-	-	-	100	3	-	-	3
302046	Digital Manufacturing Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302047	Skill Development	-	2	-	-	-	25	-	-	25	-	1	-	1
302048	Audit course - V$	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**1**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**5**	**1**	**21**
Semester-VI														
302049	Artificial Intelligence &Machine Learning	3	2	-	30	70	-	-	25	125	3	1	-	4
302050	Computer Aided Engineering	3	2	-	30	70	-	50	-	150	3	1	-	4
302051	Design of Transmission Systems	3	2	-	30	70	-	-	25	125	3	1	-	4
302052	Elective II	3	-	-	30	70	-	-	-	100	3	-	-	3
302053	Measurement Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302054	Fluid Power &Control Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302055	Internship/Mini project *	-	4	-	-	-	100	-	-	100	-	4	-	4
302056	Audit course - VI$	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**14**	**-**	**120**	**280**	**200**	**50**	**50**	**700**	**12**	**9**	**-**	**21**

Elective-I		**Elective-II**	
302045-A	Advanced Forming & Joining Processes	302052-A	Composite Materials
302045-B	Machining Science & Technology	302052-B	Surface Engineering

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam, **TW**: Term Work, **OR**: Oral

Note: Interested students of TE (Automobile Engineering and Mechanical Engineering) can opt for any one of the audit course from the list of audit courses prescribed by BOS (Automobile and Mechanical Engineering)

Instructions:

- Practical/Tutorial must be conducted in FOUR batches per division only.
- Minimum number of Experiments/Assignments in PR/Tutorial shall be carried out **as mentioned in the syllabi** of respective courses.
- Assessment of tutorial work has to be carried out similar to term-work. The Grade cum marks for Tutorial and Term-work shall be awarded on the basis of **continuous evaluation.**
- $Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

302041: Numerical and Statistical Methods					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial	**1Hr./Week**	**Tutorial**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**

Prerequisites: System of linear equations, Partial differentiation, Statistics, Probability, Problem solving and programming.

Course Objectives:

1. **UNDERSTAND** applications of systems of equations and solve mechanical engineering applications.
2. **APPLY** differential equations to solve the applications in the domain of fluid mechanics, structural, etc.
3. **LEARN** numerical integration techniques for engineering applications.
4. **COMPARE** the system's behavior for the experimental data.
5. **INTERPRET** Statistical measures for quantitative data.
6. **ANALYZE** datasets using probability theory and linear algebra.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **SOLVE** system of equations using direct and iterative numerical methods.
CO2: **ESTIMATE** solutions for differential equations using numerical techniques.
CO3: **DEVELOP** solution for engineering applications with numerical integration.
CO4: **DESIGN** and **CREATE** a model using a curve fitting and regression analysis.
CO5: **APPLY** statistical Technique for quantitative data analysis.
CO6: **DEMONSTRATE** the data, using the concepts of probability and linear algebra.

Course Contents

Unit 1	**Roots of Equation and Simultaneous Equations**	**07 Hrs.**

Roots of Equation: Bracketing method and Newton-Raphson method
Solution of simultaneous equations: Gauss Elimination Method with Partial pivoting, Gauss-Seidel method, Thomas algorithm for Tri-diagonal Matrix.

Unit 2	**Numerical Solution of Differential Equations**	**08 Hrs.**

Ordinary Differential Equations [ODE]: Taylor series method, Euler Method, Runge-Kutta 4th order. Simultaneous equations using Runge-Kutta 2nd order method.
Partial Differential Equations [PDE]: Finite difference method, Simple Laplace method, PDE's Parabolic explicit solution, Elliptic explicit solution.

Unit3	**Numerical Integration**	**06 Hrs.**

Numerical Integration (1D): Trapezoidal rule, Simpson's 1/3rdRule, Simpson's3/8thRule, Gauss Quadrature2-point and 3-point method.
Double Integration: Trapezoidal rule, Simpson's 1/3rdRule.

Unit 4	Curve Fitting and Regression Analysis	08 Hrs.
Curve Fitting: Least square technique- first order, power equation, exponential equation and quadratic equation. **Regression Analysis:** Linear regression, Nonlinear regression, Multiple regressions, Polynomial regression. Lagrange's interpolation, Numerical interpolation and differentiation using Newton's forward method, inverse interpolation (Lagrange's method only).		
Unit 5	**Statistics**	**08 Hrs.**
Measures of central tendency: mean, median, mode. Measurement of variability and dispersion: Standard deviation, standard error, variance, range. Measure of shape: skewness, kurtosis Statistical diagram: scattered diagram, histogram, pie charts, and measure of association between two variables. Correlation: Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations.		
Unit 6	**Probability and Linear Algebra**	**08 Hrs.**
Probability: Joint, conditional and marginal probability, Bayes' theorem, independence, theorem of total probability, expectation and variance, random variables. Probability distributions: Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Normal and Chi square. **Linear algebra:** Review of matrix operations, vector and vector spaces, linear mapping.		

Books and other resources

Text Books:

1. Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
2. B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication.
3. B. S. Grewal, 'Higher Engineering Mathematics', Khanna Publication.

References Books:

1. Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley India
2. Joe D. Hoffman, 'Numerical Methods for Engineers and Scientists', CRC Press
3. Sheldon M. Ross, 'Introduction to Probability and Statistics for Engineers and Scientists', 5e, by Elsevier Academic Press
4. Deisentoth, Faisal, Ong, 'Mathematics for machine learning', Cambridge University Press.
5. Kandasamy, 'Numerical methods', S Chand.
6. Jason Brownlee, 'Statistical Methods for Machine Learning', Machine learning Mastery.

Web References:

1. http://nptel.ac.in/courses/111101003/
2. http://nptel.ac.in/courses/111105038/
3. http://nptel.ac.in/courses/111107063/
4. http://nptel.ac.in/courses/111105041/
5. http://nptel.ac.in/courses/111104079/
6. https://www.analyticsvidhya.com/

List of Tutorials
Term Work shall consist of: **Group A – (Any three programs using suitable programming language)** 1. Roots of equation 2. Simultaneous equations 3. Ordinary differential equation 4. Partial differential equation 5. Numerical Integration **Group B (Any three programs for simple dataset using suitable programing)** 6. Curve fitting using least square technique 7. Regression analysis 8. Determine statistical measures 9. Probability distribution **Group C (Mandatory)** 10. One program based mini project using mechanical engineering application dataset **Note: Tutorials shall be mandatorily conducted in the computer laboratory.**

302042: Heat and Mass Transfer					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Practical	**50 Marks**

Prerequisites: First and Second Law of Thermodynamics, Fluid properties, Continuity equation, Differential and Integral Calculus, Ordinary differential and Partial Differential Equations, Numerical solution for Differential Equations.

Course Objectives:

1. **IDENTIFY** the laws for different modes of heat transfer.
2. **UNDERSTAND** the properties and economics of thermal insulation and **ANALYZE** heat transfer through fins and thermal systems with lumped heat capacitance.
3. **ANALYZE** the natural and forced convective mode of heat transfer in various geometric configurations.
4. **UNDERSTAND AND REALIZE** various laws with their interrelations and analyze Radiation heat transfer in black and grey bodies/surfaces with or without radiation shields.
5. **UNDERSTAND** the fundamentals and laws of mass transfer and its applications.
6. **ANALYZE** various performance parameters for existing heat exchanger and **DEVELOP** methodologies for designing a heat exchanger under prescribed conditions and for a particular application, with references TEMA standards

Course Outcomes: On completion of the course, learner will be able to

CO1. **ANALYZE** & **APPLY** the modes of heat transfer equations for one dimensional thermal system.

CO2. **DESIGN a** thermal system considering fins, thermal insulation and & Transient heat conduction.

CO3. **EVALUATE** the heat transfer rate in natural and forced convection & validate with experimentation results.

CO4. **INTERPRET** heat transfer by radiation between objects with simple geometries, for black and grey surfaces.

CO5. **ABILITY** to analyze the rate of mass transfer using Fick's Law of Diffusion and understands mass diffusion in different coordinate systems.

CO6. **DESIGN & ANALYSIS** of heat transfer equipments and investigation of its performance.

Course Contents

Unit 1	Fundamentals of Heat Transfer	08 Hrs.

Basic Concepts: Different Modes and Laws of heat transfer, 3-D heat conduction equation in Cartesian coordinates (with derivation), and its simplified equations, simplified equations in cylindrical and spherical coordinates (simplified equations, no derivation) thermal conductivity,

thermal diffusivity, electrical analogy, Thermal contact Resistance.
Boundary and initial conditions: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition.
1-D steady state heat conduction without and with heat generation: Heat conduction without heat generation in plane wall, composite wall, composite cylinder, composite sphere. Heat conduction with heat generation in Plane wall, Cylinder and Sphere with different boundary conditions.

Unit 2	**Heat Transfer through Extended Surfaces & Transient Heat Conduction**	**08 Hrs.**

Thermal Insulation – Critical thickness of insulation, Types and properties of insulating materials, Safety considerations in thermal insulation, Economic and cost considerations, Payback period, Numerical on payback period.
Heat transfer through extended surfaces: Types of fins and its applications, Governing Equation for constant cross sectional area fins, Solution for infinitely long fin (with derivation), adequately long fin with insulated end tip and short fins (no derivation), Fin Efficiency & Effectiveness of fins, estimation of error in Temperature measurement by thermometer.
Transient heat conduction: Validity and criteria of lumped system analysis, Biot Number, Fourier Number, Time Constant and Response of thermocouple, Use of Heisler Charts for plane wall, cylinder and sphere

Unit 3	**Convection**	**08 Hrs.**

Principles of Convection: Local and average heat transfer coefficient, Hydrodynamic and Thermal boundary layer for a flat plate and pipe flow.
Forced Convection: Physical significance of non-dimensional numbers, Empirical correlations for flat plate, pipe flow, and flow across cylinders, spheres, tube banks.
Free Convection: Physical significance of non-dimensional numbers, Free convection from a vertical, horizontal surface, cylinder and sphere. Mixed Convection
Boiling and Condensation: Types of boiling, Regimes of pool boiling, Film wise condensation, Drop wise condensation (No Numerical treatment), Critical heat flux.

Unit 4	**Radiation**	**07 Hrs.**

Thermal Radiation; definition of various terms used in radiation mode; Stefan-Boltzmann law, Kirchhoff's law, Planck's law and Wein's displacement law. Intensity of radiation and solid angle; Lambert's law; Radiation heat exchange between two black surfaces, configuration or view factor. Radiation heat exchange between grey surfaces, Electrical analogy for radiation, Radiation shields, Numerical.

Unit 5	**Mass Transfer**	**07 Hrs.**

Physical origins, applications of mass transfer, Mixture Composition, Phase diagram, Fick's Law of Diffusion with numerical treatment, Restrictive Conditions, Mass diffusion coefficient, Conservation of Species,
The Mass Diffusion equation – Cartesian coordinates deviation, cylindrical coordinates and Spherical coordinates (no derivation), Boundary and initial conditions.

Unit 6:	Heat Exchangers and Equipment Design	07 Hrs.

Heat Exchangers: Classification and applications of heat exchangers, Heat exchanger analysis – LMTD for parallel and counter flow heat exchangers, Effectiveness– NTU method for parallel and counter flow heat exchangers, cross flow heat exchangers, LMTD correction factor, Heat Pipe, Introduction to electronic cooling - Active and passive methods of augmented heat transfer.

Process Equipment Design: Condenser Design, Introduction to TEMA standards, Design considerations for heat exchangers, Materials of construction and corrosion, Temperature effects, Radiation effects, Economic consideration, Condenser and Heat exchanger design and performance calculations, Design of shell and tube type Heat Exchanger

Books & Other Resources

Text Books:

1. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
4. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. Joshi's Process Equipment Design, by V.V. Mahajani , S.B. Umarji ,Trinity Press

Reference Books:

1. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
2. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
3. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.
4. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
5. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
6. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
7. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
8. B.K. Dutta, Heat Transfer-Principles and Applications, PHI.
9. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science.
10. Process heat Transfer, D. Q. Kern, Wiley Publication

NPTEL Links:

E books: Links to be provided

1. https://libgen.is
2. http://libgen.li/item/index.php?md5=314BFA11A24C3C1ACFDED2B5AB88E5E9

Links of NPTEL / related videos

1. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
2. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
3. https://www.youtube.com/watch?v=J_zqQcncAu4&index=3&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3
4. https://www.youtube.com/watch?v=SNnd0f3xXlg&list=PLpCr5N2IS7Nmu22MOgDWOr0s

SlIpUNUz3&index=11

5. https://www.youtube.com/watch?v=SNnd0f3xXlg&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3&index=11
6. https://www.youtube.com/watch?v=lnFjt30goiY&index=18&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Complete **eight** experiments and **two** assignments (Sr. no.10 to 13).

1. Determination of Thermal Conductivity of insulating powder.
2. Determination of Thermal Conductivity of metal rod.
3. Determination of local and average heat transfer coefficient in Natural Convection.
4. Determination of local and average heat transfer coefficient in Forced Convection.
5. Determination of temperature distribution, fin efficiency in Natural / Forced Convection.
6. Determination of Emissivity of a Test surface.
7. Determination of Stefan Boltzmann Constant.
8. Determination of heat transfer, overall heat transfer coefficient and effectiveness of Plate Heat Exchanger.
9. Study of Pool boiling phenomenon and determination of Critical Heat Flux (CHF).
10. Assignment to solve transient heat transfer problem using Heisler and Grober Charts.
11. Design of heat exchanger for any simple application.
12. Industrial visit to heat treatment industry/ heat exchanger manufacturing industry.
13. Demonstration of dropwise and filmwise condensation.
14. Virtual laboratory: study of the performance of heat exchanger /study of variation of Thermal Conductivity.

Link for Virtual Lab: - https://www.vlab.co.in/

302043: Design of Machine Elements					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: The basics of material elastic behavior, stress, strain, its relationship, failure modes, different theories of failure and its applications. The design cycle, basis of design considerations like strength, rigidity, manufacture, assembly and cost, standards and codes. The preferred sizes and series, tolerances and types of fits. Construction of SMD and BMD. Roots of equations, Interpolation rule.

Course Objectives:

1. **UNDERSTAND** the various design considerations, design procedure and select materials for a specific application
2. **CALCULATE** the stresses in machine components due to various types of loads and failure
3. **ANALYZE** machine components subjected to variable loading for finite and infinite life
4. **DESIGN** various machine components such as shafts, couplings, keys, screws, joints, springs

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DESIGN AND ANALYZE** the cotter and knuckle Joints, levers and components subjected to eccentric loading.

CO2. **DESIGN** shafts, keys and couplings under static loading conditions.

CO3. **ANALYZE** different stresses in power screws and **APPLY** those in the procedure to design screw jack.

CO4. **EVALUATE** dimensions of machine components under fluctuating loads.

CO5. **EVALUATE & INTERPRET** the stress developed on the different type of welded and threaded joints.

CO6. **APPLY** the design and development procedure for different types of springs.

Course Contents

Unit 1	**Design of Simple Machine Elements**	**08 Hrs.**

Factor of safety, Selection of Factor of Safety, Service factor, Design of Cotter joint, Knuckle joint, Design of hand / foot lever, lever for safety valve, bell crank lever, Design of components subjected to eccentric loading.

Unit 2	**Design of Shafts, Keys and Couplings**	**08 Hrs.**

Shaft design on the Strength basis, torsional rigidity basis and lateral rigidity basis, Design of shaft as per A.S.M.E. code. Design of square and rectangular keys, Kennedy key and splines. Design of Flange Coupling and Bushed-Pin Flexible Coupling.

Unit 3	**Design of Power Screws**	**07 Hrs.**
Terminology of Power Screw, Torque analysis and Design of power screws with square and trapezoidal threads, Collar friction torque, Self-locking screw, Efficiency of square threaded screw, Efficiency of self-locking screw, Design of screw, nuts and C-Clamp. Design of screw jack, Differential and Compound Screw and Re-circulating Ball Screw (Theoretical treatment only).		
Unit 4	**Design against Fluctuating loads**	**07 Hrs.**
Stress concentration and its factors, Reduction of stress concentration factors, fluctuating stresses, fatigue failures, endurance limit, S-N curve, Notch sensitivity, Endurance limit, Endurance strength modifying factors, Reversed stresses – Design for Finite and Infinite life, Cumulative damage in fatigue failure, Soderberg, Gerber, Goodman Lines, Modified Goodman diagrams, Fatigue design under combined stresses:- (Theoretical treatment only.)		
Unit 5	**Threaded and Welded joints**	**08 Hrs.**
Introduction to threaded joints, Bolts of uniform strength, locking devices, eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base. Introduction to welded joints, Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments.		
Unit 6	**Design of Springs**	**07 Hrs.**
Types and applications of springs, Stress and deflection equations for helical compression Springs, Springs in series and parallel, Design of helical springs, concentric helical springs, surge in spring, Design of Multi-leaf springs, Nipping of Leaf springs, Shot Peening.		

Books and other resources

Text Books:

1. Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
2. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.

References Books:

1. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
2. Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons.
3. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
4. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
5. Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series.
6. C. S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learing Pvt. Ltd.
7. D. K. Aggarwal & P. C. Sharma, Machine Design, S.K Kataria and Sons.
8. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learing Pvt. Ltd.
9. Design Data - P.S.G. College of Technology, Coimbatore.
10. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.

Term Work

The student shall complete the following activity as a Term Work;
The term work shall consist of three design projects. The design project shall consist of assembly drawing, with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of maximum four students. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components should be submitted in a separate file. Design data book shall be referred for selection of materials and standard components for given loading conditions. All three design projects should be carried out using suitable software.

Project 1: - Cotter joint/ knuckle joint/turn buckle for a specified application.

Project 2: - Bush Pin Flexible Coupling for specified application.

Project 3: - Bottle type/toggle jack for vehicles.

OR

Project 3: - A Design Project to develop and apply the knowledge of Machine Design and drafting software for any mechanical system on the basis of: (1) Idea generation, (2) Creativity, Reliability and safety, (3) Design parts of the system (4) Ergonomic Considerations (5) Use of International standards.

Web References:

	UNIT 1: Design of Simple Machine Elements	
Sr. No	**Topic Title**	**NPTEL video Link**
1	Factor of safety, Selection of Factor of Safety, Service factor	https://www.youtube.com/watch?v=ofmbhbVCUqI&list=PL3D4EECEFAA99D9BE&index=3
2	Design of components subjected to eccentric loading.	https://www.youtube.com/watch?v=__py5xbKHGA
	UNIT 2: Design of Shafts, Keys and Couplings	
3	Design of shaft as per A.S.M.E. code	https://www.youtube.com/watch?v=SL21aDqgs8Q
4	Design of a C-Clamp. Design of screw jack,	https://youtu.be/PEKfS2Q1WqM https://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19
5	Differential and Compound Screw and Re-circulating Ball Screw	https://www.youtube.com/watch?v=TPURJnlekeo
	UNIT 4: Design against Fluctuating Loads	
6	Cumulative damage in fatigue failure,	https://www.youtube.com/watch?v=WRoPQGE0WdI
7	Soderberg, Gerber, Goodman Lines, Modified Goodman Diagrams	https://www.youtube.com/watch?v=WRoPQGE0WdI
8	Fatigue design under combined stresses	https://www.youtube.com/watch?v=WRoPQGE0WdI

UNIT 5: Threaded and Welded joints		
9	Eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt	https://www.youtube.com/watch?v=__py5xbKHGA https://www.youtube.com/watch?v=YZYcMtkZiDY
10	Eccentric load on circular base	https://www.youtube.com/watch?v=__py5xbKHGA
11	Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments	https://www.youtube.com/watch?v=__py5xbKHGA https://www.youtube.com/watch?v=YZYcMtkZiDY
UNIT 6: Design of Springs		
12	Surge in spring	https://www.youtube.com/watch?v=tTBnW5gAieM
13	Shot Peening.	https://www.youtube.com/watch?v=46quOD7V-cQ
14	Design of Multi-leaf	https://youtu.be/T4IgtIkBnOo

302044: Mechatronics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Basics of Electrical components, Binary to Decimal Conversion, Data communication Module, Op amp Circuits, Linear Algebra, Laplace Transformation method, Logic gates.

Course Objectives:

1. **UNDERSTAND** the key elements of mechatronics, principle of sensor and its characteristics.
2. **UNDERSTAND** the concept of signal processing and use of interfacing systems such as ADC, DAC, Digital I/O.
3. **UNDERSTAND** the block diagram representation and concept of transfer function.
4. **UNDERSTAND** the system modeling and analysis in frequency domain.
5. **UNDERSTAND** the system modeling and analysis in time domain, controller modes and its industrial applications..
6. **UTILIZE** the concepts of PLC system and its ladder programming and significance of PLC system in industrial application.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEFINE** key elements of mechatronics, principle of sensor and its characteristics.

CO2. **UTILIZE** concept of signal processing and **MAKE** use of interfacing systems such as ADC, DAC, Digital I/O.

CO3. **DETERMINE** the transfer function by using block diagram reduction technique.

CO4. **EVALUATE** Poles and Zero, frequency domain parameter for mathematical modeling for mechanical system.

CO5. **APPLY** the concept of different controller modes to an industrial application.

CO6. **DEVELOP** the ladder programming for industrial application.

Course Contents

Unit 1	**Introduction to Mechatronics, Sensors & Actuators**	**07 Hrs.**

Introduction to Mechatronics and its Applications Measurement Characteristics (Static/Dynamic),
Sensors: Types of sensors; Motion Sensors – Encoder (Absolute & incremental), Lidar, Eddy Current, Proximity (Optical, Inductive, Capacitive), MEMS Accelerometer;
Temperature sensor –Pyrometer, Infrared Thermometer; Force / Pressure Sensors – Strain gauges, Piezoelectric sensor; Flow sensors – Electromagnetic, Ultrasonic, Hot-wire anemometer; Color sensor – RGB type; Biosensors – Enzyme, ECG, EMG
Actuators: Servo motor; Hydraulic and Pneumatic (must be restricted to classification and working of one type of linear and rotary actuator); linear electrical actuators Selection of Sensor & Actuator

Unit 2	Data Acquisition and Signal Communication	08 Hrs.
Signal Communication: Serial, Parallel; Synchronous, Asynchronous Introduction to DAQ, Types, Components of a Data Acquisition System (Sensor, Signal conditioning, processing, controlling and storage/display/action) Data Acquisition: Signal collection, Signal conditioning – Isolation& Filtering, Amplification, Sampling, Aliasing, Sample and hold circuit, Quantization, Analog-to-digital converters (4 bit Successive Approximation type ADC), Digital-to-Analog converters (4 bit R2R type DAC), Data storage Applications: DAQ in Household ,Digital Pressure Gauge, Digital Flow measurement, DVB Digital Video Broadcast, AM/FM		
Unit 3	**Control systems & transfer function based modelling**	**07 Hrs.**
Introduction to control systems, need, Types- Open and Closed loop, Concept of Transfer Function, Block Diagram & Reduction principles and problems; Applications (Household, Automotive, Industrial shop floor) Transfer Function based modeling of Mechanical, Thermal and Fluid system; Concept of Poles & Zeros; Pole zero plot, Stability Analysis using Routh Hurwitz Criterion (Numerical Approach)		
Unit 4	**Time and Frequency Domain Analysis**	**08 Hrs.**
Time Domain Analysis – Unit step Response analysis via Transient response specifications (Percentage overshoot, Rise time, Delay time, Steady state error etc.) Frequency Domain Analysis – Frequency Domain Parameters - Natural Frequency, Damping Frequency and Damping Factor; Mapping of Pole Zero plot with damping factor, natural frequency and unit step response ; Introduction to Bode Plot, Gain Margin, Phase Margin		
Unit 5	**Controllers**	**07 Hrs.**
Introduction to controllers, Need for Control, Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems in parallel form; (Numerical approach), Feed forward anticipatory control Manual tuning of PID control, Ziegler–Nichols method Applications: Electro–Hydraulic/Pneumatic Control, Automotive Control		
Unit 6	**Programmable Logic Controller (PLC)**	**08 Hrs.**
Introduction to PLC; Architecture of PLC; Selection of PLC; Ladder Logic programming for different types of logic gates; Latching; Timers, Counters; PLC control of Hydraulics / Pneumatics / Mechatronics systems involving timing and counting operations.		
Books and other resources		
Text Books: 1. William Bolton, Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering, 6th Ed, 2019 2. K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008		
References Books: 1. Alciatore and Histand, Introduction to Mechatronics and Measurement Systems, 5th Ed, 2019 2. Bishop (Editor),Mechatronics – An Introduction CRC 2006 3. Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi 4. C.D.Johnson, Process Control Instrumentation Technology, Prentice Hall,New Delhi 5. Bolton, Programmable Logic Controller, 4th Ed, Newnes, 2006		

Web References:

1. https://www.elprocus.com/what-is-a-biosensor-types-of-biosensors-and-applications/
2. https://www.elprocus.com/color-sensor-working-and-applications/
3. https://www.youtube.com/watch?v=kbjCGGTXqUo&ab_channel=Controlengineering
4. https://youtu.be/clTA0pONnMs?list=PLHMDN3JFtE5wEz95H2XuzRaafK3fUsaki
5. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-12(SS)%20(IA&C)%20((EE)NPTEL).pdf
6. https://nptel.ac.in/content/storage2/courses/112104158/lecture5.pdf

Term Work

The Term work shall consist of completion of Practical, Self-learning Study Assignments and Presentations. Oral examination shall be based on the Term work undertaken during the semester.

Practical (**Any one** experiments out of experiment no **1 to 3** from the following list whereas experiment no. **4 to 10** are mandatory).

1. Experiment on measurement of temperature using suitable sensor.
2. Experiment on measurement of load using suitable sensor.
3. Experiment on measurement of displacement using suitable sensor.
4. Development of a data acquisition / mechatronics system using low cost open source hardware and software.
5. Experiment on interfacing of suitable sensor and actuator with DAQ.
6. Modeling and analysis of mechanical system and its verification using suitable simulation software.
7. PID control of Mechanical System using suitable simulation software and experimental verification (verification only if experimental setup is available).
8. Ladder Logic Simulation of suitable application.
9. Demonstration of PLC controlled electro hydraulic / elector pneumatic circuit.
10. Industrial visit to understand integration and application of Mechatronics.

Assignments:

1. Application of Sensors and Actuators in Health Science and Selection of Suitable Sensor and Actuator.
2. Block Diagram Representation of Feedback Control System and determination of Closed Loop Transfer Function.

302045-A: Advanced Forming & Joining Processes					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite Courses: Manufacturing Processes, Engineering Materials and Metallurgy, Machine shop

Course Objectives:

1. **UNDERSTAND** advances in sheet metal forming operations
2. **UNDERSTAND** the advanced special metal forming processes.
3. **UNDERSTAND** weld metallurgy and weld characterization techniques.
4. **UNDERSTAND** and describe various advanced solid state welding processes.
5. **CLASSIFY AND DESCRIBE** various advanced welding processes.
6. **KNOW** about sustainable manufacturing and its role in manufacturing industry

Course Outcomes:

On completion of the course, learner will be able to

CO1. **ANALYSE** the effect of friction in metal forming deep drawing and IDENTIFICATION of surface defects and their remedies in deep drawing operations

CO2. **ASSESS** the parameters for special forming operation and SELECT appropriate special forming operation for particular applications

CO3. **ANALYSE** the effect of HAZ on microstructure and mechanical properties of materials

CO4. **CLASSIFY** various solid state welding process and **SELECT** suitable welding processes for particular applications

CO5. **CLASSIFY** various advanced welding process and **SELECT** suitable welding processes for particular applications.

CO6. **INTERPRET** the principles of sustainable manufacturing and its role in manufacturing industry.

Course Contents

Unit 1	**Mechanics of Sheet Metal Forming**	**08 Hrs.**

Theory of plasticity – yield criteria-work of plastic deformation- Sheet Metal Forming-Formability studies-conventional processes, Effect of friction in forming operation, Experimental techniques of evaluation of friction in metal forming, deep drawing, analysis (Numerical), surface defects identification and remedies, introduction to Forming simulation, Challenges in Forming.

Unit 2	**Special Forming Processes**	**08 Hrs.**

Special Forming Processes: HVF, HERF (Explosive Forming) techniques- super plastic forming techniques-Hydro forming-Stretch forming, Laser beam forming-principles and process parameters-Advantages, limitations and applications of different forming processes. Orbital forging-Isothermal-Hot and cold isostatic pressing-High speed extrusion, Water hammer forming, Incremental Sheet forming, Magnetic Pulse forming, Metal Spinning, Electro Hydraulic Forming, Micro forming.

Unit 3	**Weld Metallurgy**	**07 Hrs.**
Weld Metallurgy: Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of dissimilar materials, Weld characterization, Weld decay and weld sensitization, Introduction to ASME, ASWE, IS Welding Standards, (welding skill levels).		
Unit 4	**Solid State Welding Processes**	**07 Hrs.**
Solid State Welding Processes: Cold pressure welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction stir welding, Forge welding, Roll welding and Hot pressure welding processes - features, advantages, limitations and applications, Advances in adhesive bonding, cladding.		
Unit 5	**Advanced Welding Processes**	**08 Hrs.**
Advanced Welding Processes: Electrogas, electroslag welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding - principle, working and applications, Cold Metal Transfer - concepts, processes and applications, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles, Robotic Welding, Plasma Arc Welding, Plasma Transferred Arc Welding.		
Unit 6	**Sustainable Manufacturing**	**07 Hrs.**
Sustainable Manufacturing: Introduction to sustainability and drivers for sustainable development and sustainable manufacturing, fundamentals of sustainable manufacturing, various tools, factors of sustainability, Principles of Life Cycle Assessment (Goal, Scope and Life Cycle Inventory), Approaches, Role in Industry 4.0, Green Manufacturing, Environment protection norms, ISO 14000, recycling techniques, safety norms in forming and welding, socio-economic aspects, case study on waste recycling, material recycling, etc.		

Books and other resources

Text Books:

1. Sindo Kou, “Welding Metallurgy”, Wiley Publications Second Edition
2. Dr. V. D. Kodgire and S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication
3. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley & Sons, Inc.
4. O.P. Khanna, " Welding Technology", Dhanpat Rai & Sons Publications Edition 2015
5. Dr. R. S. Parmar,"Welding Processes and Technology", Khanna Publications Edition 2017
6. J. Paulo Davim, " Sustainable Manufacturing", Wiley Publications Edition 2010

References Books:

1. Z. Marciniak, J.L.Duncan, "Mechanics of Sheet Metal Forming", Butterworth Heinemann-2002.
2. Dr. Sadhu Singh, "Theory of Plasticity and Metal Forming Processes", Khanna Publishers Edition 2008
3. O.P. Khanna, " Engineering Metallurgy", Dhanpat Rai & Sons Publications
4. Ali Hasan - Islam Nawaz, "Advanced Welding Technology", SCITECH Publications India Pvt. Ltd. Edition 2018
5. Dr. K. S. Yadav, "Advanced Welding Technology'", Rajsons Publications Pvt. Ltd.
6. Tool and Manufacturing Engineers' Handbook: Forming V by Charles Wick Publisher

: Society of Manufacturing Engineers; 4th edition (1 Aug. 1996)

7. Dornfeld and David, "Green Manufacturing" - Fundamentals and Applications, DOI 10.1007/978.1.4419.6016.0_2, Springer Science +Business Media, New York 2013.
8. R. Ganesh Narayanan, Jay S Gunasekera,"Sustainable Material Forming and Joining", by CRC Press 2020.

Web References:

1. NPTEL Course on "Forming" by Dr. R. Chandramouli, IIT Madras
2. NPTEL Course on "Welding Engineering" by Dr. D. K. Dwivedi, IIT Roorkee
3. NPTEL Course on "Advances in welding and joining technologies" by Prof. SwarupBag IIT Guwahati.
4. NPTEL Course on "Welding Metallurgy" by Prof. Pradeep K. Jha, IIT Roorkee
5. NPTEL Course on "Sustainability through Green Manufacturing System – An Applied Approach" by Prof. Deepu Philip IIT Kanpur and Dr. Amardeep Singh Oberaoi, NIT Jalandar.

302045-B:Machining Science &Technology					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mechanics, Gear terminology, Material properties, Degree of freedom.

Course Objectives:

1. **KNOW** about fundamentals of metal cutting process, tool wear and tool life.
2. **IMPART** the knowledge of machining phenomenon like milling, gear and thread manufacturing, grinding, super finishing, etc.
3. **UNDERSTAND** the basic concepts, importance and functions of Jigs, Fixtures.
4. **PREPARE** list of operations, tools, set of manufacturing instructions and selection of quality assurance method.
5. **GENERATE** CNC program for appropriate machining processes like turning and milling.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEFINE** metal cutting principles and mechanics of metal cutting and tool life.

CO2. **DESCRIBE** features of gear and thread manufacturing processes.

CO3. **SELECT** appropriate grinding wheel and demonstrate the various surface finishing processes.

CO4. **SELECT** appropriate jigs/fixtures and to draw the process plan for a given component.

CO5. **SELECT** & **EVALUATE** various parameters of process planning.

CO6. **GENERATE** CNC program for Turning / Milling processes and generate tool path using CAM software.

Course Contents

Unit 1	Mechanics of Metal Cutting	08 Hrs.

Introduction to metal cutting, Elements of machining process, Geometry of single-point cutting tool, Orthogonal and Oblique cutting processes,

Chip formation, Types of chips, Chip thickness ratio, Process parameters and their effect on machining, chip breakers,

Merchant's Circle of forces analysis – forces and energy calculations, power consumed – MRR- Effect of Cutting variables on forces,

Concepts of Machinability- Factors affecting machinability, Machinability Index, Tool Life, Tool life equation of Taylor, Tool wear and its types, Factors affecting on tool life.

Unit 2	Gear and Thread Manufacturing	07 Hrs.

Introduction, Materials of gears, Methods of gear manufacturing-casting, forging, forming etc, milling of gears (indexing methods and numerical), Helical gear cutting, Gear Shaping and Gear hobbling, Gear inspection.

Thread Manufacturing: Various methods of thread manufacturing**,** thread rolling, die threading & tapping, Thread milling, Thread grinding etc.

Unit 3	**Grinding & Surface finishing**	**08 Hrs.**
Types and Operations of grinding machines, Grinding wheel– Shapes, Designation and selection, Abrasives & classification, Bond & bonding, Grit, Grade & Structure of wheels, Types of grinding wheels, mounting of grinding wheels, Glazing and loading of wheels, Dressing and truing of wheels, Balancing of wheels, Diamond wheels. **Super-finishing processes** – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)		
Unit 4	**Jigs and Fixtures**	**08 Hrs.**
Significance and purpose of jigs and fixtures and their functions in the manufacturing processes, Concept of degree of freedom, 3-2-1 principle of location. General guidelines to design jigs and fixtures, advantages of jigs and fixtures. **Jigs-** Definition, Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, Latch type jig. **Fixtures:** Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, turning fixture, welding fixture, Milling fixture, Assembly and Inspection fixtures.		
Unit 5	**Process Planning**	**06 Hrs.**
Introduction- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection, process parameters calculation for various production processes, Selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, Economics of process planning, case studies.		
Unit 6	**CNC Programming**	**08 Hrs.**
CNC Programming-CNC part programming adaptable to suitable controller. Steps in developing CNC part program. CNC part programming for Lathe Machine – Threading & Grooving cycle (Canned cycle). CNC part programming for Milling Machine - Linear & circular interpolation, milling cutter, tool length compensation & cutter radius compensation. Pocketing, contouring & drilling, subroutine and Do loop using canned cycle.		

Books and other resources

Text Books:

1. A Text Book of Production Technology, P. C. Sharma, S.Chand Publications
2. A Text Book of Manufacturing Technology, R. K. Rajput, Laxmi Publications (p) LTD
3. A Text book of Manufacturing Technology, Metal Cutting and Machine Tools, P. N. Rao, Vol. 2, 2nd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2002
4. Elements of Workshop Technology, Vol-II, S. K. HajraChaudhary, Media Promoters &Publications Pvt Ltd.
5. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional

References Books:

1. Theory of Metal Cutting, M. C. Shaw, 1st Edition, Oxford and I.B.H. publishing, 1994
2. Jigs & Fixtures, P.H. Joshi, Third edition, McGraw Hill, 2017
3. Production Technology Manufacturing Systems VOL-I & II, R. K. Jain, Khanna Publishers
4. Production Technology –HMT, Tata McGraw Hill publication
5. An Expert Process Planning System, Chang, T. C., Addison Wesley Longman, 1990

6. Process Planning- Design/Manufacture Interface, Scallan P, Butterworth-Heinemann, 2003
7. CNC Machines, B. S. Pabla, M. Adithan, New Age International, 2018
8. Manufacturing Science, Amitabh Ghosh and AshokKumar Mallik, Affiliated East-West Press, 2010

Web References:

1. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-
2. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-32.pdf
3. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-34.pdf
4. https://nptel.ac.in/courses/112/107/112107143/

302046: Digital Manufacturing Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Construction and operating of conventional machine tools, principles of machining and forming processes, cutting tool and machining parameters, programming languages like C, Python etc., basics of 3D printing.

Course Objectives:

1. **ACQUIRE** skills to handle conventional machines and CNC machine for manufacturing of a component.
2. **PREPARE** manual part program for given component as per ISO standards.
3. **ACCUSTOM** skills of Additive manufacturing technology.
4. **APPRECIATE** the influence of cutting tool parameters on the performance.
5. **APPLY** Digital Manufacturing tools for process simulation of manufacturing processes.
6. **SELECT** appropriate type of jigs and fixtures for a given component

Course Outcomes:

On completion of the course, learner will be able to

CO1.**DEVELOP** a component using conventional machines, CNC machines and Additive Manufacturing Techniques.

CO2.**ANALYZE** cutting tool parameters for machining given job.

CO3.**DEMONSTRATE** simulation of manufacturing process using Digital Manufacturing Tools.

CO4.**SELECT** and **DESIGN** jigs and Fixtures for a given component.

CO5.**DEMONESTRATE** different parameters for CNC retrofitting and reconditioning.

Guidelines for Laboratory Conduction

The learner shall complete the following activity as a Term Work;

1. Demonstration of cutting tool geometry and nomenclature of the tools used in conventional and CNC machines.
2. Machining of a mechanical component using conventional machines such as lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement. Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.
3. Preparing manual CNC part program using G Codes and M Codes as per ISO (DIN 66025) and RS274 standards for CNC lathe/mill machine.
4. Machining of mechanical component using CNC machine (Lathe/Mill/HMC/VMC). Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.
5. Demonstration of Additive Manufacturing technology (from modelling to printing) (To be performed Batch-wise)
6. Demonstration of the usage of Digital Manufacturing tools for process simulation of manufacturing processes like casting, forging, sheet metal, plastic processing (free / open source software)

7. Demonstration of various types of jigs and fixtures, and a case study on design and use of Jigs & Fixture for any given component.
8. Preparing Online Calculator/Catalogue for selection of cutting parameters by using programming languages like C, Python etc.
9. Study on CNC retrofitting and reconditioning
10. Visit to an Industry which uses advanced manufacturing processes

Please note following instructions regarding Laboratory Conduction:

1. Sr. No. 1 to 7are mandatory and any 2 from Sr. No. 8 to 10.
2. Practical are to be performed under the guidance of concerned faculty member.
3. Journal should consist of Job Drawing, Process Sheet and Program, appropriate write-up and shall be part of term-work submission.

302047: Skill Development					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**TW**	**25 Marks**

Prerequisites: Students should have knowledge of Construction and working of IC engine / compressor / gear box / centrifugal pump/tail stock. Working principles of any type of mechanism / power plants. Working of electric and hydraulic systems of 4 wheeler vehicle. Working of machine tools, engine and transmission of different automotive and home appliances. Advanced manufacturing processes. Solid mechanics and design of machine elements.

Course Objectives:

1. **INTRODUCE** the skills required in an industry such as design, development, assembly & disassembly.
2. **DEVELOP** the skills required for fault diagnose of engine and transmission of different automotive and various home appliances.
3. **ESTABLISH** the skills required for maintenance of any machine tool.
4. **CREATE** awareness about industrial environment.

Course Outcomes:

On completion of the course, learner will be able to

CO1.**APPLY& DEMONSTRATE** procedure of assembly & disassembly of various machines.
CO2.**DESIGN & DEVELOP** a working/model of machine parts or any new product.
CO3.**EVALUATE** fault with diagnosis on the machines, machine tools and home appliances.
CO4.**IDENTIFY & DEMONSTRATE** the various activities performed in an industry such as maintenance, design of components, material selection.

Course Contents

1. Assembly and Disassembly of any of the following mechanical systems/ subsystems: bicycle (geared), e-Bikes, e-Motor Cycles, Drones, Flying devices, gear box, IC engines, centrifugal pump etc.
2. Assembly- Disassembly/ Fault diagnosis of home appliances such as mixer, grinder, washing machine, fan, ovens, gas geyser, chopping machine, kneading machine, exercise machines, etc.
3. Development and demonstration of working/animation model of any mechanism.
4. Design a circuit of electric and hydraulic system of4 wheelers and its verification.

   OR

   Circuit design /PCB design using software for control of BLDC electric motors used in e-Vehicles.
5. Undertake total preventive maintenance for any machine tool or mechanical system.
6. Visit to an industry for awareness about preventive maintenance.
7. Use of ergonomic principles for the design of hand tools, control in automobile dashboards, human operated mobile devices.

8. Use of alternative materials in the construction of daily activity machine and tool components
9. Interpretation of Drawings; Exercises in identifying the type of production, extracting important functional dimensions, checking the number of parts in an assembly. Checking and listing missing dimensions.
10. Exercises in -preparation of detailed production drawings as per BIS standard of simple machine parts having relevant notes and indications (limits/tolerances, surface finish, the process of production, relevant tools, materials, measuring instruments).

The documentation activity as a part of the Term work shall not be restricted to merely generation of 2D/3D CAD Drawings with dimensions (as applicable), Exploded View, Flowchart of Maintenance Work etc. but can be beyond.

Skill Development Documentation Diary must be maintained by every student.

302048: Audit Course V		
Teaching Scheme	**Credits**	**Examination Scheme**
	Non-Credit	

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from third year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course V

- Entrepreneurship and IP strategy
- Engineering Economics
- Mangment of Inventory Systems

\# The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BOS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the

corresponding online course available on the NPTEL platform as an Audit course. • Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal. • After clearing the examination successfully; student will be awarded with a certificate.
Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary. • During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the mark-sheet.

302049: Artificial Intelligence & Machine Learning					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Linear Algebra, Probability, Statistics, Logical Reasoning.

Course Objectives:

1. **ACQUAINT** with fundamentals of artificial intelligence and machine learning.
2. **LEARN** feature extraction and selection techniques for processing data set.
3. **UNDERSTAND** basic algorithms used in classification and regression problems.
4. **OUTLINE** steps involved in development of machine learning model.
5. **FAMILIARIZE** with concepts of reinforced and deep learning.
6. **IMPLEMENT AND ANALYZE** machine learning model in mechanical engineering problems.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEMONSTRATE** fundamentals of artificial intelligence and machine learning.
CO2. **APPLY** feature extraction and selection techniques.
CO3. **APPLY** machine learning algorithms for classification and regression problems.
CO4. **DEVISE AND DEVELOP** a machine learning model using various steps.
CO5. **EXPLAIN** concepts of reinforced and deep learning.
CO6. **SIMULATE** machine learning model in mechanical engineering problems.

Course Contents

Unit 1	**Introduction to AI & ML**	**06 Hrs.**

History of AI, Comparison of AI with Data Science, Need of AI in Mechanical Engineering, Introduction to Machine Learning. **Basics:** Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation.

Approaches to AI: Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical.

Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.

Unit 2	**Feature Extraction and Selection**	**08 Hrs.**

Feature extraction: Statistical features, Principal Component Analysis.

Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical Engineering.

Unit 3	**Classification & Regression**	**08 Hrs.**

Classification: Decision tree, Random forest, Naive Bayes, Support vector machine.

Regression: Logistic Regression, Support Vector Regression. **Regression trees:** Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Mechanical Engineering.

Unit 4	Development of ML Model	07 Hrs.
Problem identification: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.		
Unit 5	**Reinforced and Deep Learning**	**08 Hrs.**
Characteristics of reinforced learning; Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of Deep Learning, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning in Mechanical Engineering.		
Unit 6	**Applications**	**08 Hrs.**
Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Dynamic System Order Reduction, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms.		

Books and other resources

Text Books:

1. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
3. Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015
4. Stuart Russell and Peter Norvig (1995), "Artificial Intelligence: A Modern Approach," Third edition, Pearson, 2003.

References Books:

1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
4. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
5. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH

Web References:

1. http://nptel.ac.in/courses/111101003/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/112/103/112103280/
4. https://www.analyticsvidhya.com/

Term Work
List of Experiments: 1. To study supervised/unsupervised/Reinforcement learning approach. 2. To acquire, visualize and analyze the data set (from time-domain/ frequency-domain/ etc.) . 3. To extract features from given data set and establish training data. 4. To select relevant features using suitable technique. OR 5. To use PCA for dimensionality reduction. 6. To classify features/To develop classification model and evaluate its performance (any one classifier). 7. To develop regression model and evaluate its performance (any one algorithm). 8. Markov process for modelling manufacturing processes. OR 9. Reinforced Learning for optimizing engineering designs / Robot Guidance and Navigation. 10. GA for optimization of multi-dimensional function / path planning in robotics. OR 11. NN for parameter and model identification / tuning of Control Algorithms. **Note:** • Students need to apply the computational algorithms using suitable software / programming language. • Experiment 1, 2, 3, 6 & 7 are compulsory. Experiment 2 to 7 to be taken on same data set

302050: Computer Aided Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Practical	**50 Marks**

Prerequisite Courses: Solid Mechanics, Numerical and Statistical Methods, Engineering Mathematics, Manufacturing Processes, Fluid Mechanics, Heat and Mass Transfer.

Course Objectives:

1. **UNDERSTAND** the basic concepts of Computer Aided Engineering (CAE) and **CHARACTERISTICS** of various elements required for analysis.
2. **NURTURE** students about the discretization process and criteria for quality mesh.
3. **UNDERSTAND** the approaches of Finite Element Method (FEM) and to find displacement and stresses over the body.
4. **DEVELOP** the knowledge and skills needed to effectively evaluate the results using Finite Element Analysis (FEA).
5. **APPLY** computational technique to solve complex solid mechanics problems and its loading states.
6. **STUDY** the applications of CAE in the various domains of the Mechanical Engineering.

Course Outcomes:

On completion of the course, learner will be able to

CO1: **DEFINE** the use of CAE tools and **DESCRIBE** the significance of shape functions in finite element formulations.

CO2: **APPLY** the various meshing techniques for better evaluation of approximate results.

CO3: **APPLY** material properties and boundary condition to SOLVE 1-D and 2-D element stiffness matrices to obtain nodal or elemental solution.

CO4: **ANALYZE** and **APPLY** various numerical methods for different types of analysis.

CO5: **EVALUATE** and **SOLVE** non-linear and dynamic analysis problems by analyzing the results obtained from analytical and computational method.

CO6: **GENERATE** the results in the form of contour plot by the USE of CAE tools.

Course Contents

Unit 1	**Elemental Properties**	**07 Hrs.**

Introduction to Computer Aided Engineering (CAE), Use of CAE in Product development, Discretization methods – Finite Element Method (FEM), Finite Difference Method (FDM) and Finite Volume Method (FVM), CAE Tools- Pre-processor, Solver and Post-Processor.

Element Shapes – 1D, 2D and 3D elements, Nodal Unknowns and field variables, Coordinate Systems, Shape Functions- linear, quadratic and cubic, Convergence Requirements of Shape Functions, Derivation of Polynomial Shape Functions using coordinate systems for Bar, Beam, Triangular, and rectangular elements.

Unit 2	Meshing Techniques	06 Hrs.
Discretization of a Structure, 1D, 2D and 3D element Meshing, Element selection criteria, Refining Mesh, Effect of mesh density in critical region, Use of Symmetry. Element Quality Criterion:-Jacobian, Aspect ratio, Warpage, Minimum and Maximum angles, Average element size, Minimum Length, skewness, Tetra Collapse etc., Higher Order Element vs Mesh Refinement, Geometry Associate Mesh, Mesh quality, Bolted and welded joints representation, Mesh independent test.		
Unit 3	**1D Finite Element Analysis**	**08 Hrs.**
Consistent Unit System, Introduction to approaches used in Finite Element Analysis (FEA) such as direct approach and energy approach **Bar and Truss Element** - Element stiffness matrix, Assembling stiffness Equation, Load vector, stress and reaction forces calculations. **Temperature effect on Bar Element-** Calculation due to uniform temperature change, Stress and reaction forces calculations.		
Unit 4	**2D Finite Element Analysis**	**08 Hrs.**
Plane Stress-Strain, axi-symmetric problems in 2D elasticity. **Constant Strain Triangle (CST) -** Element Stiffness matrix, Assembling stiffness equation, Load vector, Stress and reaction forces calculations. **Post Processing Techniques** – Check and validate accuracy of results, Average and Un-average stresses, and special tricks for Post Processing. Interpretation of results and design modifications, CAE reports.		
Unit 5	**Non-Linear and Dynamic Analysis**	**08 Hrs.**
Non-Linear Analysis: Introduction to Nonlinear Problems, Comparison of Linear and Nonlinear analysis, Types of Nonlinearities, Stress-strain measures for Nonlinear analysis, Analysis of Geometric, Material Nonlinearity, Solution Techniques for Nonlinear analysis, Newton Raphson Method, Essential steps in Nonlinear analysis. **Dynamic Analysis:** Introduction to Dynamic Analysis, Comparison of Static and Dynamic analysis, Time domain and frequency domain, Types of loading, Simple Harmonic motion, Free vibration, Boundary conditions of free vibration, Solution.		
Unit 6	**Applications of Computer Aided Engineering**	**08 Hrs.**
Computational Fluid Dynamics (CFD): Introduction, Three dimensions of Fluid Dynamics, Equilibrium Equation for a fluid, Conservation form of Fluid flow equation, Integral form of the Conservation Laws. **Injection moulding of Plastics:** Simplification of Mould Geometry for FEA, Material Model for Mould FEA, Boundary Conditions for Mould FEA, Loading of Mould in FEA, Results Analysis. **Simulation for Manufacturing Processes like Casting and Sheet Metal Applications:** Introduction and workflow of Casting Simulation Software and Sheet Metal Applications. **Durability Analysis:** Durability, Reliability and Fatigue**,** FEA bases fatigue analysis viz: Stress-Life approach (S-N method) and Strain-Life approach (E-N method). **Crash Analysis:** Introduction, Explicit time integration schemes, implicit integration schemes. **Noise Vibration and Harshness (NVH) Analysis:** NVH Concepts, Terminology, FEA for structural Dynamics, FEA for Acoustics.		

Books and other resources
Text Books: 1. Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., Practical Finite Element Analysis, Finite to Infinite, Pune, 1st Edition, 2008. 2. S. S. Bhavikatti, Finite Element Analysis, New Age International Publishers, Third Edition, 2015. 3. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002. 4. G Lakshmi Narasaiah, Finite Element Analysis, BS Publications / BSP Books, 2nd edition, 2020. 5. J. N. Reddy, An Introduction to the Finite Element Method, Mcgraw Hill Series in Mechanical, 2005. 6. P. Seshu, Text book of Finite Element Analysis, PHI Learning Private Limited, New Delhi, 10th Printing, 2012.
References Books: 1. K. J. Bathe, Finite Element Procedure, Prentice-Hall of India (P) Ltd., New Delhi, 1996. 2. Cook R. D., Finite Element Modeling for Stress Analysis, John Wiley and Sons Inc, 1995. 3. G.R. Liu S. S. Quek, The Finite Element Method- A Practical Course, Butterworth Heinemann, 2013. 4. Fagan M. J., Finite Element Analysis Theory and Practice, Harlow Pearson/Prentice Hall, 2012. 5. S. Moaveni, Finite element analysis, theory and application with Ansys, Pearson, Third Edition, 2011. 6. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill, 2017. 7. Mukhopadhyay M and Sheikh A. H., Matrix and Finite Element Analyses of Structures, Ane Books Pvt. Ltd., 2009 8. Daryl L. Logan, A First Course in the Finite Element Method, Fourth Edition, Thomson Canada Limited, 2007. 9. O.C. Zienkiewicz, The Finite Element Method: Its Basis and Fundamentals, Sixth Edition, Elsevier Butterworth-Heinemann, 2005.
Web References: • **https://nptel.ac.in/courses/112/104/112104116/-**for Basics of Finite Element Analysis by Prof.Nachiketa Tiwari, IIT Kanpur • **https://nptel.ac.in/courses/112/106/112106130/**for Advanced Finite Element Analysis by Dr. R. Krishnakumar, Department of Mechanical Engineering, IIT Madras • **https://nptel.ac.in/courses/112/103/112103299/**for Finite Element Analysis for Welding Analysis by Prof. Swarup Bag, Department of Mechanical Engineering, IIT Guwahati. • **https://sites.ualberta.ca/~wmoussa/AnsysTutorial/** for ANSYS Tutorials

Term Work
The student shall complete the following activity as a Practical using any commercial FEA software or open-source software's 1. 1D Bar Element – Structural Linear Analysis 2. Truss Analysis using 1D Element 3. Plate/Shell Element – Structural Linear and Non-Linear Analysis 4. Beam Element – Non-Linear Buckling Analysis 5. Thermal Analysis – Static/Transient Analysis 6. Coupled Analysis- (Structural + Thermal) 7. Analysis of Machine Component using 3D Elements 8. Non-Linear Analysis of Assembly using Contact Elements 9. Modal Analysis – Spring -Mass system, simply supported/Cantilever beam, etc. 10. Presentation on advanced applications of FEA, NVH, CFD, Crash, Fatigue, Manufacturing, etc. **Note:** • The lab report shall consist of completion of Practical's and Presentations. • Practical examination shall be based on the practical undertaken during the semester.

302051: Design of Transmission Systems					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Classification of Gears, Gear Terminology, Terminology of Helical gear, Virtual number of teeth. Classification, selection and application of Belt, chain and rope drives.

Course Objectives:

1. **APPLY** fundamentals for the design and/or selection of elements in transmission systems.
2. **UNDERSTAND** the philosophy that real engineering design problems are open-ended and challenging.
3. **DEMONSTRATE** design skills for the problems in real life industrial applications.
4. **DEVELOP** an attitude of team work, critical thinking, communication, planning and scheduling through design projects.
5. **PERCEIVE** about safety, ethical, legal, and other societal constraints in execution of their design projects.
6. **BUILD** a holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcomes:

On completion of the course, learner will be able to

CO1.**APPLY** the principle of Spur & Helical gear design for industrial application and PREPARE a manufacturing drawing with the concepts of GD&T.

CO2.**EXPLAIN** and **DESIGN** Bevel & Worm gear considering design parameters as per design standards.

CO3.**SELECT&DESIGN** Rolling and Sliding Contact Bearings from manufacturer's catalogue for a typical application considering suitable design parameters.

CO4.**DEFINE** and **DESIGN** various types of Clutches, Brakes, used in automobile.

CO5.**APPLY** various concept to **DESIGN** Machine Tool Gear box, for different applications

CO6.**ELABORATE** various modes of operation, degree of hybridization and allied terms associated with hybrid electric vehicles.

Course Contents

Unit 1	**Spur and Helical Gears**	**07 Hrs.**

Introduction to gears: Material selection for gears, Modes of gear tooth failure, Gear Lubrication Methods.

Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.

AGMA (American Gear Manufacturing Association) approach of Gear design (Only mathematical relations, no numerical)

Helical Gears: Force analysis of Helical Gear, Beam Strength of Helical Gear, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. (No numerical on force analysis of helical)		
Unit 2	**Bevel and Worm Gear**	**08 Hrs.**
Bevel Gears: Types of Bevel gears, Terminology, Virtual number of teeth, and force analysis of Straight Bevel Gear. Design of Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. (Simple numerical to be taken no design calculations) **Worm Gears:** Worm and worm gear terminology and proportions of worm and worm gears, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive. *(Simple numerical to be taken no design calculations)*		
Unit 3	**Sliding and Rolling Contact Bearing**	**07 Hrs.**
Sliding contact bearing (Theoretical treatment only): Introduction to sliding contact bearing, classification, Reynolds's equation (2D), Petroff's equations, Sommerfeld number, Parameters of bearing design. **Rolling Contact Bearings**: Types of rolling contact Bearings and its selection, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Selection of rolling contact bearings from manufacturer's catalogue, Design for cyclic loads, Types of failure in rolling contact bearings - causes and remedies. (Simple Numerical treatment)		
Unit 4	**Design of Clutches and Brakes**	**07 Hrs.**
Clutches: Introduction, Types of clutches, Material, Positive clutches, friction clutches, single plate, multiple plate, Cone clutch, and centrifugal clutches, Application of friction clutches automotive and industrial machinery sector. (Only Theoretical Treatment) **Brakes**: Introduction, Types of brakes, Material, Design of band brake, external and internal shoe breaks internal expanding shoe brakes, design of disc brakes. Application of brakes in automotive and industrial machinery sector. (Only Theoretical Treatment)		
Unit 5	**Design of M/C Tool Gear Box**	**08 Hrs.**
Introduction to Machine Tool Gearboxes, classification, basic considerations in design of drives and its Applications, Determination of variable speed range, Graphical representation of speed and structure diagram, Ray diagram, selection of optimum ray diagram, Kinematic /Gearing Diagram, Deviation diagram, Difference between numbers of teeth of successive gears in a change gear box. *(Note: Full design problem to be restricted up to 2 Stages only & No design problem on deviation diagram*)		
Unit 6	**Transmission system in Hybrid Electric Vehicle**	**08 Hrs.**
Introduction, Types of Hybrid Electric Vehicles: Basic Classification, Basic Modes of Operation, Other Derivatives, Degree of Hybridization. Power Split Devices (PSD): Simple and EM compound PSD, HEV Component Characteristics: The IC Engine, Electric Machines, Battery, HEV Performance Analysis: Series HEV, Parallel HEV, HEV Component Sizing: General Considerations, Sizing for Performance, Optimum Sizing, Power Management: Control Potential, Control.		

Books and other resources

Text Books:

1. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. ltd.
2. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
3. Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R.C, Fundamentals of Machine Components Design, John Wiley and Sons.

References Books:

1. Design Data - P.S.G. College of Technology, Coimbatore.
2. Vehicle Powertrain Systems by Behrooz Mashadi, David Crolla. A John Wiley & Sons, Ltd
3. Automobiles–Power trains and Automobiles–Dynamics by Crolla, David, A John Wiley &Sons, Ltd
4. Automotive Engineering Powertrain, Chassis System and Vehicle Body by David A Crolla, Elsevier B H New York, London, Oxford.
5. lack P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
6. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
7. P. Kannaiah, Design of Transmission systems‖, SCIETCH Publications Pvt Ltd.
8. C.S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
9. D.K. Aggarwal& P.C. Sharma, Machine Design, S.K Kataria and Sons.
10. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
11. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
12. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.

Web References:

1. https://www.youtube.com/watch?v=b42_IO87X4s
2. https://www.youtube.com/watch?v=vTZ4Gah3wfo
3. https://www.youtube.com/watch?v=ER6LC7ONCD8
4. https://www.youtube.com/watch?v=nMsB6Soz4Hc
5. https://www.youtube.com/watch?v=WOTDbCPukoM
6. https://www.youtube.com/watch?v=fMNQglkUfhs
7. https://freevideolectures.com/course/2363/design-of-machine-elements

Term Work
Student shall complete the following activity as a Term Work; The Submission shall consist of completion of Two Design projects and study Assignments. Oral examination shall be based on the practical undertaken during the semester. **Design Project 1 (Any one)** 1. Design of gearbox for wind mill application or sluice gate. (Use AGMA approach) 2. Design of gearbox for building Elevator. (Use AGMA approach) 3. Design of gearbox for Hoist. (Use AGMA approach) 4. Design of gearbox for Worm gear box for Sugar Industry. (Use AGMA approach) 5. Design of clutch system for automobile 6. Design of brake system for automobile **Design Project 2** Projects shall be in the form of design of mechanical systems on multi speed spindle gear box including design of belt and pulley, Prime mover selection etc. The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components. **Assignment: Any Two (PPT Presentation and Report)** 1. Application orientated Numerical on HEV 2. Lubricating oils: Properties, additives, selection of lubricating oils 3. Properties & selection of sliding bearing materials 4. Application of belt, rope and chain drives and its selection method for Industry 5. Transmission system of HEV

302052-A: Composite Materials					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Materials, Metallurgy, Manufacturing Process, Basic Design aspects.

Course Objectives:

1. **DESCRIBE** what are composite materials and their differences with respect to conventional materials.
2. **COMPREHEND** the challenges associated with Polymer Matrix composites.
3. **UNDERSTAND** the requirement of Metal Matrix Composites
4. **RECOGNIZE** design and properties aspect of composites
5. **UNDERSTAND** the testing, inspection and standard in Composites
6. **ORIENT** to the specific Application of Composites

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEFINE & COMPARE** composites with traditional materials.

CO2. **IDENTIFY & ESTIMATE** different parameters of the Polymer Matrix Composite

CO3. **CATEGORISE** and **APPLY** Metal Matrix Process from possessions landscape.

CO4. **DETERMINE** volume/weight fraction and strength of Composites.

CO5. **SELECT** appropriate testing and inspection method for composite materials.

CO6. **SELECT** composites materials for various applications.

Course Contents

Unit 1	**Introduction to Composites**	**07 Hrs.**

Definitions, Need of Composites, Classification of Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Natural Composites, Carbon Fiber composites, Properties of composites in comparison with standard materials. Advantages and Disadvantages. Natural Composites, Hybrid materials and their difference with Composite materials, Applications.

Unit 2	**Polymer Matrix Composite**	**08 Hrs.**

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibers – roving's – woven fabrics – non woven random mats – various types of fibers. PMC processes – hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fiber reinforced plastics (FRP), Glass Fiber Reinforced Plastics (GFRP). Laminated Composites.

Unit 3	**Metal Matrix Composite**	**07 Hrs.**

Characteristics and types of MMC, advantages and limitations of MMC, Reinforcements – particles – fibers. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties.

Unit 4	Mechanics of Composite Materials	08 Hrs.
Geometrical aspects – volume and weight fraction (Numerical). Large particle composites and the rule of mixtures for elastic constants, failure, fatigue, and long-term strength, methods of optimum design of materials and structures, Micromechanics of a Lamina, Unidirectional continuous fiber, discontinuous fibers, short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear (Numerical).		
Unit 5	**Testing, Inspection & Standards in Composites**	**07 Hrs.**
Test Environments, Mechanical Test (Tensile, compression, shear & Fatigue) Bond Strength / Ply Adhesion ASTM F904, Testing Techniques for Composite Double Cantilever Beam, End Notch Flexure, Inter laminar Share Strength, Materials Nondestructive Inspection (NDI) of Composites, Thermographic testing of composites. ASTM & ISO standards for composites materials.		
Unit 6	**Application of Composite Materials**	**08 Hrs.**
Applications of Composites material for Aerospace and Transportation application, viz LCA/LCH, Automobile Industry -lightweight, cost-effective, multi-material technology, compatibility with automation systems and rapid processing. Energy Applications-Ecofriendly Prime movers, Infrastructure and Building Applications, Maine Applications- Boats and Ships, Ecofriendly storage Tanks Sports Industry-Protective Equipment's.		

Books and other resources

Text Books:

1. Chawla K.K., Composite materials Science and Engineering, Springer – Springer New York-2016
2. Daniel Gay- Composite Materials- Design and Applications, CRC Press, 2014
3. Autar Kaw- Mechanics of Composite Materials, Taylor and Francis, Second Edition- 2006
4. Robert M Jones-Mechanics of Composite Material, CRC Press, 2018
5. Madhujit Mukhopadhyay - Mechanics of Composite Materials and Structure, University Pres, 2004
6. S.C. Sharma -Composite Materials, Narosa Publishing House—2000

References Books:

1. A Bent Strong- Fundamentals of Composites Manufacturing-Materials, Methods and Applications, Society of Manufacturing Engineers, 2008
2. Clyne T.W. and Withers P.J-Introduction to Metal Matrix Composites, Cambridge University Press, 1995
3. Agarwal B. D. and Broutmen L. J-Analysis and performance of Fiber Composites, Wiley Publicaions-Fourth Edition, 2017
4. M. W. Hyer, Scott R. White- Stress Analysis of Fiber-reinforced Composite Materials, DEStech Publications, Inc., 2009
5. Carl T. Herakovich- Mechanics of Fibrous Composites, Wiley Publicaions, 1998
6. Erich Fitzer, Lalit M. Manocha - Carbon Reinforcements and Carbon /carbon Composites, Springer-Verlag, 1998
7. Murray Schwartz, Mel M. Schwartz- Composite Materials Handbook, McGraw-Hill, 1992
8. Composite Materials Handbook, SAE International, 2017

Web References:

1. Introduction of Composite - https://nptel.ac.in/courses/112/104/112104229/
2. Advanced Composite - https://nptel.ac.in/courses/112/104/112104249/
3. Polymer Process - https://nptel.ac.in/courses/113/105/113105077/
4. Manufacturing of composite - https://nptel.ac.in/courses/112/104/112104221/
5. Processing of Polymer composite - https://nptel.ac.in/courses/112/107/112107221/
6. Composite materials - https://nptel.ac.in/courses/101/106/101106038/
7. Mechanics of laminated of composite - https://nptel.ac.in/courses/112/104/112104161/
8. Composite Materials and Structure - https://nptel.ac.in/courses/101/104/101104010/

302052-B: Surface Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Basic Chemistry, Engineering Materials & Basic Metallurgy concepts

Course Objectives:

1. **DEVELOP** fundamental understanding and role of materials to allow surface selection for mechanical contact surfaces
2. **UNDERSTAND** surface modification and coating method to enhance surface performance
3. **RECOGNIZE** method for testing surface properties

Course Outcomes:

On completion of the course, learner will be able to-

CO1. **DEFINE** the basic's principle & mechanism of surface degradation.

CO2. **ANALYSE & SELECT** correct corrosion prevention techniques for a different service condition.

CO3. **DEMONSTRATE** the role of surface engineering of materials to modify/improve the surface properties.

CO4. **SELECT** the suitable surface heat treatments to improve the surface properties.

CO5. **APPLY** the surface modification technique to modify surface properties.

CO6. **ANALYSE & EVALUTE** various surface coating defects using various testing/characterization method.

Course Contents

Unit 1	**Introduction to Surface Engineering and Surface Degradation**	**08 Hrs.**

Introduction to engineering components, surface dependent properties and failures, importance and scope of surface engineering; surface and surface energy; Structure and type of interfaces, surface and related equations; Surface engineering: classification, definition, scope and general principles. Adhesive wear, Abrasive wear, Erosion wear, Polishing wear; Corrosion: definition; Various Forms of Corrosion; Corrosion Triangle, Pilling and Bedworth rule, Formation and growth of films, Concept of Electrode Potential, Concept of Polarization, Electrochemical and galvanic series of metals.

Unit 2	**Corrosion Testing and Prevention methods**	**07 Hrs.**

Corrosion Testing –Introduction of Corrosion Testing by Physical (only weight loss & salt spray method) and Electrochemical Methods such as ASTM standard methods only G-5&A262-A.

Corrosion Prevention methods –Metallurgical and Environmental aspects of corrosion, Inhibitors, Internal & External coating, Cathodic & Anodic protection, use of special alloys, Improvement in design/ changes in design to control corrosion.

Unit 3	**Surface Treatment Methods**	**08 Hrs.**

Diffusion: Principles of diffusion, Fick"s law, diffusion in solids, Diffusion in liquids; Surface hardening: Carburizing, Carburizing atmosphere and Heat treatment after Case Hardening, Depth of carburization, Case depth measurement, ASTM E1077-01 Depth of carburization, ASTM standard

<table>
<tr><td colspan="3">G105, G95, Bainite control in case, Drip Feed Carburizing, dimensional changes during case hardening; Nitriding, Carbonitriding, Tufftriding, Nitrocarburising, Plasma Nitriding; Induction Hardening, Flame Hardening, Laser Hardening, Selection of steels for these treatments and their applications.</td></tr>
<tr><td>Unit 4</td><td>Advance Surface Modification Techniques</td><td>07 Hrs.</td></tr>
<tr><td colspan="3">Surface modification processes: ion beam surface treatment; sol-gel coating technology; laser surface alloying. Coating for corrosion resistance: conversion coatings; compound coatings - diamond-like nanocomposites, nitrides, silicides, and carbides. Coating for wear resistance: carbon nitride thin films; sputter deposited nanostructured ceramic coatings; dielectric coatings of Si-C alloy films. Electroless coating.</td></tr>
<tr><td>Unit 5</td><td>Surface Coating Techniques</td><td>07 Hrs.</td></tr>
<tr><td colspan="3">Introduction; importance of coating; types of coating: metal, inorganic, and organic. Processes of metal coatings: electrodeposition; flame spraying; Cold spray coating; cladding; hot dipping; vapor deposition. Processes of inorganic coatings: spraying; diffusion coating; chemical conversion. Processes of organic coatings: surface preparation; priming coat; top coats, Antidust coating, Hardfacing; Coatings for high temperature, Coatings for aerospace and aircrafts.</td></tr>
<tr><td>Unit 6</td><td>Surface Evaluation and Characterizations</td><td>08 Hrs.</td></tr>
<tr><td colspan="3">Coating Defects & remedies: Crawling, cratering & related defects; Flooding, wrinkling, Bubbling and Pin-holing, Overspray and Dry Spray, Blushing, foaming, blistering, checking and cracking, blooming, chalking, embrittlement, orange peel, yellowing etc.
Measurement of coating thickness; porosity and adhesion of surface coating; measurement of residual stress and stability; Surface microscopy and topography by scanning probe microscopy; spectroscopic analysis of modified surfaces; Surface roughness, Atomic force microscopy.</td></tr>
<tr><td colspan="3" align="center">Books and other resources</td></tr>
<tr><td colspan="3">Text Books:
1. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
2. M. Ohring, The Materials Science of Thin Films, Academic Press Inc, 2005.
3. Peter Martin, " Introduction to Surface Engineering and Functionally Engineered Materials", John Willey
4. M. G. Fontana - Corrosion Engineering, 3rd Edition, TATA Mc Graw Hill, 2008.
5. J. R. Davis-Surface Engineering for Corrosion and Wear Resistance, ASM International, 2001
6. R. W. Revie & H.H. Uhlig - Corrosion and Corrosion Control, An Introduction to Corrosion Science & Engineering, 4th Edition, Wiley Inter science , 2008.</td></tr>
<tr><td colspan="3">References Books:
1. Mircea K. Bologa, "Surface Engineering and Applied Electrochemistry", Springer.
2. Devis, J.R.," Surface Engineering for Corrosion & Wear Resistance", 2001 Maney Publicsing
3. D.R. Jones - Principals and Prevention of Corrosion, 2nd International Edition, Prentice Hall International Singapore, 1995.
4. L. L. Shreir- Corrosion Volume I & II, Butterworths, London, 1994.
5. ASM Handbook Volume 5: Surface Engineering, ASM International, USA, 1994.</td></tr>
</table>

Web References:

1. Aqueous Corrosion and Its Control - Course (nptel.ac.in): By Dr. V. S. Raja
2. Corrosion Failures and Analysis - Course (nptel.ac.in):By Dr. KallolMandol
3. Surface Engineering of Nanomaterials - Course (nptel.ac.in): By Prof. Kaushik Pal
4. Fundamentals of Surface Engineering: Mechanisms, Processes and Characterizations - Course (nptel.ac.in)by Prof. D.K. Dwivedi

302053: Measurement Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Basics of Linear measurements and working principles of Electrical and Electronics devices.

Course Objectives:

1. **DEVELOP** necessary skills for calibration and testing of instruments
2. **APPLY** fundamentals of measuring methods by collecting data ,analysis and interpretation
3. **APPLY** knowledge of Designing limiting gauges
4. **APPLY** knowledge of Electronic/Electrical measuring instruments

Course Outcomes:

On completion of the course, learner will be able to-

CO1. **EVALUATE** causes of errors in Vernier calipers, micrometers by performing experiments in standard metrological conditions, noting deviations at actual and by plotting cause and effect diagram, to reduce uncertainty in measurement.

CO2. **ANALYZE** strain measurement parameters by taking modulus of elasticity in consideration to acknowledge its usage in failure detection and force variations.

CO3. **EXAMINE** surface Textures, surface finish using equipment's like Talysurf and analyze surface finish requirements of metrological equipment's like gauges, jaws of vernier calipers, micrometers, magnifying glasses of height gauge and more, to optimize surface finish accuracy requirements and cost of measurement.

CO4. **MEASURE** the dimensional accuracy using Comparator and limit gauges and appraise their usage in actual measurement or comparison with standards set to reduce measurement lead time.

CO5. **PERFORM** Testing of Flow rate, speed and temperature measurements and their effect on performance in machines and mechanisms like hydraulic or pneumatic trainers, lathe machine etc. to increase repeatability and reproducibility.

CO6. **COMPILE** the information of opportunities of entrepreneurships/business in various sectors of metrology like calibrations, testing, coordinate and laser metrology etc in an industry visit report.

Term Work

The student shall complete the following activity as a Term Work

1. Fundamentals of measurements and Calibration process by using Dead weight Tester/Strain Gauges/Pressure Gauge.
2. Linear and angular Measurement: Demonstration and calculations using Vernier Caliper, Screw gauge, Dial gauge, height gauge, Bevel protector etc. and plotting cause and effect diagram for their errors in measurement with the help of OER software's or software's like Minitab or in excel sheet.
3. Limit Gauges: Concepts, uses and applications of Go –No Go Gauges, Taylor's principle and Design of gauges (Numerical and student activity)
4. Surface roughness measurement of a given sample using surface tester. Students should also

plot of flow chart of its usage.

5. Determination of geometry and dimensions of given composite object / single point tool, by using Optical Projector / Tool makers' Microscope and differentiate between its usefulness in real life.
6. Verification of dimensions and geometry of given components using Electric/Mechanical/Optical/Pneumatic comparator in context of manufacturing.
7. Determination of modulus of elasticity of a mild steel specimen using strain gauges and its improvement to reduce cost of measurement.
8. Calibration of Thermocouple for temperature measurement / Experimentation by using Gear Tooth Vernier Caliper
9. Speed Measurement and calibration of photo and magnetic speed pickups for the measurement of speed by using Stroboscope.
10. Calibration for Flowrate measurement by using Anemometers, Ultrasonic flow meters and plotting of Risk Priority Number (RPN) of any of the used equipments.
11. Determination of geometry of a given sample by using Coordinate Measuring Machine as per NPL standard and also acknowledge requirements of ISO 10360-5:2020 in CMM measurement.
12. Applications of Open Education Resources like Scilab in measurement / Students should develop any online calculator/app for calculations/numerical analysis relevant to metrology.

Important Note:

1. Relevant theory to be taught during practical hours
2. Sr. No. 1, 2, 3 and 12 are mandatory and any 4 from Sr. No. 4 to 11.
3. Practical's are to be performed under the guidance of concerned faculty member.

Industry Visit to provide exposure to students (Anyone to be covered to fulfil CO6 essentially)

- Demonstration of CMM with the help of software and its futuristic improvements as per Industry 4.0 requirements.
- Design of Go –No Go gauges and Senor applications with modernization as per IOT and Industry 4.0
- Calibration Process as per NABL accreditation norms
- Laser Metrology and its relevant setup functions to be carried out by engineers along with safety precautions to reduce measurement lead time and uncertainty.
- Temperature Measurements of Furnaces, Boilers etc with its cost analysis
- Flow Measurements of Air, Fluids to reduce measurement lead time

Text Books:

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. D.S.Kumar, Mechanical Measurements and Control Metropolitan Book Co.Pvt.Ltd.
3. I.C.Gupta, Engineering Metrology, Dhanpath Rai.
4. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, McGraw hill Publication.

Reference Books:

1. Narayana K.L., Engineering Metrology.
2. Galyer J.F &Shotbolt C.R., Metrology for engineers
3. Judge A.W., Engineering Precision Measurements, Chapman and Hall
4. Francis T. Farago, Mark A. Curtis, Handbook of dimensional measurement

5. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.
6. Connie Dotson, Fundamentals of Dimensional Metrology, ThamsonPubln. 4th Edition.

Online Education resources: viz. NPTEL web site:

1. nptel.ac.in/courses/112106179
2. www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html
3. https://nptel.ac.in/courses/112/107/112107242/
4. freevideolectures.com › Mechanical › IIT Madras
5. https://nptel.ac.in/courses/112/106/112106139/

302054: Fluid Power & Control Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Hydraulic fluids, Relay logic and Ladder Logic/PLC programming

Course Objectives:

1. **UNDERSTAND** working principles of control devices and accessories.
2. **SELECT** different components from manufactures' catalogues.
3. **DEMONSTRATE** the capabilities to simulate and design fluid power systems.
4. **UNDERTAKE** digitalization of fluid power system.

Course Outcomes:

On completion of the course, learner will be able to

CO1.**DEFINE** working principle of components used in hydraulic and pneumatic systems.

CO2.**IDENTIFY & EXPLAIN** various applications of hydraulic and pneumatic systems.

CO3.**SELECT** an appropriate component required for hydraulic and pneumatic systems using manufactures' catalogues.

CO4.**SIMULATE & ANALYSE** various hydraulic and pneumatic systems for industrial/mobile applications.

CO5.**DESIGN** a hydraulic and pneumatic system for the industrial applications.

CO6.**DESIGN & DEMONESTRATE** various IoT, PLC based controlling system using hydraulics and pneumatics.

Practical

The student shall complete the following Practical in laboratory

1. Study of fluid power control systems
   a. Fluid Power Engineering Fundamentals
      - Fluid power basics (governing laws used in fluid power systems)
      - Discuss fluid power transmission and explain basic methods of transmission of power
      - Advantages and disadvantages of fluid power systems
      - Explain role of fluid power engineering in today's industrial automation
      - Clarify the aims of automation

   b. Components of Fluid Power System
      - Components of hydraulic system
      - Components of pneumatic systems
      - Draw symbols of hydraulic and pneumatic components
2. Study and trial on actuators
   a. Study of actuators used in hydraulics and pneumatics
      - Introduction
      - Types of actuators
        - Linear actuators
        - Rotary actuators
        - Limited rotary actuators

   b. Test on linear /rotary actuator. Calculate force/speed/rpm/torque as per case.

3. A) Study and trial on Gear/Vane/Piston pump

a. Study of hydraulic pumps.

- Introduction and classification
- Advantages of positive displacement pumps
- Types of pumps
  - External and internal gear pump
  - Vane pumps
  - Piston pumps
    - Axial pumps
    - Radial piston pumps

b. Trial Gear/Vane/Piston pump.

OR

B) Study and testing of pressure control valve.

a. Circuits with pressure control valve i.e. pressure reducing/counterbalance/brake valve/Sequencing circuit

b. Test on pressure relief valve

4. Study and design of compressed air generation and distribution system

a. Reservoir
b. Driers
c. Types of Regulators
d. Filters
e. Lubricators
f. FRL
g. Loop piping system
h. Assignment on calculation (manual/excel sheet/simulation tool) of pressure loss in piping system

5. Study of control valves

a. Introduction
b. Types of control valves
  - Directional control valves
  - Pressure control valves
  - Flow control valves
  - Cartridge valves
  - Proportional control valves/Electro-hydraulics/proportional valves
  - Demonstration of cut-section/transparent/dismantling of any one valve
c. Regenerative circuit
d. Speed control circuits
e. Transverse and feed circuit.

6. Study of accessory used in hydraulic systems

a. Reservoirs
b. Accumulators: weight loaded, spring loaded, gas loaded.
c. Intensifier
d. Fluid conductors/pipes; pipe fittings
e. Demonstration of electro hydraulic circuit/accumulator/intensifier

7. Following experiments to be done on pneumatic trainer

a. Automatic reciprocating circuit
b. Speed control circuit/Flow control valve
c. Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve
d. Electro pneumatic circuits

8. a) Simulation of hydraulic and pneumatic circuits: Design of any two industrial hydraulics and two pneumatic circuits using manufacturers' catalogue and analysis using any open source/free/commercial software or application.

OR

b) Design of industrial hydraulic and pneumatic circuits, selection of components using the manufacturer's catalogue and analysis using any open source/free/commercial software or application.

9. A) Industrial visit. (Automotive workshop, small or medium scale /automation industry)
B) Trouble shooting of fluid power system.

10. Study and implementation of IoT based system to operate electro-pneumatic/hydraulic circuit from a remote location.
i.e. Demonstration of one cycle of operation of cylinder extension by actuation of solenoid and then retraction by deactivation of the solenoid through proximity sensor.

OR

Demonstration of counting and stopping a cycle once the number of the cycle's are completed (using PLC)

OR

any other application of relay ladder logic or PLC. (Equipments required for implementation include Smart Phone, Node MCU, Relay 5 volt to 24 volt and account on cloud.)

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a Term Work Journal;

Important Note:
Term Work of the Student shall be evaluated based on the completion of Practical, Industrial Visit Report and Group Assignment. Continuous evaluation by the faculty shall be done for the award of the Credit associated with the course.

No practical examination shall be conducted for the award of the credit

Books and other resources

Text Books:

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References Books:

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
4. ISO - 1219, Fluid Systems and components, Graphic Symbols
5. Standard manufacturing catalogues
6. Fundamentals of Pneumatics, Vol I, II and III. FESTO
7. Fundamentals of fluid power control, John Watton Cambridge University press 2012
8. Introduction to Fluid power, Thomson Prentcie Hall 2004
9. Hydraulic Control Systems Herbert E. Merritt John Wiley and Sons, Inc

Web References:

URL links:

1. https://nptel.ac.in/courses/112/106/112106175/
2. http://ndl.iitkgp.ac.in/document/QXBqK1czOUpyM3FlamVjTmREMWFEUFdEb25sZ01FZVRtZmhWNXlobUZ0MFJ0Zk1kU1dSYmEwK1RSZG1FMUNDNQ
   Fluid Power Control: Web-Course Module-01 Module-02 Module-03 Module-04

Links of Video Lectures:

1. https://nptel.ac.in/courses/112/106/112106300/
2. https://www.digimat.in/nptel/courses/video/112105047/L01.html

Recommended on line courses: https://nptel.ac.in/course.html

302055: Internship/Mini project				
Teaching Scheme**		Credits	Examination Scheme	
		04	TW	100 Marks

Prerequisites: Knowledge of design, manufacturing processes, modeling, and mechanical systems

Course Objectives:

Internship provides an excellent opportunity to learner to see understand the conceptual aspects learned in classes and deployed into the practical world. Industry/on project experience provides much more professional experience as value addition to classroom teaching.

1. To encourage and provide opportunities for students to get professional/personal experience through internships.
2. To learn and understand real life/industrial situations.
3. To get familiar with various tools and technologies used in industries and their applications.
4. To nurture professional and societal ethics.
5. To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

Course Outcomes:

On completion of the course, learners should be able to

CO1. **DEMONSTRATE** professional competence through industry internship.

CO2. **APPLY** knowledge gained through internships to complete academic activities in a professional manner.

CO3. **CHOOSE** appropriate technology and tools to solve given problem.

CO4. **DEMONSTRATE** abilities of a responsible professional and use ethical practices in day to day life.

CO5. **DEVELOP** network and social circle, and **DEVELOPING** relationships with industry people.

CO6. **ANALYZE** various career opportunities and **DECIDE** career goals.

****Guidelines:**

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:
Internship is to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.
Internship work Identification:
Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry. Students must get Internship proposals sanctioned from college authority well in advance. Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination and before academic schedule of semester VI. Student can take internship work in the form of the following but not limited to: 1. Working for consultancy/ research project, 2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute / 3. Learning at Departmental Lab/Tinkering Lab/ Institutional workshop, 4. Development of new product/ Business Plan/ registration of start-up, 5. Industry / Government Organization Internship, 6. Internship through Internshala, 7. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship, 8. Research internship under professors, IISC, IIT's, Research organizations, 9. NGOs or Social Internships, rural internship, 10. Participate in open source development.
Internship Diary/ Internship Workbook:
Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor. Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.
Internship Work Evaluation:
Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Program Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks

Evaluation through Seminar Presentation/Viva-Voce at the Institute

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Depth of knowledge and skills
- Communication & Presentation Skills
- Team Work and Creativity
- Planning & Organizational skills
- Adaptability
- Analytical Skills
- Attitude & Behavior at work
- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Diary/Workbook
- Student's Feedback from External Internship Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

Internship Diary/workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries
- Adequacy & quality of information recorded
- Data recorded
- Thought process and recording techniques used
- Organization of the information

The report shall be presented covering following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details- Company background-organization and activities/Scope and object of the study / Supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor(External and Internal)
Post internship, faculty coordinator should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership… **Reference:** 1. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf 2. https://internship.aicte-india.org/

IMPORTANT NOTE:

The student shall be encouraged to undertake the industrial internships however the Industry may provide opportunity to a limited few amongst the students available. In such scenario it becomes the moral responsibility of the faculty to create opportunity for such group of students (similar to the ones in Industry) by assigning them some real life problem as a part of the mini project and encouraging/mentoring them to attempt viable solutions. Hence the provision of Mini project is being done to accommodate such students and expose them with the Industrial practices in house. The students can be encouraged to consider analysis of the global patents available as a mini project,

Mini project					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**4 Hrs./Week**	**Practical**	**4**	**Term work**	100

Course Objectives:

Students shall UNDERTAKE and EXECUTE a Mini Project through a group of students to

1. **UNDERSTAND** the "Product Development Cycle", through Mini Project.
2. **PLAN** for various activities of the project and distribute the work amongst team members.
3. **LEARN** budget planning for the project.
4. **INCULCATE** mechanical/interdisciplinary implementation skills.
5. **DEVELOP** students' abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
6. **UNDERSTAND** the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **EXPLAIN** plan and execute a Mini Project with team.

CO2. **IMPLEMENT** hardware/software/analytical/numerical techniques, etc.

CO3. **DEVELOP** a technical report based on the Mini project.

CO4. **DELIVER** technical seminar based on the Mini Project work carried out.

Course Contents

Maximum Group Size: Minimum 2 and maximum 4 students can form a group for the mini project.

Project Type: (The selected mini project must be based on any of the following)

1. Development of a prototype mechanical system/product.
2. Investigate performance of mechanical systems using experimental method

3. Parametric analysis of components/systems/devices using suitable software **4.** Investigation of optimum process/material for product development using market survey. **5.** Solution for society/industry problems
The Assessment Scheme will be: *a.* **Continuous Assessment 50 marks** *(based on regular interaction, circuit development)* b. **End Semester 50 marks** *(based on poster presentation, demonstration / Seminar)*
Project domain may be from the following, but not limited to: 1.Thermal Systems 2. Robotics Mechanisms/design systems 3. Production/advance manufacturing 4. Materials: Composite/Nano 5. Automation and Control Systems 6. Mechatronic Systems 7. Agriculture system. 8. Smart systems using AI-ML
A project report with following contents shall be prepared: 1. Title 2. Objectives 3. Relevance and significance 4. Methodology 5. Analysis-Simulation/experimentation/survey/testing etc. 6. Result and Discussion 7. Conclusion

302056: Audit Course VI		
Teaching Scheme	**Credits**	**Examination Scheme**
	Non-Credit	

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from third year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course VI

- Business and Sustainable Development
- Management Information System
- International Business

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BOS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary. • During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the mark-sheet.

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
For
Fourth Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering
(2019 Course)
Board of Studies – Mechanical and Automobile Engineering
(With Effect from Academic Year 2022-23)

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-VII														
402041	Heating Ventilation Air-Conditioning and Refrigeration	3	2	-	30	70	-	-	25	125	3	1	-	4
402042	Dynamics of Machinery	3	2	-	30	70	-	-	25	125	3	1	-	4
402043	Turbomachinery*	2	2	-	-	50	25	-	25	100	2	1	-	3
402044	Elective – III	3	-	-	30	70	-	-	-	100	3	-	-	3
402045	Elective - IV	3	-	-	30	70	-	-	-	100	3	-	-	3
402046	Data Analytics Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
402047	Project (Stage - I)	-	4	-	-	-	50	-	50	100	-	2	-	2
402054	Audit Course VII$	-	-	-	-	-	-	-	-	-	-	NC		
	Total	**14**	**12**	**-**	**120**	**330**	**125**	**-**	**125**	**700**	**14**	**6**	**-**	**20**
Semester-VIII														
402048	Computer Integrated Manufacturing	3	2	-	30	70	25	-	25	150	3	1	-	4
402049	Energy Engineering	3	2	-	30	70	25	-	25	150	3	1	-	4
402050	Elective - V	3	-	-	30	70	-	-	-	100	3	-	-	3
402051	Elective - VI	3	-	-	30	70	-	-	-	100	3	-	-	3
402052	Mechanical Systems Analysis Laboratory	-	2	-	-	-	25	-	25	50	-	1	-	1
402053	Project (Stage - II)	-	10	-	-	-	100	-	50	150	-	5	-	5
402055	Audit Course VIII$	-	-	-	-	-	-	-	-	-	NC			
		12	**16**	**-**	**120**	**280**	**175**	**-**	**125**	**700**	**12**	**8**	**-**	**20**

Elective-III		Elective-V	
402044A	Automobile Design	402050A	Quality and Reliability Engineering
402044B	Design of Heat Transfer Equipments	402050B	Energy Audit and Management
402044C	Modern Machining Processes	402050C	Manufacturing Systems and Simulation
402044D	Industrial Engineering	402050D	Engineering Economics and Financial Management
402044E	Internet of Things	402050E	Organizational Informatics
402044F	Computational Fluid Dynamics	402050F	Computational Multi Body Dynamics
Elective-IV		**Elective-VI**	
402045A	Product Design and Development	402051A	Process Equipment Design
402045B	Experimental Methods in Thermal Engineering	402051B	Renewable Energy Technologies
402045C	Additive Manufacturing	402051C	Automation and Robotics
402045D	Operations Research	402051D	Industrial Psychology and Organizational Behavior
402045E	Augmented Reality and Virtual Reality	402051E	Electrical and Hybrid Vehicle

Audit Courses			
402054A	Yoga Practices	**402054B**	Stress Management
402055A	Managing Innovation	**402055B**	Operations Management

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam, **TW**: Term Work, **OR**: Oral

- Student can select any elective subjects from the list given as per his/her choice. However, it is advised to select the subjects from within a group identified for specialization.

Instructions:

- Practical/Tutorial must be conducted in **FOUR batches per division** only.
- Minimum number of Experiments/Assignments in PR/Tutorial shall be carried out **as mentioned in the syllabi** of respective courses.
- Assessment of tutorial work has to be carried out similar to term-work. The Grade cum marks for Tutorial and Term-work shall be awarded on the basis of **continuous evaluation.**
- End semester examination shall be of 2 hrs. for the ***** Marked Turbomachinery Course.
- $^{\$}$Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude and behavior that students acquire through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of an engineering graduate.

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:

    a. that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;

    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;

    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;

    d. which need to be defined (modelled) within appropriate mathematical framework; and

    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an

understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402041: Heating, Ventilation, Air Conditioning and Refrigeration					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Thermodynamics, Applied Thermodynamics, Fluid Mechanics, Heat and Mass Transfer.

Course Objectives:

1. To understand and compare different refrigerants with respect to properties, applications and Environmental issues and Air refrigeration systems.
2. To understand Multistage compression cycles and multistage evaporator systems.
3. To understand various components, operating and safety controls employed in Refrigeration and Air Conditioning systems and advanced refrigeration systems.
4. To understand the basic air conditioning processes on psychometric charts, human comfort and to provide the knowledge of indoor and outdoor air quality requirements.
5. To study the ventilation and infiltration in air conditioning and duct design for various comfort conditions and industrial air conditioning systems.
6. To understand advanced A/C systems and heat pump.

Course Outcomes:

On completion of the course the learner will be able to;

CO1.**ANALYSE** different air-craft refrigeration systems and **EXPLAIN** the properties, applications and environmental issues of different refrigerants.

CO2.**ANALYSE** multi pressure refrigeration system used for refrigeration applications.

CO3.**DISCUSS** types of compressors, condensers, evaporators and expansion valves along with regulatory and safety controls and **DESCRIBE** Transcritical and ejector refrigeration systems.

CO4.**ESTIMATE** cooling load for air conditioning systems used with concern of design conditions and indoor quality of air.

CO5.**DESIGN** air distribution system along with consideration of ventilation and infiltration.

CO6.**EXPLAIN** the working of types of desiccants, evaporative, thermal storage, radiant cooling, clean room and heat pump systems.

Course Contents

Unit 1	**Gas Cycle Refrigeration and Refrigerants**

Gas Cycle Refrigeration: Application to air-craft refrigeration, Simple system, Bootstrap, Regenerative, reduced ambient system, Concept of Dry Air Rated Temperature (DART)

Refrigerants: Introduction, Definition and requirement, Classification of refrigerants, Designation of refrigerants, Desirable properties of Refrigerants-Thermodynamic, Chemical and Physical.

Properties of ideal refrigerant. Environmental issues like ODP, GWP & LCCP. Selection of environment friendly refrigerants, Alternative refrigerants, Secondary refrigerants, Anti-freeze solutions, Zeotropes and Azeotropes, Refrigerant recovery, reclaims, recycle and recharge.

Unit 2	Multi Pressure Systems

Multistage or Compound Systems: Need of multi staging, Two stage compression with flash gas removal, flash intercooler and complete multistage compression system.

Multi Evaporator Systems: Single compressor-individual expansion valve, Single compressor-multiple expansion valve, Individual compressor-multiple expansion valve, Individual compressor with compound compression and flash inter cooling. (Limited to two evaporators).

Ammonia-CO_2 cascade cycle. (Only theoretical approach).

Unit 3	Practical aspects of Vapor Compression and Advanced Refrigeration Systems

Major components of refrigeration cycle: Types of compressors, Characteristics of reciprocating and centrifugal compressors, Types of evaporators, Types of condensers and Types of expansion valves.

Safety Controls: LP/HP cut-off, Low temperature control, Frost control, Motor overload control, Oil pressure failure control. Capacity controls for different compressors.

Advanced Refrigeration System: Transcritical cycle and their types, Simple ejector refrigeration system (analysis and numerical)

Unit 4	Applied Psychrometry

Psychrometric Chart, Psychrometric processes using BPF, ADP, SHF, RSHF, GSHF, ESHF, ERSHF and adiabatic mixing of two air streams. Heat load estimation: - Air conditioning, heating & cooling load calculations.

Envelop Load estimation: Concept of sol-air temperature, Time lag & Decrement method and ETD or CLTD methods.

Thermal Comfort: Basic parameters, Thermodynamics of human body, Thermal comfort and Comfort charts, Factors affecting thermal comforts.

Indoor Air Quality (IAQ): Indoor air contaminants, Basic strategies to improve indoor air quality.

Outdoor Design Conditions: Outdoor air requirements for occupants, Use of outdoor weather data in design, Outdoor weather characteristics and their influence.

Unit 5	Ventilation, Infiltration & Air Distribution systems (Ducts)

Ventilation and infiltration: Natural ventilation, Mechanical ventilation.
Duct Design: Definition of duct and types of ducts, Economic factors influencing duct layout, Materials for ducts and its specification, Flow through duct, Pressure in ducts, Friction loss in ducts, Friction chart for circular ducts, Equivalent diameter of a circular duct for rectangular sections, Methods of duct designs. (Numerical treatment on duct design).

Air Distribution System: Factors considered in air distribution system, (simple numerical). Types of air distribution devices. Fan coil unit, Fan laws, Types of fans used in air conditioning applications, Types of supply air outlets, Selection and location of outlets, Filters, Diffusers, Grillers, and Dampers.

Unit 6	Advanced Air Conditioning Systems

Advanced AC Systems: Working of summer, winter and year-round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning.

Desiccant-Based Air Conditioning Systems: Introduction, Sorbents & Desiccants, Dehumidification, Liquid spray tower, Solid packed tower, Rotary desiccant dehumidifiers, Hybrid cycles, Solid desiccant Air-Conditioning (Theoretical treatment).

Evaporative Cooling Air Conditioning Systems, Thermal storage Air Conditioning systems, clean room Air Conditioning systems, Radiant cooling. (No numerical), Heat pumps and its different circuits.

Books and other resources

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983
3. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi
4. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt.Ltd, New Delhi,1994.
5. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992.
6. S.N.Sapali , Refrigeration and Air conditioning ,Eastern Economy Edition.
7. Arora R.C., Refrigeration and Air Conditioning, PHI, India.

References Books:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000.
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications.
4. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance.
5. ASHRAE Handbook (HVAC Equipments) & ISHRAE handbook.
6. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGrawHill Publications.
7. Wilbert Stocker, Industrial Refrigeration, McGrawHill Publications.
8. ASHRAE, Air Conditioning System Design Manual, IInd edition, ASHRAE.

Term Work

The student shall complete the following activity as a Term Work (Any eight experiments, No. 8 or 9 is compulsory):

1. Trial on Ice Plant.
2. Performance Simulation of Central Air-conditioning plant.
3. Trial on Air-conditioning system.
4. Performance analysis of Cooling tower.
5. Building heat load simulation using suitable software.
6. Design of cold storage with process layout.
7. Analysis of Vapor Compression Cycle using suitable software.
8. Visit to Refrigeration or cold storage Plant
9. Visit to Air Conditioning Plant.
10. Trial on heat pump/ejector/cascade/desiccant/evaporative systems.

402042: Dynamics of Machinery					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Pre-requisites: Strength of Materials, Engineering Mechanics, Kinematics of Machinery, Engineering Mathematics and Numerical Methods

Course Objectives:

1. To conversant with balancing problems of machines.
2. To understand mechanisms for system control – Gyroscope.
3. To understand fundamentals of free and forced vibrations.
4. To develop competency in understanding of vibration in Industry.
5. To develop analytical competency in solving vibration problems.
6. To understand the various techniques of measurement and control of vibration and noise.

Course Outcomes:

On completion of the course, students will be able to -

CO1. **APPLY** balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.

CO2. **ANALYZE** the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles.

CO3. **ESTIMATE** natural frequency for single DOF un-damped & damped free vibratory systems.

CO4. **DETERMINE** response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.

CO5. **ESTIMATE** natural frequencies, mode shapes for 2 DOF un-damped free longitudinal and torsional vibratory systems.

CO6. **DESCRIBE** noise and vibration measuring instruments for industrial / real life applications along with suitable method for noise and vibration control.

Unit 1	**Balancing**

Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines. Introduction to Balancing machines – Types, Classification and Methods

<table>
<tr><td>Unit 2</td><td>Gyroscope</td></tr>
<tr><td colspan="2">Introduction, Precessional angular motion, Gyroscopic couple, Effect of gyroscopic couple on an airplane, Effect of gyroscopic couple on a naval ship during steering, pitching and rolling, Stability of a Four Wheel drive moving in a curved path (Theoretical treatment only), Stability of a two wheel vehicle taking a turn (Theoretical treatment only), Effect of gyroscopic couple on a disc fixed rigidly at a certain angle to a rotating shaft.</td></tr>
<tr><td>Unit 3</td><td>Single Degree of Freedom Systems – Free Vibration</td></tr>
<tr><td colspan="2">Fundamentals of Vibration: Elements of a vibratory system, vector representation of S.H.M., degrees of freedom, Introduction to Physical and Mathematical modeling of vibratory systems: Bicycle, Motor bike and Quarter Car. types of vibration, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)
Un-damped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems. (Numerical on only longitudinal and transverse systems.)
Damped free vibrations: Different types of damping, Viscous damping – over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations.(Numerical only on Logarithmic decrement)</td></tr>
<tr><td>Unit 4</td><td>Single Degree of Freedom Systems - Forced Vibrations</td></tr>
<tr><td colspan="2">Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation (Numerical on only longitudinal systems), excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility
Quality Factor. Half power bandwidth method, Critical speed of shaft having single rotor of undamped systems. (Theoretical treatment only)</td></tr>
<tr><td>Unit 5</td><td>Two Degree of Freedom Systems – Un-damped Vibrations</td></tr>
<tr><td colspan="2">Free vibration of spring coupled systems – longitudinal and torsional, torsionally equivalent shafts, natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method (Numerical only on longitudinal systems and Matrix Method)
Combined rectilinear and angular motion, Vibrations of Geared systems (Theoretical treatment only)</td></tr>
<tr><td>Unit 6</td><td>Measurement and Control of Vibrations, Introduction to Noise</td></tr>
<tr><td colspan="2">A) Measurement: Vibration Measuring Instruments, Accelerometers, Impact hammer, Vibration shakers, Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards related to measurement of vibration.

B) Control: Vibration control methods - passive, semi active and active vibration control, control of excitation at the source, control of natural frequency, Vibration isolators, Tuned Dynamic Vibration Absorbers.

C) Noise: Fundamentals of noise, Sound concepts, Decibel Level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement, Noise control at the Source, along the path and at the receiver, Reverberation chamber, Anechoic Chamber, Noise standards. (Unit VI – Only theoretical treatment)</td></tr>
</table>

Books
Textbook: 1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi. 2. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee 3. Wiiliam J Palm III, Mechanical Vibration, Wiley India Pvt. Ltd, New Delhi 4. Uicker J. John, Jr, Pennock Gordon R, Shigley Joseph E., Theory of Machines and Mechanisms, International Version, OXFORD University Press, New Delhi. 5. M L Munjal, Noise and Vibration Control, Cambridge University Press India 6. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
References: 1. Weaver, Vibration Problems in Engineering, 5th Edition Wiley India Pvt. Ltd, New Delhi. 2. Bell, L. H. and Bell, D. H., Industrial Noise Control – Fundamentals and Applications‖, Marcel Dekker 3. Alok Sinha, Vibration of Mechanical System, Cambridge university Press, India 4. Debabrata Nag, Mechanical Vibrations, Wiley India Pvt. Ltd, New Delhi. 5. Kelly S. G., Mechanical Vibrations, Schaums outlines, Tata McGraw Hill Publishing Co. Ltd. 6. Meirovitch, L., Elements of Mechanical Vibrations‖, McGraw Hill. 7. Ver, Noise and Vibration Control Engineering, Wiley India Pvt. Ltd, New Delhi. 8. Bies, D. and Hansen, C., Engineering Noise Control - Theory and Practice, Taylor and Francis. 9. Shrikant Bhave, Mechanical Vibrations Theory and Practice, Pearson, New Delhi
Term Work
A] Compulsory Experiments (Sr. No. 1 to 6) 1. Balancing of wheel / rotor on computerized balancing machine OR Experimental verification of dynamic balancing of rotating masses. 2. To determine the natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient. 3. To obtain frequency response curves of single degree freedom system of vibration for different amount of damping. 4. To verify natural frequency of torsional vibration of two rotor system and position of node. 5. To measure vibration of healthy and faulty beam using FFT analyzer in time and/ or frequency domain and further classify the condition. 6. To measure noise of any healthy and faulty machine element and represent it into time and/or frequency domain and further predict the condition in future. B] Any Two Experiments from the following: 1. To determine critical speed of shaft with single rotor. 2. Experimental verification of principle of dynamic vibration absorber. 3. Experiment on shock absorbers and to plot its characteristic curve. 4. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect. 5. Industrial visit based on Conditioning Monitoring and Fault Diagnosis. C] List of Compulsory Assignment: 1. Simulation (using suitable software) of free response of SDOF damped system to demonstrate different damping conditions by solving differential equation numerically.

OR

2. Simulation (using suitable software) of total response of SDOF damped system to harmonic excitation by solving differential equation numerically.

OR

1. 3. A case study based on conditioning monitoring and fault diagnosis using machine learning.

Savitribai Phule Pune University
Board of Studies - Mechanical and Automobile Engineering
Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402043: Turbomachinery					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**2 Hrs./week**	**Theory**	**2**	**In-Semester**	**-**
Practical	**2 Hrs./week**	**Term Work**	**1**	**End-Semester***	**50 marks**
				Term Work	**25 marks**
End semester examination shall be of 2 hrs.				**Oral**	**25 marks**

Prerequisites: Fluid Mechanics, Thermodynamics, Heat Transfer, Engineering Mathematics

Course Objectives:
1. To provide the knowledge of basic principles, governing equations and applications of Turbomachines.
2. To provide the students with opportunities to apply basic thermos-fluid dynamics flow equations to Turbomachines.
3. To explain construction and working principles of Turbomachines.
4. To evaluate the performance characteristics of Turbomachines.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **VALIDATE** impulse moment principle using flat, inclined and curved surfaces and **INVESTIGATE** performance characteristics of hydraulic turbines.

CO2: **DETERMINE** performance parameters of impulse and reaction steam turbine along with discussion of nozzles, governing mechanism & losses.

CO3: **MEASURE** performance parameters of single & multistage centrifugal pumps along with discussion of cavitation and selection.

CO4: **EXPLAIN** performance parameters of centrifugal compressor along with discussion of theoretical aspects of axial compressor.

Course Contents

Unit 1	**Impact of Jet and Hydraulic Turbines**

Introduction and Impact of Jet: Introduction to Turbomachines (Hydraulic & Thermal), Classification of Turbo machines, Applications of Turbomachines. Impulse momentum principle and its application to fixed and moving flat, inclined, and curved plate/vanes. Velocity triangles and their analysis, work done equations, vane efficiency (No numerical)

Hydraulic Turbines:

Introduction to Hydro power plant, Classification of Hydraulic Turbines, Concept of Impulse and Reaction Turbines. Construction, Principle of Working, design aspects, velocity diagrams and its analysis of Pelton wheel, Francis, and Kaplan turbines, Degree of reaction, Draft tube: types and efficiencies, governing of hydraulic turbines, Cavitation in turbines.

Unit 2	Steam Turbines

Steam Nozzle: Equations for velocity and mass flow rate (No derivation, no numerical)
Steam Turbines: Construction and working of Impulse and Reaction steam turbine, velocity diagram, work done efficiencies, Multi-staging, compounding, Degree of reaction, losses in steam turbine, governing of steam turbines

Unit 3	Centrifugal Pumps

Introduction & classification of rotodynamic Pumps, Main Components of Centrifugal Pump, Construction and Working of Centrifugal Pump, Types of heads, Velocitytriangles and their analysis, Effect of outlet blade angle, Work done and Efficiency, Series and parallel operation of pumps, Priming of pumps, specific speed

Unit 4	Rotary Compressors

Centrifugal Compressors: Classification of Centrifugal Compressor, construction and working, velocity diagram, flow process on T-S Diagram, Euler's work, actual work input, various losses in Centrifugal Compressor

Axial flow compressors: Construction and working, stage velocity triangle and it's analysis, enthalpy entropy diagram, stage losses and various efficiencies of axial flow compressors, [No numerical]

Books and other resources

Text Books:

1. Fluid mechanics and hydraulic machines, Dr. R.K. Bansal, Laxmi Publication
2. Hydraulics & Fluid Mechanics and Machinery, Modi P N & Seth S N, Standard Book House
3. Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
4. Turbomachines, B. U. Pai, Wiley India
5. Steam and Gas Turbines and Power Plant Engineering, R. Yadav, Central Publication house

Web References:

https://nptel.ac.in/courses/112105206
https://nptel.ac.in/courses/112105182
https://nptel.ac.in/courses/112104117

Guidelines for Laboratory Conduction

- Term work shall consist of eleven experiments.
- Experiment No1,3,8,10,11 and 12 are compulsory.
- From remaining experiments (2,4,5,6,7 and 9) any five experiments are to be performed.
- Data from any one trial performed should be analyzed by using suitable software.

Term Work
The student shall complete the following activity as a Term Work: 1. Study of Impulse momentum principle and its application to fixed flat, moving, inclined, and curved plates/vanes. 2. Verification of Impulse Momentum Principle. 3. Study of Unit quantities, Specific speed and performance characteristics of hydraulic turbines. 4. Study and Trial on Impulse water Turbine and plotting the main and operating characteristics 5. Study and Trial on any one hydraulic Reaction Turbine and plotting the main and operatingcharacteristics. 6. Study and Trial on Convergent-Divergent Air/Steam nozzle 7. Study and Trial on steam Turbine and plotting the operating characteristics. 8. Study of Cavitation, NPSH, Thoma's cavitation factor, maximum suction lift. 9. Study and Trial on Centrifugal Pump and plotting the operating characteristics. 10. Study of Surging, stalling and choking phenomenon in compressors, performancecharacteristics of Centrifugal and Axial flow Compressors. 11. Visit to hydro/steam power plant and report to be submitted. 12. Visit to Pumping Station and report to be submitted. **OR** 12. Design of Pumping system installation using Manufacturers catalogue, specific to housing or industrial application.

402044A: Automobile Design					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Engineering Mathematics-I and II, Systems in Mechanical Engineering, Engineering Mechanics, Theory of Machines, Automobile Engineering, Design of Machine Elements

Course Objectives:

1. To help the students to acquire in-depth knowledge of design of Different engine components and engine subsystems.
2. To make students to understand the different chassis components selection and design.
3. To enable the students with the knowledge of Vehicle Packaging and System Integration and NVH.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **COMPREHEND** the steps involved in the design process of Principal Engine Components.
CO2: **GAIN** the knowledge and design of Engine Sub-Systems.
CO3: **COMPUTE** the critical dimensions of chassis components involved in the Steering System and Differential and final drive of a vehicle.
CO4: **SELECT** the tyres and wheels required for automobile vehicle and design the various types automotive brakes.
CO5: **UNDERSTAND** the design concepts of Automotive Suspension system
CO6: **POSSES** the knowledge of Vehicle Packaging and System Integration, NVH.

Course Contents

Unit 1 — Principal Engine Components

Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod. Design of crank-shaft and crank-pin, (Theoretical treatment only). Material for I. C. engine components.

Unit 2 — Engine Subsystems

Design of cooling system - radiator, water pump and fan, Computation of air cooling system, Design of fuel system, Governor, Intake and exhaust system, Selection of lubricant, lubricating system, pump and filters.

Unit 3 — Steering System and Differential

Mechanical Steering Gears, Power Steering Drives, Basic Principles of the Steering Process, Steering Kinematics, Steering Mechanism Design- Geometry for Correct Steering, Linkages, Basic Wheel

Alignment.

Design of propeller shaft. Design details of final drive gearing. Design of Bevel Gears in deferential, Design details of full floating, semi-floating and three quarter floating rear shafts.(Theoretical treatment only)

Unit 4	Wheels, Tyres and Automotive Brakes

Wheels and Tyres: Introduction, wheel tyre assemblies, wheels, rims, Wheel fixing, Tyres, Constructional details, Tread Design, Noise, Aspect Ratio, Tread Design consideration, Run Flat Tyres, Materials, Retreading and Manufacturing, Factors affecting tyre life.

Automotive Brakes: Mechanical Brakes, Hydraulic brakes, Servo brakes, Air brakes, ABS, Brake Lining, Brake efficiency, Stopping Distance, Theory of Internal Shoe Brake, banking of vehicles, Banking of vehicle on curved path. Numerical.

Unit 5	Automotive Suspension system

Springs - Types of Suspension Springs, Shock Absorbers, Independent Suspension system, Double wishbone suspensions, McPherson struts and strut dampers, Rear axle trailing-arm suspension, Semi-trailing-arm rear axles, Multi-link suspension, Air Suspension, Hydro-elastic suspensions, Rear Suspension (Dead Axle), Active Suspension, Suspension control systems,

Design of helical springs, Design of leaf springs, Numerical.

Unit 6	Vehicle Packaging and System Integration

Vehicle Packaging and System Integration: Introduction to Automotive Ergonomics, Vehicle Packaging background, Vehicle packaging organization, packaging engineering and ergonomics, Principles used in vehicle packaging, Vehicle packaging procedure, Mechanical packaging, Occupant packaging, driver package development steps and calculations, entry and exit considerations, driver field of view.

Engineering Anthropometry and Biomechanics: Engineering Anthropometry and Biomechanics, Use of Anthropometry in Designing Vehicles, Applications of Biomechanics in Vehicle Design

Books

Text Books:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", 2013, Society of Automobile Engineers Inc., ISBN: 978-1560911999
2. Engine Design – Giles J. G., Lliffe Book Ltd.
3. Engine Design – Crouse, Tata McGraw Publication, Delhi.
4. Design of Automotive Engine – A. Kolchin and V. Demidov
5. Automobile Engineering: Vol.1- Dr. Kirpal Singh, Standard Publishers Distributors.
6. A Textbook of Machine Design, R.S. Khurmi J.K. Gupta, Eurasia Publishing House.
7. Design of Machine Elements - V. B. Bhandari Tata McGraw-Hill, 2007
8. Automotive Product Development- A Systems Engineering Implementation- Vivek D. Bhise, CRC PressTaylor & Francis Group, ISBN-13: 978-1-4987-0681-0

References Books:

1. Chassis Handbook, Bernd Heißing | Metin Ersoy (Eds.) Vieweg+Teubner Verlag |Springer Fachmedien Wiesbaden GmbH 2011

2. The Motor Vehicle, T.K.Garrette, Steeds, Newton, Butterworth Heinemann.
3. The Automotive Chassis, Vol. 1: Components Design , Giancarlo Genta • Lorenzo Morello, ISBN: 978-1-4020-8673-1 e-ISBN: 978-1-4020-8675-5, 2009 Springer Science+Business Media B.V.
4. Ergonomics in the Automotive Design Process, Vivek D. Bhise, CRC Press, Taylor & Francis Group, ISBN-13: 978-1-4398-4211-9

Web References:

1. https://archive.nptel.ac.in/courses/107/106/107106088/
2. https://nptel.ac.in/courses/107103084

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402044B: Design of Heat Transfer Equipments					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Thermodynamics, Heat Transfer

Course Objectives:

1. Understand the basic concept and design methodology of heat exchangers.
2. Identify the design requirements for different types of heat exchangers
3. Define the important heat-exchanger design parameters
4. Perform sizing of a given type of heat exchanger for a specific application.
5. Make use of basic knowledge of fluid mechanics, heat transfer, and material properties in both performance and design calculations.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **EXPLAIN** the design aspect of heat exchanger considering fouling factor for Heat Transfer Applications

CO2: **SELECT** and **DESIGN** the double tube heat exchangers for process industry

CO3: **DESIGN** the Shell & Tube Heat Exchangers for specified conditions

CO4: **DESIGN** the condensers and evaporators for refrigeration applications

CO5: **DESIGN the** compact heat exchangers

CO6: **ANALYSE** the performance of counter and cross flow cooling tower.

Course Contents

Unit 1	**Fundamentals of Heat Exchanger Design**

Introduction: Introduction, classification of heat exchangers and their applications, different standards used for heat exchanger

Basics of heat exchanger design: Basic design equation, LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi –pass heat exchangers, Effectiveness - NTU method for heat exchanger design/analysis

Fouling of Heat Exchanger: Introduction, causes of fouling, types of fouling, effect of fouling, fouling factor, overall heat transfer coefficient with fouling, fouling factors for various process and services, methods to reduce fouling, cleaning process of fouled heat exchanger

Unit 2	**Double Pipe Heat Exchanger**

Constructional features, Applications, Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop, Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow, different methods to enhance the heat transfer coefficient (Theoretical Treatment only)

Unit 3	**Shell & Tube Heat Exchangers**

Tube layouts for exchangers, Baffled heat exchangers, Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter (Kerns method, Bell-Delaware method), The temperature difference in a 1-2 heat exchanger. Shell side pressure drop, Tube side pressure drop, Analysis and performance of 1-2 heat exchanger and design of shell & tube heat exchangers.

Unit 4	**Condensers and evaporators for Refrigeration systems**

Design considerations of heat exchangers for refrigeration and air conditioning applications, thermal design of heat exchanger used for refrigeration applications, air cooled condenser, Design considerations of Evaporative condensers.

Evaporator: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers,

Unit 5	**Design of compact heat exchangers**

Classification of compact heat exchangers, Plate heat exchangers (Numerical treatment), plate fin heat exchanger, tube fin heat exchanger (Numerical treatment), coiled tube heat exchangers (Numerical treatment), mini and micro channel heat exchangers, factors affecting on design of heat exchanger, Thermal analysis in compact heat exchanger.

Unit 6	**Direct Contact Heat Exchanger**

Cooling towers, relation between wet bulb & dew point temperatures, Classification of cooling towers, Cooling tower internals and the roll of fills, Heat Balance, Analysis of cooling tower requirements, Deign of counter flow, cooling towers, Determination of the number of diffusion units.

Books and other resources

Text Books:

1. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication
2. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill
3. Process Heat transfer by Donald Q Kern, McGraw Hill

References Books:

1. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
2. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press

Web References:

1. https://www.pdfdrive.com/heat-exchanger-design-handbook-e56045839.html
2. https://www.pdfdrive.com/heat-exchangers-book-e25375475.html
3. https://www.pdfdrive.com/heat-exchangers-selection-rating-and-thermal-design-third-edition-e186214274.html
4. https://www.pdfdrive.com/compact-heat-exchangers-selection-application-design-and-evaluation-e186388889.html

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402044C - Modern Machining Processes					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite

Engineering Materials and Metallurgy, Manufacturing Processes

Course Objectives

1. To understand the different modern machining process.
2. To evaluate the process parameters of modern machining processes.
3. To able to select the process for application.
4. To apply the knowledge of different modern machining for manufacturing.

Course Outcomes

On completion of the course, learner will be able to

CO1. **UNDERSTAND** and **ANALYZE** the mechanism, process parameters of mechanical assisted modern machining processes.

CO2. **UNDERSTAND** the mechanism, construction and working of laser, plasma and electron beam assisted machining.

CO3. **CLASSIFY** and **ANALYZE** the mechanism, process parameters of the chemical and electrochemical machining.

CO4. **RELATE** and **ANALYZE** the mechanism and select process parameters Electrical Discharge Machining for an application.

CO5. **ILLUSTRATE** the application of micromachining processes.

CO6. **SUGGEST** appropriate nanomachining process for the specific application.

Course Contents

Unit 1	**Mechanically Assisted Modern Machining Process**

Introduction to modern manufacturing processes, Need and classification of modern manufacturing methods.

Introduction to advanced Mechanical Energy Process machining processes and their classification, - Abrasive Jet Machining (AJM), Abrasive Water Jet Machining (AWJM), Ultra Sonic Machining (USM), Water Jet Machining (WJC) -Principle, Working, process parameters, Effect of process parameters on Material removal rate, tool wear, surface finish, Advantages, Limitations & applications, economics of machining.

Unit 2	Energy Assisted Modern Fabrication Process

Introduction to Energy Process machining processes, Principle, applications, classifications and selection, process parameters, concept of energy level, Heat Affected Zone and economics of the process in Laser beam machining (LBM) Laser Optics, Plasma arc machining (PAM), Electron Beam Machining (EBM), Focused Ion beam (FIB).

Unit 3	Electro-chemical Machining Process

Electro chemical machining (ECM): Introduction, Working Principle, equipment, process parameters, material removal rates, surface integrity, type of electrolyte, Advantages, limitations & applications of ECM, economics of machining.

Electrochemical Grinding (ECG), Electro stream Drilling (ESD), Photochemical machining (PCM) Chemical machining (ChM).

Unit 4	Electro-thermal Machining Process

Electric discharge machining (EDM): Introduction, Working Principle, EDM-Spark Circuits, selection of tool electrodes and dielectric fluids, process parameters, material removal rates, surface integrity, Heat Affected zone, Advantages, limitations & applications of EDM, Wire Electric Discharge Machining (W-EDM), Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), economics of machining. Electrochemical discharge machining (ECDM)

Unit 5	Micro And Precision Manufacturing Process

Micro machining processes that include working principle, material removal mechanism, effect of process parameters, materials processed, applications - Diamond turn machining, micro turning, Micro drilling, micro engraving, micro milling, Micro electro discharge machining, Case study on each process. economics of machining.

Unit 6	Nano-Machining And Nano Finishing Techniques

Fundamental of micro and nano technology, Effect of material aspects, concepts of micro and Nano systems and Microsystems Products, Microsystems and Microelectronics, Micro and Nano fabrication-wet and dry etching, photolithography-LIGA process, Application of Microsystems, Case study on MEMS.

Magnetic Abrasives Finishing (MAF), Abrasive Flow Finishing (AFF) Magnetorheological Finishing (MRF), Rotational - Magnetorheological Abrasive Flow Finishing (R-MRAFF).

Books & Other Resources

Text Books

1. V. K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill.
3. Production technology, HMT, McGraw Hill Education India Pvt. Ltd. 2001.
4. M. P Groover., “Fundamentals of Modern Manufacturing: Materials, Processes, and Systems”, 6th edition, Wiley 2015.

Reference Books

1. V. K. Jain, “Micro manufacturing Processes”, CRC Press.
2. R. Balasubramaniam, RamaGopal V. Sarepaka, Sathyan Subbiah, “Diamond Turn Machining:

Theory and Practice", CRC Press.
3. MEMS Material and Process Handbook, Reference proceedings, Reza Ghodssi, Pinyen Lin, Springer.
4. Hassan El-Hofy, "Advanced Machining Processes", McGraw Hill Publications.
5. Julian W. Gardner, "Microsensors MEMS and smart devices", Wiley.
6. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
7. A. Ghosh and A. K. Mallik, Manufacturing Science, East-West Press, New Delhi, 2006.

Web References

1. https://nptel.ac.in/courses/112/103/112103202
2. https://nptel.ac.in/courses/112/104/112104028
3. https://nptel.ac.in/courses/112/105/112105212

402044D: Industrial Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial		**Tutorial**		**End-Semester**	**70 Marks**

Prerequisites: Basic concepts of Mathematics and Mechanical Engineering, Industrial Orientation, Quality Control, Human Psychology, Basic Finance, Passion for Continual Improvement.

Course Objectives:

1. To introduce the concepts, principles, and framework of Industrial Engineering and Productivity enhancement approaches.
2. To familiarize the students with different time study and work measurement techniques for productivity improvement.
3. To introduce various aspects of facility design.
4. To acquaint the students with various components and functions of Production Planning and Control.
5. To acquaint the student about inventory management and approaches to control.
6. To acquire the students with concepts of ergonomics, value engineering and job evaluation.

Course Outcomes

Learner will be able to:

CO1. **EVALUATE** the productivity and **IMPLEMENT** various productivity improvement techniques.
CO2. **APPLY** work study techniques and **UNDERSTANDS** its importance for better productivity.
CO3. **DEMONSTRATE** the ability to **SELECT** plant location, appropriate layout and material handling equipment.
CO4. **USE** of Production planning and control tools for effective planning, scheduling and managing the shop floor control.
CO5. **PLAN** inventory requirements and **EXERCISE** effective control on manufacturing requirements.
CO6. **APPLY** Ergonomics and legislations for human comfort at work place and **UNDERSTANDS** the role of value engineering in improving productivity.

Course Contents

Unit 1	Introduction to Industrial Engineering and Productivity

Introduction to Industrial Engineering, Historical background and scope, Contribution of Taylor, Gilbreth, Gantt, Maynard, Ford, Deming and Ohno. Importance of Industrial engineering. Introduction to Work system design

Productivity: Definition of productivity, Measures of Productivity, Total Productivity Model, Need for Productivity Evaluation, Productivity measurement models, Productivity improvement

approaches, Principles, Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques. (Numerical on productivity measurement)	
Unit 2	**Work Study**
Method Study: Introduction and objectives, Areas of application of work study in industry, Selection and Basic procedure. Recording techniques, Operations Process Chart, Flow Process Chart (Man, Machine & Material) Multiple Activity Chart, Two Handed process chart, Flow Diagram, String Diagram and Travel Chart, Cycle and chronocycle graphs, SIMO chart, Therbligs, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design. **Work Measurement**: Techniques, time study, steps, work sampling, Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time, and standard time determination. (Numerical) Introduction to PMTS, MTM, and MOST	
Unit 3	**Production Facility Design**
Plant Location: Introduction, Factors affecting location decisions, Multi-facility location **Plant Layout**: Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart for flow analysis, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors, and process plant. Layout planning, Quantitative methods of Plant layout and relationship diagrams. Dynamic plant layout **Material Handling**: Objectives and benefits of Material handling, Relationship between layout and Material handling, Equipment selection	
Unit 4	**Production Planning and Control**
Types and methods of Production, and their Characteristics, functions and objectives of Production Planning and Control, Steps: Process planning, Loading, Scheduling, Dispatching and Expediting with illustrative examples, Capacity Planning, Aggregate production planning and Master production scheduling. Introduction to a line of balance, assembly line balancing, and progress control **Forecasting Techniques**: Causal and time series models, Moving average, Exponential smoothing, Trend and Seasonality. (Numerical)	
Unit 5	**Inventory and Inventory Control**
Materials: Profit Centre: Role of materials management techniques in material productivity improvement, cost reduction and value improvement. **Purchase Management**: Purchase management, incoming material control. Acceptance sampling and inspection. Vendor rating system.	

Inventory: Functions, Costs, Classifications, Deterministic inventory models and Quantity discount

Inventory Control: EOQ (Numericals), concepts, type of Inventory models-deterministic and probabilistic, Selective inventory control, Fundamental of Material Requirement Planning (MRP-I), Manufacturing Resource Planning (MRP-II), Enterprise Resource Planning (ERP), Just-in-Time system (JIT) and Supply Chain Management (SCM)

Unit 6	**Ergonomics, Value Engineering and Job Evaluation**

Ergonomics: Introduction to ergonomics and human factors Engineering - physiological basis of human performance, basic anatomy of human body and its functional systems; principles of ergonomics, design of display and controls in relation to information processing by human being, Introduction to Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA)

Value Engineering: VE concepts, Principles, Methodologies and standards, methods of functional analysis.

Job Evaluation and Wage Plan: Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans, Performance appraisal, concept of KRA (Key Result Areas), Introduction to industrial legislation.

Books and other resources

Text Books:

1. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
2. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication.

References Books:

1. Askin, Design and Analysis of Lean Production System, Wiley, India
2. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.
3. H. B. Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw Hill Education.
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002
5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press.
6. Barnes, Motion and time Study design and Measurement of Work, Wiley India
7. Sumanth, D.J, "Productivity Engineering and Management", TMH, New Delhi, 1990.
8. Edosomwan, J.A, "Organizational Transformation and Process re- Engineering", British Cataloging in publications, 1996.
9. Prem Vrat, Sardana, G.D. and Sahay, B.S, "Productivity Management - A systems approach", Narosa Publications, New Delhi, 1998.
10. Francis, R.L., and White, J.A, "Facilities layout and Location", Prentice Hall of India, 2002.
11. James A. Tompkins, John A. White, "Facilities Planning", Wiley, 2013
12. Richard L. Francis, Leon F Mc Ginnes and John A. White, "Facility Layout and Location-

An Analytical Approach", PHI, 1993
13. G. K. Agarawal, "Plant Layout and Material Handling", Jain Brothers, 2007

Web References:

1. https://archive.nptel.ac.in/courses/112/107/112107143/#
2. https://nptel.ac.in/courses/112107249
3. https://onlinecourses.nptel.ac.in/noc22_me04/preview
4. https://nptel.ac.in/courses/112107292
5. https://nptel.ac.in/courses/112107142

402044E: Internet of Things					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Systems in Mechanical Engineering**,** Programming and Problem Solving, Basic Electronics Engineering, Solid Mechanics, Solid Modeling and Drafting, Electrical and Electronics Engineering, Mechatronics, Measurement Laboratory, Fluid Power & Control Laboratory

Course Objectives:

1. Introduction to IoT, Overview of IoT Building Blocks
2. Build small applications in IoT for Mechanical Engineering Applications using Sensors, Actuators, Microcontrollers and Cloud
3. Learn commonly used IoT Simulation Hardware platforms
4. Understand different Communication Technologies used in IoT
5. Development of application level protocol and Security of IoT Ecosystem
6. Understand IoT applications in different domains

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** the Applications/Devices, Protocols and Communication Models of IoT
CO2. **DEMONSTARTE** small Mechanical Engineering IoT oriented applications using Sensors, Actuators, Microcontrollers and Cloud
CO3. **SELECT** commonly used IoT Simulation Hardware platforms
CO4. **APPLICATION** of Interfacing and Communication Technologies for IoT
CO5. **ILLUSTRATE** IoT Application Development and Security of IoT Ecosystem
CO6. **EVALUATE** Present and Future Domain specific Applications of IoT Ecosystem

Course Contents

Unit 1	**Introduction to the Internet of Things (IoT)**

Overview, History, Definition and Characteristics, Connectivity Terminologies, Building blocks, Types of technologies used in IoT System, Baseline Technologies (Machine-to-Machine (M_2M) communications, Cyber-Physical-Systems (CPS)), IoT Vs M_2M, IoT enabled Technologies, IoT Levels and Templates, Design Methodology, The Physical Design Vs Logical Design of IoT, Functional blocks of IoT and Communication Models/Technologies, Development Tools used in IoT, IoT Architecture and Protocols, Various Platforms for IoT, Real time Examples of IoT, Challenges in IoT, The process flow of an IoT application, Evolution of Connected Devices,

Applications of IoT, IoT Enablers, Overview of Governance, Privacy and Security Issues.	
Unit 2	**Sensors, Actuators and Microcontrollers**
Measuring physical and virtual quantities in digital world, Overview of Sensors working, Analog Vs Digital Sensors, Wired Vs Wireless Sensors, Types of Sensors, Types of Converters Types of Transducers and Actuator, Controlling Hardware, Types of Controller**,** Role of microcontroller as gateway to interfacing sensors and actuators, Microcontroller Vs Microprocessor, Type of microcontrollers in embedded System	
Unit 3	**IoT Simulation Environment Hardware platforms and Endpoint Interfacing**
IoT supported Hardware platforms: Introduction to IoT Simulation Environment and Devices (Raspberry Pi, Espressif Processors, Arduino), Architecture, Setup, IDE, Installation, Interfaces (serial, SPI, I_2C), Programming with focus on interfacing for reading input from pins, connecting external gadgets/sensors/actuators, Controlling and Displaying Output, Libraries, Basics of Embedded C programming **Interfacing:** Interfacing Input, Intermediate, Output and Display Sensors, Converters, Actuators, Controlling Hardware, Controllers and Network Devices, **IoT Architecture:** Building architecture and Open source architecture (OIC), Main design principles and needed capabilities, An IoT architecture outline, Standards Considerations	
Unit 4	**Interfacing and Communication for Building IoT Applications**
Communication: Overview and Working of Controlled Systems, Connectivity models - TCP/IP Vs OSI model, IoT Communication Models, IoT Communication APIs, Serial Vs Parallel Communication, Wires Vs Wireless Communication, their Technologies and Hardware **IoT Communication Protocols:** Protocol Standardization for IoT, Role of M_2M in IoT, M_2M Value Chains, IoT Value Chains, M_2M and WSN Protocols (SCADA and RFID) **Physical Servers and Cloud Platforms:** Web server, Posting sensor(s) data to web server, Introduction to Cloud Storage models and Communication APIs Webserver, API Virtualization concepts and Cloud Architecture, Advantages and limitations of Cloud computing, IoT Cloud platforms, Cloud services	
Unit 5	**IoT Application Development and Security of IoT Ecosystem**
Application Protocols: MQTT, REST/HTTP, SQL Back-end Application Designing (Designing with Apache, MySQL, HTML, CSS), Non SQL Back-end Application Designing (MongoDB Object Type Database, jQuery for UI Designing), JSON lib for data processing **Security:** Need of security in IoT, Security & Privacy during development, Privacy for IoT	

enabled devices, IoT security for consumer devices, Security levels, protecting IoT devices, Security, Privacy and Trust in IoT-Data-Platforms	
Unit 6	**Present and Future Domain specific Applications of IoT Ecosystem**
IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, Business, Manufacturing, Smart Homes/Home automation, Surveillance applications, Connected Vehicles, Agriculture, Healthcare, Activity Monitoring, Retail, Logistics, Security, Health and Lifestyle, Legal challenges, IoT in Environmental Protection Modern Day IoT Applications, Smart Grid, Smart Cities - Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities **Future:** Future IoT ecosystem, Need of powerful core for building secure algorithms, Examples for new trends (AI, ML penetration to IoT)	
Books and other resources	

Text Books:

1. Bahga, A. and Madisetti, V., (2015), "Internet of Things - A Hands-on Approach," Universities Press, ISBN: 9788173719547
2. Hajjaj, S S H. and Gsangaya, K. R., (2022), "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers," CRC Press, ISBN: 9781032110950
3. Raj, P. and Raman, A. C., (2017), "The Internet of Things: Enabling Technologies, Platforms, and Use Cases," Auerbach Publications/CRC Press, ISBN: 9781498761284
4. Adrian McEwen, A. and Cassimally, H., (2013), "Designing the Internet of Things," John Wiley and Sons, ISBN:
5. Veneri, G., Capasso, A., (2018), "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0," Packt Publishing, ISBN: 9781789537222
6. Hersent, O, Boswarthick, D., Elloumi, O., (2012), "The Internet of Things: Key Applications and Protocols", Wiley, ISBN: 9781119994350
7. Uckelmann, D., Harrison, M., Michahelles, F., (2011), "Architecting the Internet of Things," Springer, ISBN: 9781119994350

References Books:

1. daCosta, F., (2013), "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, ISBN: 9781430257417
2. Waher, P., (2015), "Learning Internet of Things," Packt Publishing, ISBN: 9781783553532
3. Ovidiu, V. and Friess, P., (2014), "Internet of Things - From Research and Innovation to Market Deployment," River Publishers, ISBN: 9788793102941, https://www.riverpublishers.com/pdf/ebook/RP_E9788793102958.pdf
4. Ida, N., (2020), "Sensors, Actuators and Their Interfaces," SciTech Publishers, ISBN: 9781785618352
5. Pfister, C., (2011), "Getting Started with the Internet of Things," O'Reilly Media, ISBN:

9781449393571
6. Wallace, S., Richardson, M., Wolfram Donat, W., (2021), "Getting Started With Raspberry Pi: Getting to Know the Inexpensive ARM-Powered Linux Computer," Make Community, LLC, ISBN: 9781680456998
7. Elangovan, U., (2019), "Smart Automation to Smart Manufacturing: Industrial Internet of Things," Momentum Press, ISBN: 9781949449266
8. Jha, S., Tariq, U., Joshi, G. P., Solanki, V. K., (2022), "Industrial Internet of Things: Technologies, Design, and Applications," CRC Press, ISBN: 9780367607777
9. Schwartz, M., (2016), "Internet of Things with Arduino Cookbook," Packt Publishing, ISBN: 9781785286582
10. Kurniawan, A., (2019), "Internet of Things Projects with ESP32: Build exiting and powerful IoT projects using the all-new Expresif ESP32," Packt Publishing, ISBN: 9781789956870

Web References:

1. https://nptel.ac.in/courses/106105166
2. https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/
3. http://playground.arduino.cc/Projects/Ideas
4. http://www.megunolink.com/articles/arduino-garage-door-opener
5. http://www.willward1.com/arduino-wifi-tutorial
6. http://www.toptechboy.com/arduino-lessons
7. https://www.eprolabs.com
8. http://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives

402044F: Computational Fluid Dynamics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Systems in Mechanical Engineering, Engineering Thermodynamics, Applied Thermodynamics, Fluid Mechanics, Numerical & Statistical Methods, Heat & Mass Transfer, Computer Aided Engineering

Course Objectives:

1. Model fluid / heat transfer problems, apply fundamental conservation principles and Identify Discretization methods
2. Formulate a model the for conduction and advection problems
3. Formulate a model the for Convection-Diffusion problems
4. Understand the External/Internal flow simulation
5. Recognize the Scales of turbulence and Understand the formulation methods
6. Understand the Fluid-Structure Interaction Problems and their applications

Course Outcomes:

On completion of the course the learner will be able to;

- CO1. **DISTINGUISH** and **ANALYSE** the governing equations of fluid mechanics and heat transfer in various formulations
- CO2. **ANALYZE** and **MODEL** the conduction and advection problems
- CO3. **ANALYZE** and **MODEL** the Convection-Diffusion problems
- CO4. **IDENTIFY** and **EVALUATE** the External/Internal flow and its simulation
- CO5. **DISTINGUISH** and **COMPARE** concepts of stability and turbulence.
- CO6. **USE** and **APPLY** a CFD tool for effectively solving practical Fluid-Structure Interaction problems

Course Contents

Unit 1	**Introduction to Computational Fluid Dynamics**

Introduction to Computational Fluid Dynamics, CFD as a research and design tool, Applications in various branches of Engineering, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions, Discretization methods for the CFD (FDM, FVM, FEM, Hybrid Methods), Intro to Meshless Methods, Meshed Vs Meshless Methods

Unit 2	Conduction and Advection
Conduction: Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Stability Criteria **Advection:** Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD, second order upwind and QUICK convection schemes	
Unit 3	**Convection-Diffusion**
Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number	
Unit 4	**Introduction to External/Internal flow simulation**
Solution of Navier-Stoke' equation for incompressible flow using SIMPLE algorithms for lid driven cavity flow problem, Introduction to external flow simulation – Flow over circular Cylinder and Aerfoils.	
Unit 5	**Turbulent Flow Modeling**
Introduction to turbulence, Scales of turbulence, Reynolds Averaged Navier-Stokes (RANS) equation, One equation model (Derivation) and two equation model, Introduction to Direct Numerical Simulation (DNS), Large Eddy Simulation (LES)	
Unit 6	**Introduction to Fluid-Structure Interaction**
Types of Fluid-Solid Couplings, Applications, Mechanical Forces and Equilibrium, Rigid Body Motions, Balance Laws in Lagrangian and Eulerian Form, Lagrangian Solid System, Eulerian Fluid System, Kinematics of Eulerian and Lagrangian Modeling, Continuum Mechanics of Moving Domains, Coupled Fluid-Structure Equations, Application of Arbitrary Lagrangian Eulerian (ALE) Formulation	

Books and other resources

Text Books:

1. Ghoshdastidar, P. S. (2017), "Computational Fluid Dynamics and Heat Transfer," Cengage learning, ISBN: 9788131533079
2. Atul Sharma, A., (2016), "Introduction to Computational Fluid Dynamics: Development, Application and Analysis," Wiley, ISBN: 9781119002994
3. Versteeg, H. K., Malalasekhara, W., (2007), "An Introduction to Computational Fluid Dynamics: The Finite Volume Method," PHI, ISBN: 9780131274983
4. Muralidharan, K., Sundarajan , T., (2009), "Computational Fluid Flow and Heat Transfer," Narosa Pub, ISBN: 9788173195228
5. Rao, J.S., (2017), "Simulation Based Engineering in Fluid Flow Design," Springer, ISBN: 9783319463810
6. Anderson, Jr., D. A. A (2017), "Computational Fluid Dynamics - the Basics with

Applications," , McGraw Hill Education, ISBN: 9781259025969

7. Jaiman, R. K. and Joshi, V., (2022), "Computational Mechanics of Fluid-Structure Interaction: Computational Methods for Coupled Fluid-Structure Analysis," Springer, ISBN: 9789811653544

References Books:

1. Thompson, J. F., Soni, B. K., Weatherill, N. P., (1998), "Handbook of Grid Generation," CRC Press, ISBN: 9780849326875
2. Ferziger, J. H., Perić, M., Street, R. L., (2019), "Computational Methods for Fluid Dynamics,"Springer, ISBN: 9783319996912
3. Pletcher, R.H., Tannehill, J.C., Anderson, D.A., (2012), "Computational Fluid Mechanics and Heat Transfer," CRC Press, ISBN: 9781591690375
4. Patankar, S. V., (2017), "Numerical Heat Transfer and Fluid Flow," CRC Press, ISBN: 9781138564695
5. Chung, T. J., (2014), "Computational Fluid Dynamics," Cambridge University Press, ISBN: 9781107425255
6. Tu, J., Yeoh, G-H. and Liu, C., (2018), "Computational Fluid Dynamics: A practical approach," Butterworth-Heinemann, ISBN: 9780081011270
7. Date, A. W., (2005), "Introduction to Computational Fluid Dynamics," Cambridge University Press, ISBN: 9780521685337
8. Schlichting, H., Gersten, K., (2016), "Boundary-Layer Theory," Springer, ISBN: 9783662529171
9. Tennekes, H. and Lumley, J. L., (2018), "A First Course in Turbulence," The MIT Press, ISBN: 9780262536301
10. Wilcox, D.C., (1998), "Turbulence Modeling for CFD," DCW Industries, ISBN: 9780963605153
11. Paidoussis M. P., Price, S. and de Langre, E., (2011), "Fluid-Structure Interactions: Cross-Flow-Induced Instabilities," Cambridge University Press, ISBN: 9780521119429
12. Bungartz, H-J. and Schäfer, M., (2006), "Fluid-Structure Interaction: Modelling, Simulation, Optimization," Springer, ISBN: 9783540345954

Web References:

1. Singh, K. M., (2019), "Computational Fluid Dynamics," IIT Roorkee, https://nptel.ac.in/courses/112107080
2. Ramakrishna, M., (2019), "Introduction to CFD," IIT Madras, https://archive.nptel.ac.in/courses/101/106/101106045/
3. Roy, A., (2019), "Introduction to CFD," IIT Kharagpur, https://archive.nptel.ac.in/courses/101/105/101105085/
4. Chakraborty, S., (2020), "Computational Fluid Dynamics," IIT Kharagpur, https://archive.nptel.ac.in/courses/112/105/112105254/
5. Chandrasekaran, S., (2019), "Advanced Marine Structures," IIT Madras, https://nptel.ac.in/courses/114106037

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402045A: Product Design and Development					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Pre requisites: Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes Etc.

Course Objectives:

To explain student's significance of

1. Product design and Product development
2. Market Survey & Product Specification Finalization
3. Concept Inception, Verification and selection
4. Concept Exploration & Development
5. Design Verification and Validation
6. Robust Design and Development

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** Product design and Product development processes

CO2. **UNDERSTAND** Processes, tools and techniques for Market Survey & Product Specification Finalization

CO3. **UNDERSTAND** Processes, tools and techniques for Concept Inception, Verification and selection

CO4. **UNDERSTAND** Processes, tools and techniques for Concept Exploration & Development

CO5. **UNDERSTAND** Processes, tools and techniques for Design Verification and Validation

CO6. **UNDERSTAND** Processes, tools and techniques for Robust Design and Development

Course Contents

Unit 1	**Introduction to Product Design and Development**

Topics- Product design and Development definition, Objectives of Product design and development, Engineering Design Process, Engineering Development Process (Gateway System), Product Design Vs Product Development, Features of successful product design and development, Essential Factors for product design, The challenges of product development, ASIMOW Model/Morphology of product design, Who design and develops product-Concurrent engineering approach/CFT Approach, Reasons for new product failure, Product Life Cycle

<table>
<tr><td>Unit 2</td><td>Market Survey & Product Specification Finalization</td></tr>
<tr><td colspan="2">Topics- Product definition, Types of products, Customer Population and Market segmentation- Types of customers and Needs, Customer need Models- Introduction to Kano Model, Triz Method/Altshuller Matrix, Design Thinking, etc. Types of Design information and the Various Sources of information, Product planning and its Phases, Mission statement and Technical Questioning, Technology forecasting and S-curve, Tools for gathering Customer needs, QFD and House of quality</td></tr>
<tr><td>Unit 3</td><td>Concept Inception, Verification and selection</td></tr>
<tr><td colspan="2">Topics- Idea generation and Idea generation approaches-Triz Method, Benchmarking, Brainstorming, Alternate thinking, Reverse Engineering etc, Product Policy of an organization, Selection of Profitable Concept- SWOT Analysis, Concept Selection Process, Pugh’s Concept selection process, Concept Analysis- Marketing aspect, Product characteristics (Functional/ Operational/Durability/Aesthetic/Ergonomic Aspects), Economic analysis, Production aspect, functional Modelling and decomposition- Functional analysis system technique, Subtract and operate procedure</td></tr>
<tr><td>Unit 4</td><td>Concept Exploration & Development</td></tr>
<tr><td colspan="2">Topics-Solid Modelling of part and assembly, Product architecture, Digital product design of part and assembly with respect to Engineering drawing definition, Classification of engineering drawing, Elements of production drawing, Bill of material, Types of dimensions, Arrangement of dimensions, Principles of dimensioning, Limits, Fits and Tolerances, Geometric Tolerances, Datum System, Design for Assembly, Design for manufacturing, Design for processes, Product design Steps, Introduction of Ergonomics in product design, Design Review/Part Print Analysis</td></tr>
<tr><td>Unit 5</td><td>Design Verification and Validation</td></tr>
<tr><td colspan="2">Topics-FEA-CFD-MBD-FSI, Simulation driven design, Additive manufacturing, Policy and Homologation certification by National and International agencies, Introduction to Break Even analysis and Production capacity planning, Make VS buy Decision, Business case Preparation, Facility tooling and gauges design and Development- Vendor Development, Letter of Intent, Purchase order, Product costing, Product Testing and Validation, Introduction to Production part approval process tools (PPAP)</td></tr>
</table>

Unit 6	**Robust Design and Development**

Tools and Techniques for Robust design and Development- Advance Product Quality Planning, Design Failure Mode Effect Analysis, Value Analysis and Value Engineering, Product Life cycle management and Product data Management etc.

Case studies on-

1. Teamcenter application in Product design and Development
2. DFMEA (Minimum Three parts)
3. Process Flow Chart (Minimum Three Parts)
4. Part Print analysis (Minimum Three Parts)

Text Books:

1. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
2. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000.
3. How Products are made by Jocqueline L. Longe
4. Creating Innovative products Using Total Design by Don Clausing and Ron Andrade
5. Metrics and Case Studies For Evaluating engineering designs by Jay Alan Moody
6. Understanding Engineering Design by Richard Birmingham
7. Designing for quality by Robert H. Lochner
8. New Product development by Barclay Z. Dann P. Holroyd
9. Developing an Ergonomics Processes by Alison Heller

References Books:

1. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education Inc.
2. Grieves, Michael, Product Lifecycle Management McGraw Hill
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub.
2. 4. Karl Ulrich, product design and development, TMH.

402045B: Experimental Methods in Thermal Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Basics of Physics. Fundamentals of Thermodynamics, Fluid Mechanics & Heat transfer.

Course Objectives:

1. To introduce the theory and experimentation in thermal engineering - Problem solving approaches, types of engineering experiments, computer simulation and physical experimentation.
2. To enhance the knowledge of various measuring instruments, techniques and importance of error and uncertainty analysis.
3. To give the exposure to measurement of pressure, flow velocity, measurement of temperature, optical methods of measurement.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **IDENTIFY** the suitable instrument for measuring parameters as per performance characteristics

CO2. **ANALYZE** experimental data by using different statistical techniques and estimate error

CO3. **DISTINGUISH** different methods of temperature measurements and thermal radiation

CO4. **CLASSIFY** various pressure measurement instruments and their comparison

CO5. **EXPLAIN** different flow measurement methods and flow visualization techniques

CO6. **APPLY** knowledge of modern engineering experimentation, including calibration, data acquisition, analysis and interpretation using different AI and ML techniques

Course Contents

Unit 1	**Measuring instruments**

Basics of measuring instruments: Fundamental elements of a measuring instrument, Calibration, System response, Importance of measurement and experimentation, Selection of measuring system

Characteristics of instruments: Elements of Measuring Instruments Performance characteristics - Static & Dynamic characteristics, Response of general form of instrument, Random and transient input, Instrument loading under static and dynamic condition, Transducer and sensor used for thermal systems

<table>
<tr><td>Unit 2</td><td>Design of Experiments</td></tr>
<tr><td colspan="2">Analysis of Experimental Data: Analysis of experimental data, Causes and type of experimental errors, data reduction techniques, statistical analysis of experimental data, Statistical distributions, probability distributions and curve fitting, Regression analysis, Co-relations

Uncertainty Analysis: Nomenclature, Precision Vs Accuracy, Errors in measurement, Sampling. (Numerical on Uncertainty analysis)

Design of Experiments: Factorial Design, Taguchi Method, Response Surface Design (Case studies of experimental work)</td></tr>
<tr><td>Unit 3</td><td>Temperature, Heat flux and Radiation measurements</td></tr>
<tr><td colspan="2">Temperature and Heat flux measurement: Overview of thermometry, Thermoelectric temperature measurement, Hg-in-glass thermometer, RTD (Resistance Temperature Detector), thermistor, thermocouple, thermopile, liquid-crystal thermography, optical pyrometer. Themo well, Issues in Heat flux measurements. Thermos profile of heat exchanger. Non-contact type temperature Measurements

Thermal radiation measurements: Detection of thermal radiation, Radiation Thermometry, Measurement of emissivity, Reflectivity and transmissivity measurements, Solar radiation measurements.</td></tr>
<tr><td>Unit 4</td><td>Pressure measurements</td></tr>
<tr><td colspan="2">Different pressure measurement instruments and their comparison, Types of Sensors used in Pressure Measurement, Manometers, bourdon tube pressure gauge, diaphragm gauge, bellow gauge, McLeod gauge, Pirani gauge and ionization gauge. Transient response of pressure transducers. Pressure measurements in combustions. Applications of Pressure measurements. (Numerical on Pressure measurements)</td></tr>
<tr><td>Unit 5</td><td>Flow measurements and Visualization techniques</td></tr>
<tr><td colspan="2">Flow measurements: Introduction to Flow Measurement, Positive displacement flow meters, Flow obstruction methods, Magnetic flow meters, LDA (Laser Doppler Anemometry), Other methods. Applications of flow measurements.

Flow visualization techniques: Shadowgraph, Schlieren and interferometer. Other methods. Ultrasonic flow measurement. Flow measurements techniques used to validate CFD results. Micro channel flow measurement. Velocity measurement based on thermal effect.</td></tr>
<tr><td>Unit 6</td><td>DAS and AIML</td></tr>
<tr><td colspan="2">Data Acquisition System (DAS) and Signal analysis: General Data Acquisition System, Signal conditioning, storage, Data transmission, - A/D & D/A conversion - Data storage and Display

AI & ML (Artificial Intelligence & Machine Learning) Applications: Introduction to AI / ML.</td></tr>
</table>

Approaches of AI/ ML. Predication of Measurement Parameter using ML Approaches such as Regression/ Classification. Finding Statistical Parameter such as ANOVA (Analysis of Variance), Correlation.

Books and other resources

Text Books:

1. Holman, J.P., “Experimental methods for engineers”, Tata McGraw hill 7th Edition, 2007
2. E.O. Doebelin, Measurement systems, Application and Design, 5 th edition, Tata McGraw-Hill, 2008
3. Beckwith & Buck : Mechanical Measurements
4. Willard, Mertt, Dean,Settle : Instrumental Methods of analysis

References Books:

1. Morris A.S, “Principles of Measurements and Instrumentation”, 3 Edition, Butterworth-Heinemann, .
2. Prebrashensky V., “Measurement and Instrumentation in Heat Engineering”, Vol.1, MIR Publishers, .
3. T.G. Beckwith, J.H. Lienhard V, R. D. Marngoni, Mechanical Measurements, 5 th edition, Pearson Education, 2010
4. D.C. Montgomery, Design and Analysis of Experiments, John Wiley, New York.
5. Introduction to Machine learning, Nils J.Nilsson
6. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402045C: Additive Manufacturing					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite: Manufacturing processes, Engineering metallurgy, Solid mechanics

Course Objectives

1. To know the principle, methods, possibilities and limitations as well as environmental hazards of Additive Manufacturing technologies.
2. To get familiar with the characteristics of the different materials used in Additive Manufacturing technologies
3. To explore the potential of additive manufacturing technologies in real life applications.

Course Outcomes

On completion of the course, learner will be able to

- CO1. **USE** and **CLASSIFY** the fundamentals of Additive Manufacturing Technologies for engineering applications.
- CO2. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using light-based photo-curing, LASER based technologies and **STUDY** their applications, benefits.
- CO3. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using extrusion-based deposition, inkjet-based technologies and **STUDY** their applications, benefits.
- CO4. **SYNTHESIZE, RECOMMEND** and **DESIGN** the suitable material and process for fabrication and build behavior of verities of product.
- CO5. **DESIGN** and **CONSTRUCT** the AM equipment's for appropriate applications and the input CAD model.
- CO6. **DEVELOP** the knowledge of additive manufacturing for various real-life applications.

Course Contents

Unit 1	**Introduction to Additive Manufacturing**

Introduction to AM, Historical Development, Additive v/s Conventional Manufacturing, Role of AM in Product development cycle, Rapid prototyping, Relevance of AM in Industry 4.0, Current industry and manufacturing trends driving AM, AM Process-Chain, Reverse engineering, Advantages, Types of materials, Classification of AM Processes (Process-based, material form based, application-based - direct and indirect processes and Micro- and Nano-additive processes), Process Planning for Additive Manufacturing

Unit 2	Light and LASER based Techniques
Introduction, Process and mechanism, Materials, Process Physics, Parameters, Benefits, Drawbacks, Limitations and Applications of **Light-Based Photo-curing**: Stereolithography (SLA), Digital Light Processing (DLP), Direct Laser Writing (DLW), Continuous Liquid Interface Production (CLIP) **Laser-Based Melting**: Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Selective Laser Melting (SLM), Electron-Beam Melting (EBM), Laser Blown Powder, Laser Wire Deposition, Laser Engineered Net Shaping (LENS), 3D Laser Cladding	
Unit 3	**Extrusion and energy based Techniques**
Introduction, Process and mechanism, Materials, Process Physics, Parameters, Benefits, Drawbacks, Limitations and Applications of **Extrusion-Based Deposition**: Fused Deposition Modeling (FDM), Fused Filament Fabrication (FFF), Direct Ink Writing (DIW), Robocasting, Bio-printing **Inkjet(droplet)-Based Deposition and Fusion**: Multi-jet Modeling (MJM), Polyjet Printing, Nanoparticle Jetting, Binder Jetting, Multi-Jet Fusion, Color-jet Printing (CJP), Energy Deposition Techniques: Plasma/TIG/MIG/Arc Deposition, Electron Beam-based DED, Direct Metal Deposition (DMD)	
Unit 4	**Materials and Design for AM**
Introduction, Materials: Metals, Polymers, Ceramics & Bio-ceramics, Composites, Hierarchical Materials, Biomimetic Materials, Shape-Memory Alloys, 4D Printing & Bio-active materials, Material selection, **AM Material Specific Process Parameters**: Processes, Heat or Chemical Treatments, Phase Transformations, Process Selection for various applications, DfAM: Process specific strategies, Rules and Recommendations, **Quality considerations and Post-Processing techniques**: Requirements and Techniques, Support Removal, Sanding, Acetone treatment, Polishing, Heat treatments, Hot isostatic pressing, Materials science, Surface enhancement Techniques and its Material Science Analysis of AM's error sources	
Unit 5	**Hardware and Software for AM**
Construction of Basic AM Machines: Equipment Layout and sub-system Design, Construction, Working, Equipment Topology/Layout Frame Designs, 3D Printer Design Considerations (Filament, Frame, Build Platform, Extruder Design, Nozzles, Print Bed, Heated build/Base Plate, Heater, Dispenser, Optical system, Cooling system, Gas Recirculation System, Laser controller, Gas Filtration, Inert Gas Cooling system, Powder Handling System, Loading/unloading System, Moving Parts and end stops, Sensors, Actuators, Motors and Control Electronics, Power supply, Machine Tool Peripheral), Raw Material Manipulation **Software and Controller**: Types of In-fill, Types of slicing, Software Integration (with Process, Slicing, etc), Control system (PLC and safety PLC, micro control/ Microcontroller, Micro-processor control), CAD Software and Controller Interfacing, CURA Software, Relevant G/M Codes, Standard firmware (Merlin Software, etc), In-process Monitoring, Calibration	

Unit 6	Case Studies, Application and Special Topics

Case Studies and Application of AM: 3D printing in prominent industries (Aerospace, Electronics, Defense, Automotive, Construction, Architectural, Machine-Tools), Other industrial applications (Health-Care, Personalized Surgery, Bio-medical Applications, Assistive Devices, Food-Processing, Food & Consumer Applications, Art, Fashion, Jewelry, Toys & Other Applications, etc)

Special Topics: 4D/5D Printing, Bio-printing, Bio-materials, scaffolds and tissue and Organ Engineering, Mass Customization and Future trends.

Books & Other Resources

Text Books

1. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015 2.
2. Amit Bandyopadhyay, Susmita Bose, “Additive manufacturing”, CRC Press, Taylor & Francis Group, 2016 3.
3. Ian Gibson, David W. Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer, 2010

Reference Books

1. L. Lu, J. Y. H. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Springer, 2001
2. Andreas Gebhardt and Jan-Steffen Hötter, "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing" Hanser Publishers, Munich, 2016.
3. Ben Redwood, FilemonSchöffer& Brian Garret, "The 3D Printing Handbook: Technologies, design and applications", 3D Hubs B.V. 2017
4. Ehsan Toyserkani, Amir Khajepour, Stephen F. Corbin, “Laser Cladding”, CRC Press, 2004
5. Andreas Gebhardt, “Understanding Additive”, Hanser Publishers, Munich, 2011
6. Ben Redwood, Filemon Schöffer & Brian Garret, “The 3D Printing Handbook – Technologies, Design and Applications” Part One:3D Printing Technologies and Materials, 3D Hubs, 2017
7. Chee Kai, Kah Fai, Chu Sing, ‘Rapid Prototyping: Principles and Applications”, 2nd Ed., 2003
8. D. T. Pham and S.S. Dimov, “Rapid Manufacturing” Springer, 2001
9. Rupinder Singh J. Paulo Davim, “Additive Manufacturing - Applications and Innovations” CRC Press Taylor& Francis Group, 2019
10. . I. Gibson, D. W. Rosen, B. Stucker, “Additive Manufacturing Technologies” Springer, 2010
11. L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny, “3D Printing and Additive Manufacturing Technologies” Springer, 2019

Web References

1. NPTEL Course on Fundamentals of Additive Manufacturing Technologies by Prof. SajanKapil, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. Introduction to Additive Manufacturing, https://www.youtube.com/watch?v=LCQoi10cG To NPTEL IIT Kanpur, “Rapid Manufacturing”, Dt. Janakarajan Ramkumar Prof. Amandeep Singh, https://onlinecourses.nptel.ac.in/noc20_me50/preview

402045D: Operations Research					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Mathematics, Theory of Probability, Statistics, Basic Industrial Functions and Business Environment.

Course Objectives:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes

On completion of the course, learner will be able to

- CO1. **EVALUATE** various situations of Games theory and Decision techniques and **APPLY** them to solve them in real life for decision making.
- CO2. **SELECT** appropriate model for queuing situations and sequencing situations and **FIND** the optimal solutions using models for different situations.
- CO3. **FORMULATE** various management problems and **SOLVE** them using Linear programming using graphical method and simplex method.
- CO4. **FORMULATE** variety of problems such as transportation, assignment, travelling salesman and **SOLVE** these problems using linear programming approach.
- CO5. **PLAN** optimum project schedule for network models arising from a wide range of applications and for replacement situations find the optimal solutions using appropriate models for the situation.
- CO6. **APPLY** concepts of simulation and Dynamic programming

Course Contents

Unit 1	Introduction to OR, Theory of Games and Decision Analysis

Introduction to OR: Origin of Operations Research, Definition, Evolution and Classification of Quantitative methods, Operations Research Techniques and Methodology, Advantages and Limitations, Scope and Applications of OR

Theory of Games: Introduction, Classification of Games**,** Two-person Zero Sum Games, Solution of 2 x 2 Game with no Saddle Point, Dominance in Games, Subgame Method to Solve (2 x n or m x 2) Mixed Strategy Games, Graphical Method to Solve (2 x n or m x 2)

Games

Decision Analysis: Introduction, Decision Under Certainty, Decision Under Risk, Decision Under Uncertainty (Maximin, Minimax, Maximax, Minimin Criterions, Hurwicz Criterion, Laplace Criterion, Savage or MiniMax Regret Criterion), Decision Tree.

Unit 2	**Queuing Theory and Sequencing Model**

Queuing Theory: Introduction, Elements of Queuing, Characteristics of Waiting Lines, Service discipline, Service Mechanism, Terminology and Kendall's Notation of Queuing system, Single Channel systems M/M/1: FCFS/∞/ ∞ and M/M/1: FCFS/N/ ∞

Sequencing Models: Solution of Sequencing Problem - Processing of n Jobs Through Two Machines, Processing of n Jobs Through Three Machines, Processing of Two Jobs Through m Machines, Processing of n Jobs Through m Machines

Unit 3	**Linear Programming**

Introduction, Formulation of LPP, LPP by Graphical Method, Solution of LPP by Simplex Method, Big M Method and Two-phase method (Limited to 2 variables only), Conversion of Primal to Dual problems

Unit 4	**Transportation and Assignment Model**

Transportation Model: Introduction, Formulation of Transportation problem, Methods to Find Basic Feasible Solution (Vogel's Approximation Method (VAM), Least Cost Method (LCM), North West Corner Rule (NWCR)), Unbalanced Transportation Problem, Degeneracy in Transportation Problem (Theoretical treatment only), Optimality Test- Modified Distributed Method

Assignment Model: Introduction, Mathematical Formulation of Assignment Problem Difference between Transportation and Assignment problem Assignment Problem, Hungarian Method, Balanced and Unbalanced Assignment problem, Maximization in Assignment Problems, Travelling Salesman Problem (Mathematical Formulation and Numerical)

Unit 5	**Project Management**

Network Models: Fulkerson's Rule, Concept and Types of Floats, CPM and PERT, Crashing Analysis and Resource Scheduling

Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly

Unit 6	**Simulation and Dynamic Programming**

Simulation: Introduction, Simulation Definition, Types of Simulation, Steps of Simulation, Advantages and Disadvantage of simulation, Stochastic Simulation and Random numbers, Monte Carlo simulation, Random number Generation

Dynamic Programming: Introduction, Dynamic Programming Model, Applications of Dynamic Programming Model to Shortest Route problems, Bellman Optimality Principle, Resource Allocation problem by Dynamic Programming

Books and other resources
Text Books: 1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991 2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India, 2010. 3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut, 2015. 4. L.C.Jhamb, Quantative Techniques Vol. I &II, Everest Publication, 2007. 5. Manohar Mahajan, Operation Research, Dhanpatrai Publication, 2006. 6. V. K. Kapoor, Operations Research: Quantitative Techniques for Management, Sultan Chand Publications, 2013.
References: **1.** Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India, 2011. **2.** Ravindran, ―Engineering optimization Methods and Applications‖, 2nd edition, Wiley, India **3.** Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey, **4.** Operations Research - An introduction, Hamdy A Taha, Pearson Education, 2010
Web References: 1. https://nptel.ac.in/courses/110106062 2. https://nptel.ac.in/courses/111107128 3. https://www.digimat.in/nptel/courses/video/110106062/L01.html 4. https://archive.nptel.ac.in/courses/112/106/112106134/

402045E: Augmented Reality and Virtual Reality					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Programming and Problem Solving, Engineering Graphics, Solid Modeling and Drafting, Numerical & Statistical Methods, Mechatronics, Artificial Intelligence &Machine Learning, Computer Aided Engineering

Course Objectives:

1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR
2. Review the Geometric Modeling Techniques
3. Review the Virtual Environment
4. Discuss and Examine VR/AR Technologies
5. Use of various types of Hardware and Software in Virtual Reality systems
6. Simulate and Apply Virtual/Augmented Reality to varieties of Applications

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** fundamental Computer Vision, Computer Graphics and Human-Computer Interaction Techniques related to VR/AR
CO2. **UNDERSTAND** Geometric Modeling Techniques
CO3. **UNDERSTAND** the Virtual Environment
CO4. **ANALYZE** and **EVALUATE** VR/AR Technologies
CO5. **APPLY** various types of Hardware and Software in Virtual Reality systems
CO6. **DESIGN** and **FORMULATE** Virtual/Augmented Reality Applications

Course Contents

Unit 1 — **Introduction to Virtual Reality (VR)**

Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark

Unit 2 — **Computer Graphics and Geometric Modelling**

The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

Unit 3	Virtual Environment

Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)

Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system

Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft

Unit 4	Augmented Reality (AR)

Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating ARsystems

Unit 5	Development Tools and Frameworks

Human factors: Introduction, the eye, the ear, the somatic senses

Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems

Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit 6	AR / VR Applications

Introduction, Engineering, Entertainment, Science, Training, Game Development

Books and other resources

Text Books:

1. Coiffet, P., Burdea, G. C., (2003), “Virtual Reality Technology,” Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), “Augmented Reality: Principles & Practice,” Pearson, ISBN: 9789332578494
3. Norman, K., Kirakowski, J., (2018), “Wiley Handbook of Human Computer Interaction,” Wiley-Blackwell, ISBN: 9781118976135
4. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), “3D User Interfaces: Theory and Practice,” Pearson, ISBN: 9780134034324
5. Fowler, A., (2019), “Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#,” Apress, ISBN: 9781484246672
6. Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), “Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications,” Springer, ISBN: 9783030941017

References Books:

1. Craig, A. B., (2013), “Understanding Augmented Reality, Concepts and Applications,” Morgan Kaufmann, ISBN: 9780240824086
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), “Developing Virtual Reality Applications, Foundations of Effective Design,” Morgan Kaufmann, ISBN: 9780123749437
3. John Vince, J., (2002), “Virtual Reality Systems, “Pearson, ISBN: 9788131708446
4. Anand, R., “Augmented and Virtual Reality,” Khanna Publishing House
5. Kim, G. J., (2005), “Designing Virtual Systems: The Structured Approach”, ISBN: 9781852339586
6. Bimber, O., Raskar, R., (2005), “Spatial Augmented Reality: Merging Real and Virtual Worlds,” CRC Press, ISBN: 9781568812304
7. O'Connell, K., (2019), “Designing for Mixed Reality: Blending Data, AR, and the Physical World,” O'Reilly, ISBN: 9789352138371
8. Sanni Siltanen, S., (2012), “Theory and applications of marker-based augmented reality,” Julkaisija –Utgivare Publisher, ISBN: 9789513874490

Web References:

1. Manivannan, M., (2018), “Virtual Reality Engineering,” IIT Madras, https://nptel.ac.in/courses/121106013
2. Misra, S., (2019), “Industry 4.0: Augmented Reality and Virtual Reality,” IIT Kharagpur, https://www.youtube.com/watch?v=zLMgdYI82IE
3. Dube, A., (2020), “Augmented Reality - Fundamentals and Development,” NPTEL Special Lecture Series, https://www.youtube.com/watch?v=MGuSTAqlZ9Q
4. http://cambum.net/course-2.htm

402046: Data Analytics Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs.**	**Practical**	**1**	**Term Work**	**50**

Prerequisites: Engineering Mathematics**,** Artificial Intelligence & Machine Learning, Numerical and Statistical Methods, Fundamental of Mechanical Engineering

Course Objectives:

1. To explore the fundamental concepts of data analytics.
2. To understand the various search methods and visualization techniques.
3. To apply various machine learning techniques for data analysis.

Course Outcomes:

On completion of the course, the learner will be able to

CO1: **UNDERSTAND** the basics of data analytics using concepts of statistics and probability.
CO2: **APPLY** various inferential statistical analysis techniques to describe data sets and withdraw useful conclusions from acquired data set.
CO3: **EXPLORE** the data analytics techniques using various tools
CO4: **APPLY** data science concept and methods to solve problems in real world context
CO5: **SELECT** advanced techniques to conduct thorough and insightful analysis and interpret the results

Course Contents

Preamble:

The motivation behind the data analytics lab for mechanical engineers is to make them competent to learn data-driven decision-making involving predictive, prescriptive, descriptive, and diagnostic analytics. Data analytics offers a new paradigm of bottom-up versus top-down modelling and solving supported by the traditional physics-based approach. An engineer involved in traditional modelling (e.g., developing a finite analysis or a reliability model) looks at the problem of interest and in essence, fits in the model he/she was trained to use. An engineer equipped with data science knowledge gathers historical data and uses data-mining tools to build the model of interest. If needed, he/she can further optimize this data-driven model with tools such as evolutionary computation algorithms.

Possible approaches:

Predictive Analytics:
Predictive analytics involves the use of mathematical methods and tools such as machine learning, data mining, statistical analysis, and predictive models. It is used to:

- Identify anomalies in the process, which help in preventive maintenance.
- Estimate the demand for product, raw material etc.: based on historical data and current

scenario.

- Forecast possible outcomes based on data obtained from the process.

Prescriptive Analytics:
Prescriptive analytics is used to identify ways in which an industrial process can be improved. While predictive analytics tells when could a component/asset fails, prescriptive analytics tells what action you need to take to avoid the failure. So, you can use the results obtained from prescriptive analysis to plan the maintenance schedule, review your supplier, etc. Prescriptive analytics also helps you manage complex problems in the production process using relevant information.

Descriptive Analytics:
The core purpose of descriptive analytics is to describe the problem by diagnosing the symptoms. This analytics method also helps discover the trends and patterns based on historical data. The results of a descriptive analytics are usually shown in the form of charts and graphs. These data visualization tools make it easy for all the stakeholders, even those who are non-technical to understand the problems in the manufacturing process.

Diagnostic Analytics:
Diagnostic analytics is also referred to as root cause analysis. While descriptive analytics can tell what happened based on historical data, diagnostic analytics tells you why it happened. Data mining, data discover, correlation, and down and drill through methods are used in diagnostic analytics. Diagnostic analytics can be used to identify cause for equipment malfunction or reason for the drop in the product quality.

TERM WORK:

A] Experiments (Any 6)

Sr. No.	Data Domain	Objective	Methodology	Data type
1	Thermal / Heat Transfer / HVAC / Fluid Mechanics / Fluid Power	Predictive / Prescriptive / Descriptive / Diagnostic (but not limited to)	Statistical / mathematical /numerical/computational/intelligent (but not limited to)	Numeric or image based or data in any suitable form
2	Solid Mechanics / Design			
3	Machining / Manufacturing			
4	Automation & Robotics			
5	Maintenance / Reliability / Condition Monitoring			
6	Quality Control			
7	Materials and Metallurgy			
8	Energy Conservation and Management			
9	Industrial Engineering, Estimation, and Costing			
10	Automotive technology			

B] List of Assignments (Any Three)
The survey of methods used for data analysis in the data domain mentioned above **(Any Three)** and discussion on any case studies.

Guidelines for selection of data domain, source, size, etc.:

- The data domain must be selected from various fields of mechanical engineering such as (but not limited to) thermal, heat power, design, manufacturing, automotive, HVAC, condition monitoring, process industry, solid and fluid mechanics, quality, materials and metallurgy, automation & robotics, energy conservation and management, ERP, Industrial engineering, estimation, and costing, etc.

- The volume of data should be considerably larger size in view of extracting meaningful insights, such as hidden patterns, unknown correlations, trends, and customer preferences through tools such as machine learning, deep learning, reinforcement learning, etc. Though the data size cannot be bluntly defined or there is no threshold, however, the data gathered from small trials/experimentation to analyse the input-output relationship should not be considered such as a trial on an external gear pump for studying its characteristics considering limited range of parameters for few trials. The appropriate data size must be selected as per the relevant data domain to yield a reliable model. For example, in the case of vibration-based condition monitoring based on numeric data, the size of data gathered depends on the sampling frequency of data acquisition and ranges from 5 kHz to 20 kHz or even more than that as per the data domain. Same for image data, the minimum number of images with appropriate resolution should be selected w.r.t data domain to yield a robust model.
- The data collected through real-time experiments is preferred however in case of no resources/facility available, data collected through simulation, survey, etc. can also be considered. The benchmark datasets made available by standard technical/academic/research/commercial/professional societies and organizations are also allowed.
- The standard instrumentation is preferred for performing experiments and data collection; however, the use of open-source hardware for building in-house low-cost data acquisition systems is also recommended.
- The choice of programming language and software depends on the data domain and the provision of the methodology used for its processing. Any standard programming language and data analytics software can be used.
- The approach mentioned above (but not limited to) should be considered while defining the problem and objectives, selecting the data domain, and deciding the methodology. The methodology can be statistical, mathematical, numerical, computational, or intelligent.

Books and Other Resources

Text Books:

1. Brunton, S. L., & Kutz, J. N. (2022). Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press.
2. Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press.
3. Roy, S. S., Samui, P., Deo, R., & Ntalampiras, S. (Eds.). (2018). Big data in engineering applications (Vol. 44). Berlin/Heidelberg, Germany: Springer.
4. Middleton, J. A. (2021). Experimental Statistics and Data Analysis for Mechanical and

Aerospace Engineers. Chapman and Hall/CRC.

5. Brandt, S. (1970). Statistical and computational methods in data analysis.
6. Robinson, E. L. (2017). Data analysis for scientists and engineers. In Data Analysis for Scientists and Engineers. Princeton University Press.
7. Araghinejad, S. (2013). Data-driven modeling: using MATLAB® in water resources and environmental engineering (Vol. 67). Springer Science & Business Media.
8. Niu, G. (2017). Data-driven technology for engineering systems health management. Beijing, China: Springer.

References Books:

1. Zsolt Nagy, "Artificial Intelligence and Machine Learning Fundamentals", Packt Publishing, 2018, ISBN: 978-1-78980-165-1
2. Hastie, Trevor, Robert Tibshirani, Jerome H. Friedman, and Jerome H. Friedman. The elements of statistical learning: data mining, inference, and prediction. Vol. 2. New York: springer, 2009.
3. Zaki, Mohammed J., Wagner Meira Jr, and Wagner Meira. Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press, 2014.
4. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a Term Work in the form of Journal.

Important Note:

Term Work of the Student shall be evaluated based on the completion of experiments, group assignments and case studies. Continuous evaluation by the faculty shall be done for the award of the credit associated with the course.

402047: Project (Stage I)					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**4 Hrs./Week**	**Practical**	**2**	**Term Work**	**50 Marks**
				Oral	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Laboratory works, Skill Development, Audit Courses, Industrial Visits

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **IMPLEMENT** systems approach.
CO2. **CONCEPTUALIZE** a novel idea / technique into a product.
CO3. **THINK** in terms of a multi-disciplinary environment.
CO4. **TAKE ON** the challenges of teamwork, and **DOCUMENT** all aspects of design work.
CO5. **UNDERSTAND** the management techniques of implementing a project.
CO6. **DEMONSTRATE** the final product for Functionality, Designability, and Manufacturability.

Course Contents

Project work in the seventh semester is an integral part of the Term Work. The project work shall be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society.

1. Fabrication of product/testing setup of an experimentation unit/small equipment, in a group.
2. Experimental verification of principles used in Mechanical Engineering Applications

3. Projects having valid database, algorithm, and output reports, preferably software based.
4. Study projects are strictly **not** allowed.

Project Lab

1. There has to be a **Project Lab** in the department.

a. It consists of necessary tools required to do a project.
b. Previous projects and their components.
c. Common measuring instruments.
d. Previous years' project reports.
e. Project related books and Publications.
f. Proper linkage with central workshop and various laboratories.
g. Safety measures.

2. All the project activities must be handled with a digital platform which is developed in the department according to the policies laid down by the institution. Respective authority levels to be created to maintain the transparency and confidentiality of the process. (ERP)

Books and other resources

Web References:

1. SWAYAM-NPTEL Course.
2. MOOCs' Courses.

Guidelines for Project Execution

At the end of the VIth Semester

1. A group of 3-4 students shall be formed according to their suitability.
2. Department faculty will float prospective Project Titles through Project Coordinator.
3. Department will take care of a list of titles at least two times of the groups.
4. Students will interact with guides for scope and outline of the project.
5. Maximum of two groups will be given to a guide.
6. Guide and Project groups will be finalized at the end of sixth semester so that project work can be started at the start of Seventh semester.

During the VIIth Semester

1. Project work is expected to be done in the Project Lab.
2. Projects must be executed in association with industrial experts/facilities.
3. Progress of project work is monitored regularly on weekly project slots/project day.
4. Regular interval presentations are to be arranged to review and assess the work.
5. Project work is monitored and continuous assessment is done by guide and authorities.

Term Work

- The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.
- Recommended performance measure parameters may Include-Problem definition and scope of the project, Literature Survey, Appropriate Engineering approach used, Exhaustive and

Rational Requirement Analysis.

- Comprehensive Implementation - Design, modeling, documentation, Usability, Optimization considerations (Time, Resources, Costing), Thorough Testing, Project Presentation and Demonstration (ease of use and usability), Social and environment aspects.
- The term work under project submitted by students shall include work Diary;

Work Diary to be maintained by a group and countersigned by the guide (weekly). The contents of work diary shall reflect the efforts taken by project group for;

a. Searching suitable project work

b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up the project.

c. Brief report of feasibility studies carried to implement the conclusion.

d. Rough Sketches/ Design Calculations

e. Synopsis

- The group should submit the synopsis in the following form.
  - i. Title of Project
  - ii. Names of Students
  - iii. Name of Guide
  - iv. Relevance
  - v. Present Theory and Practices
  - vi. Proposed work
  - vii. Expenditure
  - viii. References
- The synopsis shall be signed by each student in the group, approved by the guide (along with external guide in case of sponsored projects) and endorsed by the Head of the Department.
- Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Examination Scheme

- During university examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work.
- During the process of monitoring and continuous assessment & evaluation the individual and team performance is to be measured.
- The project term work shall be evaluated on the basis of reviews. In first semester two reviews are to be taken and evaluated for total 50 marks (25 marks each)
- Review 1 and 2 will be based on synopsis submission (team members, Title of the Project Work, Abstract, Problem Definition, work done earlier, Objectives of the Project, Methodology of the Project, Application / Significance of the Project, Duration of the Project, Individual Role of the Student, References, sponsored etc.)
- The final presentation shall be taken in front of external examiner and to be evaluated for 50 marks

  20 marks for presentation (Oral, Written)

  30 marks for quality of the project work

Project Report
● Stage I report shall be in the booklet form ● Plagiarism check is must, and certificate shall be attached in the report
References: • References format MUST BE STANDARD – ASME, SAE or IEEE

402054: Audit Course VII					
Teaching Scheme		**Credits**	**Examination Scheme**		
		Non- Credit			

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'

- If any of the following listed course is selected through Swayam/ NPTEL/ virtual platform, the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.
- Students can join any online platform or can participate any online/offline workshop to complete the Audit course with prior-permission of mentor.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from Final year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level. The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself

List of Courses to be opted (Any one) under Audit Course
A. Yoga Practices **B.** Stress Management Note:-The title indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.
Using NPTEL Platform: (preferable)
NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in • Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course. • Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal. • After clearing the examination successfully; student will be awarded with a certificate.
Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary • During the course students will be submitting the online assignments/report/course completion certificate etc. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments/report/course completion certificate etc., the institute can mark as "Present" and the student will be awarded the grade AP on the mark-sheet.

402048: Computer Integrated Manufacturing					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**
				Oral	**25 Marks**

Prerequisites: knowledge of earlier studied subjects like Solid Modeling and Drafting, Computer Aided Engineering, Industrial Engineering

Course Objectives:

1. **Understand and realize** need of CIM and factory automation.
2. **Learn** to integrate hardware and software elements for CIM.
3. **Generate and Integrate** CNC program for appropriate manufacturing techniques.
4. **Learn** to integrate processes planning, quality and MRP with computers.
5. **Know** about flexible, cellular manufacturing and group technology.
6. **Understand** IOT, Industry-4.0 and cloud base manufacturing.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** CIM and factory automation.
CO2. **UNDERSTAND** the integration of hardware and software elements for CIM
CO3. **APPLY** CNC program for appropriate manufacturing techniques.
CO4. **ANALYZE** processes planning, quality and MRP integrated with computers.
CO5. **INTERPRET** flexible, cellular manufacturing and group technology.
CO6. **ANALYZE** the effect of IOT, Industry-4.0 and cloud base manufacturing.

Course Contents

Unit 1 Introduction to CIM

Need of CIM, Introduction, Evolution of CIM,CIM Hardware and software, Role of CIM System, Definition of CIM, automation and types of automation, Reasons for automation, Types of Production, Functions in Manufacturing, CIM wheel, Computerized element of CIM, Advantages of CIM

Unit 2 Data Integration

CAD-CAM Integration, Product development through CIM, Design Activities in a networked environment, Networking in a manufacturing company, hardware elements of networking, CIM Database, Database requirements of CIM, Database management, Database Models, EDM, Product Data Management (PDM), Product life cycle Management(PLM)

Unit 3	**Computer Aided Manufacturing (CAM)**

Introduction to Computer Aided Manufacturing (CAM), Coordinate system, working principal of CNC Lathe, Turning Centers, Milling Machine, Machining Centers. Steps in developing CNC part program, Tool and geometric compensations, CNC Lathe and Mill part programming, Canned cycles, subroutine and Do loop, CIM Integrable Machines

Unit 4	**Computer Aided Process Planning and Quality Control**

Process Planning: Computer Aided Process Planning (CAPP), Benefits of CAPP, Logical steps in Computer Aided Process Planning, Approaches to CAPP, Material Requirement Planning, Capacity Planning, Manufacturing Resource Planning (MRP) - Input, working, outputs and benefits, Concept of dependent demand, structure of MRP system, planning & implementation issues, MRP-II & Enterprise Resource Planning (ERP), Computer Aided Production Scheduling, Control Systems: Shop Floor Control, Inventory Control, Computer Aided Inspection and Quality Control, Manufacturing Execution System(MES)

Unit 5	**FMS & Cellular Manufacturing**

Introduction Flexible Manufacturing Systems, FMS components, Material handling and storage system, applications, benefits, computer control systems, types of FMS Layout, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture.

Group Technology(GT), Part Families – Parts Classification and coding, Simple Problems in Opitz Part Coding system – Production flow Analysis, Cellular Manufacturing – Composite part concept – Machine cell design and layout, Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method, Arranging Machines in a GT cell – Hollier Method – Simple Problems

Unit 6	**Future Smart Factories**

Industry 4.0: Functions, Applications and Benefits. Components of Industry 4.0, Introduction to Industry 5.0, Internet of Things (IoT): IoT applications in manufacturing, Big-Data and Cloud Computing for IoT, IoT for smart manufacturing, influence of IoT on predictive maintenance, Supply-Chain Optimization, Supply-Chain & logistics, Internet of Things and M_2M Communication Technologies

Digital Manufacturing w.r.t. Industry 4.0: Industrial Automation, Cyber-Physical Manufacturing Systems, Digital Twin Driven Smart Manufacturing, Digital Manufacturing, Assembly and Automation Systems, Scheduling and Cloud Manufacturing, Knowledge Management, Digital Supply Chains, Reconfigurable Manufacturing Systems, Web based Application in Manufacturing

Books and other resources

Text Books:

1. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person

India, 2007 2nd edition.

2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India

References Books:

1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR.
2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.
3. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.
4. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley Publications.
5. Harrington J, Computer Integrated Manufacturing Krieger Publications 1979.
6. Zeid, CAD/CAM, Tata McGraw Hill.
7. Jha, N.K. "Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.

NPTEL Link:

1. https://youtube.com/playlist?list=PLFW6lRTa1g808_CfYhZKdv2eXplAQiAwS
2. https://nptel.ac.in/courses/112104289
3. https://onlinecourses.nptel.ac.in/noc22_me10/preview
4. https://archive.nptel.ac.in/courses/112/104/112104289/
5. https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-me44/

Link for Virtual Lab: - http://vlabs.iitkgp.ac.in/cim/#

Guidelines for Laboratory Conduction

1. Practical/Tutorial must be conducted in FOUR batches per division only.
2. Minimum 08 numbers of Experiments/Assignments shall be completed.
3. Experiments shall be conducted following 'Case Based Methodology'
4. Open source software, simulation tools may be used wherever required.

Term Work

The student shall complete the following activity as a Term Work:

1. Modelling of Mechanical Component using any 3D CAD software, Preparing CNC part program using any CAM software, and execute it on CNC Turning.
2. Modelling of Mechanical Component using any 3D CAD software, Preparing CNC part program using any CAM software, and execute it on CNC Milling.
3. Generate Bill of Material (BOM) from Assembly and other data using CAD Software.
4. Prepare Computer Aided Process Plan for selected part using variant type of CAPP Software.
5. Use MRP (Material Resource Planning) Software for CIM and Assembly.
6. Generate Part Family Code for a machine components using OPITZ Method
7. Study FMS system from Video clip and identify various elements of FMS and its controlling by computer.
8. Modeling and Simulation of Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources)
9. Machine vision based quality control. (VLab IIT, Kharagpur OR comparable sources)
10. Remote Monitoring and Operation of a Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources)

402049: Energy Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**
				Oral	**25 Marks**

Prerequisites: Thermodynamics, Applied Thermodynamics, Heat Transfer, Turbo machines

Course Objectives:

1. To study the energy scenario, the components of thermal energy based plant, improved Rankine cycle
2. To understand details of steam condensing plant, cooling tower system, analysis of condenser, the environmental impacts and methods to reduce various pollution from energy systems
3. To study layout, component details of diesel engine power plant, hydel and nuclear energy systems
4. To understand components; layout of gas and improved power cycles
5. To learn basic principles of energy management, storage and economics of power generation
6. To study the working principle , construction of renewable energy systems

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **EXPLAIN** the power generation scenario, the layout components of thermal power plant and **ANALYZE** the improved Rankine cycle.

CO2: **ANALYZE** the performance of steam condensers, cooling tower system; RECOGNIZE an environmental impact of energy systems and methods to control the same.

CO3: **EXPLAIN** the layout, component details of diesel engine plant, hydel and nuclear energy systems.

CO4: **ANALYZE** gas and improved power cycles.

CO5: **EXPLAIN** the fundamentals of renewable energy systems.

CO6: **EXPLAIN** basic principles of energy management, storage and economics of power generation.

Course Contents

Unit 1	**Energy Scenario and Thermal Energy based Power Plants**

Energy Scenario: global and Indian energy scenario, role of Government and Private organizations, energy crisis, energy security, energy policy, India’s low carbon transition.

Thermal Energy Based Plant: layout of modern thermal energy based plant with different circuits, site selection, classification of coal, coal benefication, selection of coal for thermal power plant, slurry type fuels, in-plant handling of coal, pulverized fuel handling systems, FBC systems, high pressure boilers, improved Rankine cycle: Rankine cycle with only reheating and only regeneration (Numerical Treatment) **,** energy conservation in boilers

Unit 2	**Steam Condensers, Cooling Towers and Environmental Impact of Energy System**

Steam condensers: need, elements of steam condensing plant, classification, Dalton’s law of partial pressure, condenser efficiency, vacuum efficiency, cooling water requirements (Numerical Treatment), air leakage and its effects on condenser performance, air pumps (Numerical Treatment for Air Pump capacity), steam condenser market.

Cooling Towers: need, classification of condenser water cooling systems, classification of cooling pond and cooling towers. environmental effects of cooling towers, next generation cooling towers

Environmental impact of energy system: different pollutants from energy plants, methods to control pollutants: types of scrubbers; ash handling system; dust collections; ESP, carbon credits and footprints, water treatment in thermal energy based plant

Unit 3	**Diesel, Hydel, Nuclear Energy systems**

Diesel engine power plant: general layout; different systems of DEPP, plant layout of high/medium /low capacity DEPP, performance operating characteristics based on heat rate, advantages; disadvantages; applications; methods of energy conservation

Hydel energy: basics of hydrology, hydrograph, flow duration curve, mass curve (Numerical Treatment), hydel power plant (HPP)- site selection, classification of HPP (Based on head, nature of load, water quantity), criteria for turbine selection, components of HPP- dams; spillways; surge tank and forebay, advantages and disadvantages of HPP.

Nuclear energy: nuclear fission/fusion, elements of NPP, types of nuclear reactor (PWR, BWR, CANDU, LMCR, GCR, Fast Breeder) nuclear fuels, moderators, coolants, control rod and shielding, nuclear waste disposal, nuclear power development programme of India**.**

Unit 4	**Gas and Improved Power cycle**

Gas turbine power plant: components, general layout of GTPP, open & closed cycle gas turbine plant, Brayton cycle analysis for thermal efficiency, work ratio, maximum & optimum pressure ratio, methods to improve thermal efficiency of GTPP: only inter-cooling; only reheating & only regeneration cycle (numerical treatment),

Improved cycle based Power Plant: gas and steam combined cycle plant, Cogeneration, introduction to tri-generation, steam power plants with process heating (Numerical Treatment), Integrated Gasification Combined Cycle (IGCC) plant, Kalina (Cheng) Cycle.

Unit 5	Energy Management, Storage and Economics of Power Generation

Energy management and storage: energy management with storage systems, energy demand estimation, energy pricing, thermal energy storage methods.

Power plant instrumentation: layout of electrical equipment, switch gear, circuit breaker, protective devices, measurement of high voltage, current and power.

Economics of power generation: cost of electrical energy, fixed and operating cost [methods to determine depreciation cost] (numerical treatment), load curves, performance and operation characteristics of power plants, load division, all terminologies related to fluctuating load plant, tariff (numerical treatment), analysis of energy bill

Unit 6	Renewable Energy Systems

Solar thermal and photovoltaic energy: solar thermal plant based on flat plate collector; solar photovoltaic systems, applications, economics and technical feasibility.
Wind Energy: wind availability, basic components of wind mills, performance operating characteristics, wind solar hybrid power plants, Cost economics and viability of wind farm.
Geothermal Energy: typical geothermal field, superheated steam system, flash type, binary cycle plant**,** economics of geothermal energy.
Tidal Energy: components, single basin, double basin systems
Ocean Thermal Energy: working principle, Claude /Anderson /hybrid cycle
Wave Energy: dolphin type wave machines
MHD Power Generation: working principle, open/ close cycle MHD generator
Fuel cell: main components, working Principle
Biomass Energy: biomass gasifier
Hydrogen Energy: principle of hydrogen production, hydrogen storage, applications.

Books and other resources

Text Books:

1. Domkundwar & Arora, Power Plant Engineering, Dhanpat Rai & Sons, New Delhi
2. Domkundwar & Domkundwar- Solar Energy and Non Conventional Sources of Energy, Dhanpat Rai& Sons, New Delhi.
3. R.K.Rajput, Power Plant Engineering, Laxmi Publications New Delhi

References Books:

1. E.I.Wakil, Power Plant Engineering, McGraw Hill Publications New Delhi
2. P.K.Nag, Power Plant Engineering, McGraw Hill Publications New Delhi.
3. R.Yadav , Steam and Gas Turbines ,Central Publishing House, Allahabad.
4. G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers, Delhi
5. S.P.Sukhatme, Solar Energy,Tata McGraw-Hill Publications, New Delhi
6. G R Nagpal, Power Plant Engineering , Khanna Publication

Web References:

1. https://nptel.ac.in/courses/112107291

2. https://nptel.ac.in/courses/112103277
3. https://nptel.ac.in/courses/103103206
4. https://nptel.ac.in/courses/115103123
5. https://cea.nic.in/?lang=en

Term Work

The student shall complete the following activity as a Term Work:

1. Trial on Steam Power Plant to determine
   a) Plant Efficiency, Rankine Efficiency Vs Load
   b) Specific Steam consumption Vs Load
   c) Rate of Energy Input Vs Load
   d) Heat Rate and Incremental heat Rate Vs Load
2. Trial on Diesel Power Plant to determine
   a) Plant Efficiency Vs Load
   b) Total fuel consumption Vs Load
   c) Rate of Energy Input Vs Load
   d) Heat Rate and Incremental heat Rate Vs Load
3. Analysis of HT/LT electricity bill and recommendations for energy saving opportunities.
4. Case study on different control systems in thermal power plant .
   (Review of control principles, Combustion control, pulveriser control, control of air flow, Furnace pressure and feed water, steam temperature control, turbine control, Safety provisions / Interlocks)
5. Design and component selection for solar photovoltaic power plant with net metering.
6. Estimation of annual energy from wind data and component selection for wind mill.
7. Case study on cogeneration in Sugar mill/Paper mill/Cement kiln.
8. Design and performance analysis of steam surface condenser for steam thermal power plant.
9. Design and performance analysis of cooling tower system for steam thermal power plant.
10. Case study on biomass gasification and analysis of properties of syngas.
11. Case study on production of bio-diesel and evaluation of its properties and its use in diesel engine based power plant.
12. Design and performance analysis of Thermal energy storage system.
13. Case study on energy management in conventional/ renewable energy power plant
14. Visit to Thermal Energy Based plant /Co-generation Power plant.
15. Visit to GTPP/Combined Cycle/renewable energy plants.

IMP Notes for Term Work:

1. Eight experiments from No.1 to 15 from above list should be conducted.
2. Experiment No, 1and 2 are compulsory.
3. Any six experiments can be performed 3 to 15.

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050A: Quality & Reliability Engineering

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Mathematics, Probability, Statistics

Course Objectives:

1. To analyze and apply Quality & Reliability Tools to solve real-life problems.
2. To plot control charts and calculate process capability.
3. To ascertain System reliability for sustainable product design.
4. To find out FMEA and understand reliability centered Maintenance.

Course Outcomes:

On completion of the course the learner will be able to:

CO1. **UNDERSTAND** basic concepts of quality and **RELATE** various quality tools

CO2. **DEVELOP** analytical competencies to **SOLVE** problems on control charts and process capability.

CO3. **UNDERSTAND** fundamental concepts of reliability**.**

CO4. **EVALUATE** system reliability.

CO5. **IDENTIFY** various failure modes and **CREATE** fault tree diagram.

CO6. **UNDERSTAND** the concept of reliability centered maintenance and **APPLY** reliability tests methods.

Course Contents

Unit 1	Introduction to Quality and Quality Tools

Precision and accuracy, Quality dimensions, Statements, Cost of quality & value of quality, Deming‟s cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools, Introduction to N Seven Tools, Quality Circle, 5S, Kaizen, Poka yoke, Kanban, JIT, QMS (ISO 9000, TS16949, ISO14000). Criteria for Quality Award (National & International)

Unit 2	Statistical quality control

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control, Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability (Indices: cp, cpk, ppk), Statistical Process Control and six sigma. Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plans, calculation of sample size, AOQ, Probability of acceptance

Unit 3	Fundamental concepts of Reliability

Reliability definitions, failure, failure density, failure Rate, hazard rate, Mean Time to Failure (MTTF),

Mean Time Between Failure (MTBF), pdf, cdf, safety and reliability, life characteristic phases, modes of failure, areas of reliability, quality and reliability assurance rules, importance of reliability, Uncertainty analysis, Probability theory and probability distributions	
Unit 4	**System Reliability & Allocation Techniques**
Series, parallel, mixed configuration, k- out of n structure, analysis of complex systems, conditional probability method, cut set and tie set method, Redundancy & Types, Reliability allocation or apportionment, reliability apportionment techniques - equal apportionment, AGREE, ARINC, reliability predictions from predicted unreliability, minimum effort method	
Unit 5	**Reliability in Design & Development**
Reliability techniques- Failure mode, effects analysis (FMEA), Failure mode, effects and criticality analysis (FMECA)-Case Studies, RPN, Basic symbols, Ishikawa diagram for failure representation, Fault Tree construction and analysis - case studies, minimal cut & tie set methods	
Unit 6	**Reliability Testing and Management**
Objectives & types of maintenance, Maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability, Reliability Centered Maintenance, Stress strength interaction, Introduction to reliability testing, Testing for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing (HALT)	
Books and other resources	

Text Books:

1. L. S. Srinath, Reliability Engineering, EWP , 4th Edition 2011
2. E. Balgurusamy, Reliability Engineering, McGraw Hill Education 2002
3. S. S. Rao, Reliability Based Design, Mc Graw Hill Inc. 1992

References Books:

1. E. E. Lewis, Introduction to Reliability Engineering, John Wiley and Sons.
2. Alessandro Birolini, Reliability Engineering Theory and Practice, Springer.
3. B. S. Dhillon, Maintainability, Maintenance and Reliability for Engineers, CRC press.
4. K. C. Kapoor and L. R. Lubersome, Reliability in Engineering Design Willey Publication.
5. Basu S.K, Bhaduri , Terotechnology and Reliability Engineering, Asian Books Publication.

402050B: Energy Audit and Management					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Engineering Thermodynamics, Applied Thermodynamics, Heat and Mass Transfer, HVAC, Turbomachines

Course Objectives:

1. To impart basic knowledge to the students about current energy scenarios, energy conservation, energy audit and energy management.
2. To inculcate the systematic knowledge and skill in assessing the energy efficiency, energy auditing and energy management.
3. To carry out an energy audit of Institute/Industry/Organisation

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** the energy need and role of energy management
CO2. **CARRY OUT** an energy audit of the Institute/Industry/Organization
CO3. **ASSESS** the ENCON opportunities using energy economics
CO4. **ANALYSE** the energy conservation performance of Thermal Utilities
CO5. **ANALYSE** the energy conservation performance of Electrical Utilities
CO6. **EXPLAIN** the energy performance improvement by Cogeneration and WHR method

Course Contents

Unit 1 — Energy Scenario and Management

Energy needs of a growing economy, Current and long-term energy scenario - India and World, Concept of energy conservation and energy efficiency, Energy and environment, Need of Renewable energy, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy sector reforms.

Unit 2 — Energy Audit

Need of Energy Audit, Types of energy audit, Energy audit methodology, Energy audit instruments, Analysis and recommendations of energy audit, Benchmarking, Energy audit reporting, Introduction to software and simulation for energy auditing, Current Energy Conservation Act and Electricity Act and its features.

Unit 3 — Energy Economics

Costing of Utilities (Numerical): Determination of the cost of steam, fuels, compressed air and electricity

Financial Analysis Techniques (Numerical): Simple payback, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis, Energy performance contracts and role of ESCOs.

Unit 4	Evaluation of Thermal Utilities

Energy performance opportunities and assessment of Boilers and Furnaces (Numerical on direct method), Heat exchangers, Cooling towers, DG sets, Fans & blowers, Pumps, Compressors, Compressed air systems and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.

Unit 5	Evaluation of Electrical Utilities

Electricity billing, Electrical load management and maximum demand control, penalties, Power factor improvement and benefits, Selection and location of capacitors. Distribution and transformer losses, Harmonics.

Electrical motors: Types, Efficiency, Selection, Speed control, Energy efficient motors

Lamp types and their features, recommended illumination levels, Lighting system performance assessment and efficiency improvement (Numerical), Electricity saving techniques.

Unit 6	Cogeneration and Waste Heat Recovery

Cogeneration: Need, applications, advantages, classification, Introduction to Trigeneration

Waste Heat Recovery: Classification, Application, Concept of Pinch analysis, Potential of WHR in Industries, Commercial WHR devices, saving potential, CDM projects and carbon credit calculations.

Case Studies: Energy Audit of Institute/MSMEs/Organization, Guidelines for Energy Manager and Energy Auditor examination conducted by BEE.

Books and other resources

Text Books:

1. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

References Books:

1. Barney L. Capehart, Wayne C. Turner and William J. Kennedy, "Guide to Energy Management", Seventh Edition, The Fairmont Press Inc., 2012.
2. Craig B. Smith, "Energy Management Principles", Pergamon Press, 2015.
3. Hamies, "Energy Auditing and Conservation; Methods, Measurements, Management and Case Study", Hemisphere Publishers, Washington, 1980.
4. Albert Thumann P.E. CEM, William J. Younger CEM, "Handbook of Energy Audit", The Fairmont Press Inc., 7th Edition.
5. Wayne C. Turner, "Energy Management Handbook", The Fairmont Press Inc., , Georgia.
6. Abbi Y. A., Jain Shashank, "Handbook on Energy Audit and Environment management",

TERI, Press, New Delhi, 2006.
7. Anthony L Kohan, “Boiler Operator’s Guide”, Fourth Edition, McGraw Hill
8. Robert L. Loftness, “Energy Hand Book”, Second edition, Von Nostrand Reinhold Company
9. G. G. Rajan, “Optimizing Energy Efficiencies in Industry”, Tata McGraw Hill, 2001
10. Amlan Chakrabarti, “Energy Engineering and Management”, Prentice Hall, India 2011

Web References:

1. www.npcindia.gov.in
2. http://www.bee-india.nic.in
3. www.aipnpc.org (for entire course material along with case studies)
4. https://beeindia.gov.in/sites/default/files/EC%20Guidelines-Final.pdf

402050C: Manufacturing System and Simulation					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding of manufacturing and business processes, industrial engineering principles and concepts.

Course Objective:

1. To help mechanical engineers understand broadly the functioning of manufacturing systems.
2. To describe the role of facilities and support systems.
3. To enable students understand various types of simulations used in manufacturing environment.
4. To acquaint with the methodology of manufacturing simulation using computer software and the repercussions of changes & variability therein, over time.
5. To showcase the areas of simulation applications in manufacturing and allied field.

Course Outcomes

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** the concepts of manufacturing system, characteristics, type, etc.

CO2. **UNDERSTAND** the concepts of Facilities, manufacturing planning & control and Support System.

CO3. **UNDERSTAND** the concepts of manufacturing towards solving productivity related problems.

CO4. **DEVELOP** a virtual model to solve industrial engineering related issues such as capacity. utilization, line balancing.

CO5. **BUILDING** tools to view and control simulations and their results.

CO6. **PLAN** the data representation & Evaluate the results of the simulation.

Course Contents

Unit 1	**Manufacturing System**

Preamble: Industrial Revolutions, Smart manufacturing, Challenges, Digitalization, Manufacturing System, Simulation, Data Analysis & Predictive decision-making, Types and classification of production systems and their characteristics, Introduction to manufacturing systems (manual, worker-machine and automated), Components & classifications, principles of manufacturing systems

Characteristics, requirements and operation of Manufacturing Systems: Custom manufacturing system, Intermittent manufacturing system, Continuous manufacturing system, Flexible manufacturing system, Mass customization, Assembly systems: Manual assembly systems,

<table>
<tr><td colspan="2">Automated assembly systems, Hybrid assembly systems, and Reconfigurable manufacturing systems, Laws of Manufacturing, Manufacturing Systems as a Foundations of World-Class Practices, Performance measures of manufacturing systems and approaches to enhance the performance</td></tr>
<tr><td>Unit 2</td><td>Facilities and Manufacturing Support System</td></tr>
<tr><td colspan="2">Overview, characteristics, principles and requirements of following facilities and manufacturing support systems:
Facilities: Material Handling Equipment, Quality control approaches, Computer systems to control manufacturing operations, Factory and Plant Layout, Group Technology (GT) & Cellular Layout, Robotics

Manufacturing Planning: Process Planning, Production Planning, Master Scheduling, Material requirement planning and capacity planning

Manufacturing Control: Shop floor control, Inventory control, Quality Control and Maintenance strategies

Business Functions: Business functions and Sequence of information processing activities.</td></tr>
<tr><td>Unit 3</td><td>Manufacturing Simulation: Introduction</td></tr>
<tr><td colspan="2">History of simulation, basic simulation concept, purpose, appropriateness and considerations, advantages and disadvantages of simulation, areas of application, Overview of types of simulations [Discrete event simulation (DES), System dynamics (SD), Agent-based modeling (ABM), Intelligent simulation using artificial intelligence (AI) techniques, Petri net, Monte Carlo simulation (MCS), Virtual simulation], Steps in simulation study, simulation as a decision making tool</td></tr>
<tr><td>Unit 4</td><td>Discrete Event Simulation: Introduction</td></tr>
<tr><td colspan="2">Problem Formulation: Formulating problem statement, Tools for Developing the Problem Statement, Orientation Process, simulation project objectives, evaluation of simulation project

System Definition: Discrete versus Continuous, Components and Events to Model, Manufacturing System Processes and Events

Input Data Collection and Analysis: Sources for input data, collecting input data, deterministic vs. probabilistic input data, discrete vs. continuous input data, random numbers, variables, common input data distributions, analyzing input data</td></tr>
<tr><td>Unit 5</td><td>Discrete Event Simulation: Model Translation, Validation and Analysis</td></tr>
<tr><td colspan="2">Simulation Program Selection: Overview of various simulation software like AutoMod, ProModel, Arena, WITNESS Horizon, Quest, SIMFACTORY, FlexSim etc. Case study on translation to showcase model box, elements, building the model, attributing the data, queuing, material handling and conveyors, etc., output data)</td></tr>
</table>

Verification, and Validation: Verification of Simulation Models, Calibration and Validation of Models, Face Validity, Validation of Model Assumptions, Validating Input-Output Transformations (Using Historical Input Data, Using a Turing Test), Design of Simulation Experiments, What if analysis, Sensitivity Analysis, Predictive decision-making **Interpretation of Outputs**: Measures of Performance and their estimation, Analysis of terminating and non-terminating systems	
Unit 6	**Discrete Event Simulation: Applications and Case Studies**
Applications: Assembly line balancing (Design and balancing of assembly lines), Capacity planning (Uncertainty due to changing capacity levels, increasing the current resources, improving current operations to increase capacity), Cellular manufacturing (Comparing planning and scheduling in CM, comparing alternative cell formation), Just-in-time (Design of Kanban systems), Scheduling (rules, capacity, layout, analysis of bottlenecks, performance measurement), Production planning and inventory control (Safety stock, batch size, bottlenecks, forecasting, and scheduling rules), Resource allocation (Allocating equipment to improve process flows, raw materials to plants, resource selection), Scheduling (Throughput, reliability of delivery, job sequencing, production scheduling, minimize idle time, demand, order release), Robotics, PLCs, Material Handling Equipments (Electronic Monorail System, Power & Free Conveyors, AGVs,) **Case Studies**: 1-2 detailed case studies on above applications	

Books and other resources

Text Books:

1. Obi S. C., Introduction to manufacturing systems, Author House, 2013.
2. Banks J. and Carson J.S., Nelson B.L., "Discrete event system simulation", 4th Edition, Pearson., United Kingdom, 2005.
3. Christopher A. Chung, Simulation Modeling Handbook: A Practical Approach, CRC Press, 2004
4. Al-Aomar, R., Williams, E. J., & Ulgen, O. M. (2015). Process simulation using witness. John Wiley & Sons.

References Books:

1. Peiter Mosterman, Discrete-Event Modeling and Simulation: A Practitioner's Approach, Taylor & Francis Group, 2009
2. David Elizandro and Hamdy Taha , Performance Evaluation of Industrial Systems: Discrete Event Simulation in Using Excel/VBA, Second Edition, CRC Press, 2012
3. Evon M. O. Abu-Taieh, Asim Abdel Rahman El Sheikh, Handbook of Research on Discrete Event Simulation Environments: Technologies and Applications, Information science reference, 2010
4. Steffen Bangsow (Ed.), Use Cases of Discrete Event Simulation: Appliance and Research, Springer 2012
5. Byoung Kyu Choi, Donghun Kang, Modeling And Simulation Of Discrete-Event, Systems, John Wiley & Sons, Inc, 2013

6. Ernst G. Ulrich, Vishwani D. Agrawal, Jack H. Arabian, Concurrent And Comparative Discrete Event Simulation, Springer Science+Business Media, 1992
7. Lawrence Leemis, Steve Park, Discrete-Event Simulation: A First Course, Prantice Hall, 2004
8. Theodore T. Allen, Introduction to Discrete Event Simulation and Agent-based Modeling, Springer.

Web References:

1. https://archive.nptel.ac.in/courses/110/106/110106044/
2. https://archive.nptel.ac.in/courses/112/107/112107220/
3. https://www.youtube.com/user/WitnessSimulation/videos
4. https://vimeo.com/lanner
5. https://www.lanner.com/en-gb/insights/customer-stories/
6. https://onlinecourses.nptel.ac.in/noc19_me45/preview

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050D: Engineering Economics and Financial Management

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial		**Tutorial**		**End-Semester**	**70 Marks**

Prerequisites: Understanding of economics & Finance in organizational functions and zeal to learn the subject

Course Objectives:

1. To introduce the concepts of economics & finance in industry.
2. To understand cost analysis and pricing
3. To acquire knowledge on basic financial management aspects and develop the skills to analyze financial statements
4. To understand the budgetary process and control.
5. To understand the international business process and associated financial facets
6. To introduce the entrepreneurial financial aspects.

Course Outcomes

On completion of the course, students will be able to -

CO1. **UNDERSTAND** the business environment, concepts of economics and demand-supply scenario.

CO2. **APPLY** the concepts of costing and pricing to evaluate the pricing of mechanical components.

CO3. **UNDERSTAND** accounting systems and analyze financial statements using ratio analysis

CO4. **SELECT** and **PREPARE** the appropriate type of budget and understand the controlling aspects of budget.

CO5. **UNDERSTAND** the international business and trade system functioning

CO6. **DEMONSTRATE** understanding of financing decisions of new ventures and performance

Course Contents

Unit 1	**Introduction to Business and Economics**

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance

Economics: Significance of Economics, Micro and Macro Economic Concepts, Various terms and

Concepts, Importance of National Income, Inflation, Money Supply in Inflation, Factors of Production, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics **Market Structures:** Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition **Demand and Supply:** Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting. Determinants of Supply, Supply Function & Law of Supply. Utility and Laws of returns	
Unit 2	**Costs and Cost Accounting**
Costs: Standard cost, estimated cost, First cost, Fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Cost curves, Breakeven point and breakeven chart, Limitations of breakeven chart, Interpretation of breakeven chart, margin of safety, Angle of incidence and multi product break even analysis, Cost Output Decision and Estimation of Cost, Zero Based Costing and numerical **Cost Accounting:** Objectives of cost accounting, elements of cost: material cost, labor cost, and expenses, allocation of overheads by different methods, Costing based on direct and indirect costs, Overheads apportionment and absorption, Different Models of Depreciation. Numerical on costing **Pricing:** Contribution, P/V-ratio, profit-volume ratio or relationship, Types of Pricing, Pricing policies, Pricing methods, Product Life Cycle based Pricing, Price fixation, depreciation and methods of calculating depreciation	
Unit 3	**Financial Accounting**
Accounting, Cost accounting & Management accounting, Various types of business entities, Accounting principles, postulates & meaning of accounting standards, Accounting cycle, Capital and revenue, Revenue, Expenses, Gains & Losses, Types of accounts & their rules, Journal Entries Create ledger, Preparation of Trial Balance, Finalizations, Preparation of Trading & Profit & Loss account, Understanding of Assets & Liabilities **Balance sheet and related concepts** - Profit & Loss Statement and related concepts, Financial Ratio Analysis, Cash flow analysis, Funds flow analysis, Comparative financial statements, Analysis & Interpretation of financial statements, Concept of Ratio Analysis, Preparation of Balance sheet (numerical) **Investments:** Risks and return evaluation of investment decision, Average rate of return, Payback Period, Net Present Value, Internal rate of return	
Unit 4	**Budget and Budgetary Control**
Budgeting and Budgetary Control: Concept of budget, Types and classification of budgets,	

Advantages and limitations, Methods of budgeting

Budgetary Control: objectives, merits and limitations, Budget administration. Functional budgets. Fixed and flexible budgets, Installation of Budgetary Control System, Zero base budgeting, Taxes and Financial Planning, Impact of Taxation and Inflation on Financial Management

Unit 5	**International Business and Finance**

Concept of globalization, factors influencing globalization, concept of international business and motives, international trade, institutional framework in international business, the significance of foreign trade policy, export-import procedures

Definition and function of money, Qualities of a good money, classification of money, value of money, index numbers, appreciation and depreciation of money, Gresham's Law and its limitations, Theory of exchange, barter, stock exchange, Speculation Taxation and Insurance

Balance of Trade and Balance of Payments, Barriers to Trade, Benefits of Trade/Comparative Advantage, Foreign Currency Markets/Exchange Rates, Monetary, Fiscal and Exchange rate policies, Economic Development

Unit 6	**Entrepreneurial Finance**

Sources of Funds for Entrepreneurs and Start Ups: Entrepreneurial Finance Vs. Corporate Finance; Traditional Sources of Funds, Early-Stage Sources of Funds- Incubators, Accelerators, Crowd Funding, Business Angels, Mezzanine Funds, Venture Capitals, Private Equity, LBO, Funding Process - Deal Sourcing, Deal Negotiation, Deal Agreement, Term Sheet

Investment Decisions for Start Ups: Time Value of Money, Types of Investment Decisions, Capital Budgeting Process - Investment Evaluation, Risk Analysis in Capital Budgeting - Risk Adjusted Discount Rate, Certainty Equivalent, Decision Tree, Sensitivity Analysis, Scenario Analysis

Valuation and Measurement of Financial Performance: Pre Money and Post Money Valuation, Factors Influencing Valuation, Valuation Methods, Dilution and Valuation of Equity, Metrics used for Performance Evaluation, Harvesting-Exit Strategies

Books and other resources

Text Books:

1. Hay, Donald A. and Derek J. Morris. Industrial Economics and Organization: Theory and Evidence, 2nd Edition (Oxford: Oxford University Press), 1991.
2. Lall, Sanjaya. Competitiveness, Technology and Skills (Cheltenham: Edward Elgar), 2001. 4. Scherer, F. M. and D. Ross. Industrial Market Structure and Economic Performance, 3rd Edition (Houghton: Mifflin), 1990.
3. Financial Accounting", Dr. Kaustubh Sontakke [Himalaya Publishing House]
4. Chandra, Prasanna (2004). Financial Management: Theory and Practice. New Delhi: TATA McGraw Hill

References Books:

1. Accounting Theory & Practice Prof Jawahar Lal [Himalaya Publishing House]

2. Brearley, Richard A. and Myers, Stewart C. (1988). “Principles of Corporate Finance”, New Delhi: McGraw-Hil
3. Engineering Economics, Tara Chand, Nem Chand and Brothers, Roorkee
4. Engineering Economy, Thuesen, G. J. and Fabrycky, W. J., Prentice Hall of India Pvt. Ltd.
5. Mechanical Estimating and Costing, T. R. Banga and S. C. Sharma, Khanna Publishers, Delhi
6. Industrial Organization and Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publishers, New Delhi
7. Mechanical Estimating and Costing, D. Kannappan et al., Tata McGraw Hill Publishing Company Ltd., New Delhi
8. A Text Book of Mechanical Estimating and Costing, O. P. Khanna, Dhanpat Rai Publications Pvt. Ltd., New Delhi
9. Industrial Engineering and Management, O. P. Khanna, Dhanpat Rai and Sons, New Delhi
10. Financial Management, I. M. Pandey, Vikas Publishing House Pvt. Ltd., New Delhi
11. Engineering Economics, James L. Riggs, David D. Bedworth and Sabah U. Randhawa, Tata McGrawHill Publishing Co. Ltd., New Delhi
12. Engineering Economy, Paul DeGarmo, Macmillan International Inc., New York
13. Entrepreneurial Finance-The Art and Science of Growing Ventures, Edited by Alemany L. and Andreoli, J.J, 2018, Cambridge University Press.
14. Rogers, S and Makonnen, R, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur, 4th Ed., Mc Graw Hill Education, 2020

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_ma44/
2. https://onlinecourses.nptel.ac.in/noc22_hs72/
3. https://onlinecourses.nptel.ac.in/noc22_mg63/
4. https://onlinecourses.nptel.ac.in/noc22_mg108/
5. https://onlinecourses.nptel.ac.in/noc22_hs113/
6. https://onlinecourses.nptel.ac.in/noc22_ma44/

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050E: Organizational Informatics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding of design, manufacturing and business processes, industrial engineering principles and concepts and information technology. Manual processes of data / information generation, handling and interpretation / usage.

Course Objectives:

1. To provide a comprehensive grounding in many facets of Organizational Information systems.
2. To describe the role of information technology at various levels of organization.
3. To introduce integrated and co-ordinate network of components required for information system.
4. To enable students understand the Product Data Management (PDM) and Product Lifecycle Management (PLM) spanning product development and beyond.
5. To acquaint with information needs and ERP for manufacturing activities.
6. To introduce manufacturing execution system.
7. To describe the information requirements for successful integration of business activities.

Course Outcomes

Learner will be able to:

CO1. Demonstrate an understanding of the scope, purpose and value of information systems in an organization.

CO2. Understand the constituents of the information system.

CO3. Demonstrate the Understanding of the management of product data and features of various PLM aspects.

CO4. Relate the basic concepts of manufacturing system and the ERP functionalities in context of information usage.

CO5. Understand the manufacturing execution system and it's applications in functional areas.

CO6. Outline the role of the information system in various types of business and allied emerging technologies.

Course Contents

Unit 1	**Information Systems in the Enterprise**

Types of information: operational, tactical, strategic and statutory, Pyramid Diagram, management structure, requirements of information at different levels of management and various functions, Information Quality

The Need for Information Systems: Digital Convergence and the changing Business Environment,

Information and Knowledge Economy, Contemporary Approach to IS and Management Challenges, Information requirements for Industry 5.0 **Information Systems in the Enterprise**: Types of Information Systems in the Organization-Transaction Processing System (TPS), Decision Support System (DSS), Management Information System (MIS) and Executive Support System (ESS). Functional Perspective of IS; Enterprise Systems; Strategic uses of Information Systems; Economic, Organizational and Behavioral Impacts; IT Impact on Decision Making; Leveraging Technology in the Value Chain; MIS and Core Competencies; Strategic Information Systems (SIS)	
Unit 2	**Components of Information System**
Introduction to technical and non-technical components of Information System Hardware, Software and IT Infrastructure: Evolution of IT Infrastructure; Digital Storage; IT Infrastructure Components; Current Trends in Hardware Platforms; Enterprise Software; Groupware **Databases and Data Warehouses**: Traditional vs Database approach; Database Models, Introduction to Relational Model, and Object Oriented Model; Relational Operations SQL, Data Modelling; Databases on the Web, Data Warehousing, Advances in Database Technology, Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN	
Unit 3	**Product Data and Product Lifecycle Management System**
Product Data Management: Product Data, Product Data Management, Basic Functions of a PDM System, Product Data issues - Access, applications, Archiving, Availability, Change, and Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow **Product Life-cycle Management system**: system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of PLM systems. Introduction, modules and features of various PLM software like Arena, TeamCenter, Windchill, Oracle, SAP, Aras etc.	
Unit 4	**Manufacturing Information System**
The Evolution from MRP to MRP II to ERP, ERP: Principle, ERP framework, Business Blue Print, Business Engineering V/S Business Process Reengineering (BPR), Introduction to various ERP software like SAP, People soft, Baan and Oracle, Comparison, ERP Modules, their Features and applications, Customization and ERP Implementation, Manufacturing Information Systems in lean manufacturing and industry 5.0 environments, Manufacturing Database Integration.	
Unit 5	**Manufacturing Execution System**
Concept, functional hierarchy model, generic activity model of manufacturing operations management, various modules like detailed production scheduling, product definition management and production execution management, Historians, diverse reporting and tracking & tracing, plant dashboard, workflow management, interfaces, integration with ERP, and Plant modules, Advantages	

per Functional Area, MES implementation	
Unit 6	**Business Information System**

Electronic Commerce and the Digital Organization: Cross functional Enterprise Information System, Internet based Business Models. B2B, EDI and B2C Models; Role of Intranets/Extranet, Web Enabled Business Management, Strategic Enterprise Systems - Information requirement and systems for SCM, CRM, SRM

Emerging Technologies in IS: Cloud Computing, Artificial intelligence systems; Knowledge based expert system (KBES), Knowledge Management System

Management of Information System: Implementation Processes, Maintenance, Evaluation and Security of Information System, Protection of Information System

Books and other resources

Text Books:

1. Kenneth C. Laudon & Jane P. Laudon. “Management Information Systems”. Pearson Publishing
2. W. S. Jawadekar, Management Information Systems, Tata McGraw Hill, 2002
3. Robert Schultheis and Mary Summer, Management Information Systems –The Managers View, TataMcGraw Hill, 2008.
4. Goyal D.P., Management Information Systems –A Managers Perspective, Macmillan Publishers.
5. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
6. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
7. Vaman, ERP in Practice, TMH, 2009
8. Sartori, L.G., “Manufacturing Information Systems”, Addison-Wesley Publishing Company
9. Date, C.J.,”An Introduction to Database Systems” Addison Wesley”, 8th Edn,. 2003
10. Orlicky, G., “Material Requirements Planning”, McGraw-Hill, 1994.
11. Kerr, R., “Knowledge based Manufacturing Management”, Addison-Wesley
12. Franjo, C., “Manufacturing Information & Data Systems Analysis, Design & Practice”, Butterworth-Heinemann, 2002.
13. Weiming S, “Information Technology for Balanced Manufacturing Systems”, Springer, 2006.

References Books:

1. Gupta Uma G., Management Information Systems –A Managers Perspective, Galgotia Publications.
2. Gordon Davis, Management Information System: Conceptual Foundations, Structure and Development, Tata McGraw Hill, 2000.
3. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005.
4. Turban, McLean and Wetherbe, Information Technology for Management –Transforming Organizations in the Digital Economy, John Wiley, 2007.

5. Raymond McLeod and Jr. George P. Schell, Management Information Systems, Pearson Education, 2007.
6. James O Brien, Management Information Systems – Managing Information Technology in the Ebusiness enterprise, Tata McGraw Hill, 2002.
7. Avgerou, C., Ciborro, C., & Land, F. (2004). The social study of information and communication technology: Innovation, actors, and contexts. London: Oxford University Press.
8. Kallinikos, J. (2011). Governing through technology: Information artefacts and social practice. New York: Palgrave Macmillan.
9. Luff, P., Hindamarsh, J., & Heath, C. (2000). Workplace studies: Recovering work practice and informing system design. London: Cambridge University Press.
10. Alex Leon and Mathew Leon: "Data Base Management Systems", Vikas Publishing House, New Delhi.
11. Mahadeo Jaiswal, Monika Mital: "Management Information System", Oxford University Press, New Delhi, 2008.
12. Murthy C.S.V.: "Management Information System", Himalaya Publications, New Delhi, 2008.
13. Panneerselvam R.: "Database Management System", PHI Private Limited, New Delhi, 2008.
14. Philip J, Pratt, Joseph J. Adamski: "Database Management Systems", Cengage Learning, New Delhi, 2009.
15. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.
16. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition
17. Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2004
18. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
19. C. S. V. Murthy: Management Information System, Himalaya, 2009
20. James A. Obrein: Management Information Systems, TMH, 2009

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2. https://nptel.ac.in/courses/106105195
3. https://nptel.ac.in/courses/110105148
4. https://onlinecourses.nptel.ac.in/noc19_mg54/preview
5. https://nptel.ac.in/courses/110106146
6. https://www.youtube.com/watch?v=NzyhYxUCjlg

402050F: Computational Multi Body Dynamics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Systems in Mechanical Engineering, Solid Modeling and Drafting, Kinematics of Machinery, Numerical & Statistical Methods, Computer Aided Engineering, Design of Transmission Systems, Dynamics of Machinery

Course Objectives:

1. Study basic terminology and concepts used in Multibody Dynamics
2. Understand the types of joints, its kinematics and relevant transformations
3. Understand the formulation methods and Formulate problems using Principals of Dynamics
4. Analyze the kinematics and dynamics of rigid Planar inter-connected bodies
5. Analyze the kinematics of rigid spatial inter-connected bodies
6. Analyze the kinematics and dynamics of rigid spatial inter-connected bodies and Recognize the applications of Multibody Dynamics with applications to machine and structural dynamics

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **APPLY** the basic terminology and concepts used in Multibody Dynamics to solve varieties of motion related applications

CO2. **IDENTIFY and EVALUATE** the types of joints, its kinematics and relevant transformations

CO3. **DISTINGUISH and COMPARE** the formulation methods

CO4. **DERIVE** equations of motion and **EVALUATE** the kinematics and dynamics of rigid Planar inter-connected bodies

CO5. **DERIVE** equations of motion and **EVALUATE** the kinematics of rigid Spatial inter-connected bodies

CO6. **APPLY** MBD tool effectively and **SIMULATE** it to solve and validate practical Multibody Dynamics problems and its solutions

Course Contents

Unit 1	**Introduction to Computational Multi Body Dynamics**

Introduction: Single Body Dynamics Vs Multi Body Dynamics, Machine-Design Approach Vs Control-System Approach, Basic Building Blocks (Bodies, Constraints or Joints, Forces, Motions, Sensors, Controllers, Reference Frames, Contacts, etc.)

Kinematics: Angular velocity, matrix representation of angular velocity, simple angular velocity, Differentiation in two reference frames, angular acceleration, velocity and acceleration equations, two points fixed on a rigid body, point moving on a rigid body	
Unit 2	**Joints and Kinematics**
Types of joints (planar and spatial joints), Vector formulation of Constraint equations, Jacobian, Computation of Kinematics, Transformations (body-fixed and space-fixed rotations), Velocity Transformations	
Unit 3	**Basic Principles of Dynamics**
D'Alembert's Principle, Equilibrium and Virtual work, Virtual displacements, generalized forces, workless constraints, Lagrange's equation, Non-holonomic constraints, Lagrange's form of D'Alembert's principle - Jourdain - Kane Method, Generalized Inertia, Mass matrix **Newton-Euler Equations**: Constraint equations, augmented formulation, Lagrange multipliers, embedding technique and amalgamated formulation **Principle of virtual work and Lagrange's Equation**: Kinetic energy, potential energy function, generalized forces on a rigid body, derivation of equations of motion using Lagrange's method	
Unit 4	**Planar Multi Body Dynamics Motion Simulation**
Planar Kinematic Analysis: Joint constraints (Revolute, prismatic, gear and cam pairs, etc), Motion/Force Constraints, The automatic assembly of the systems of equations for position, velocity and acceleration analysis, Iterative solution of systems of non-linear equations, **Dynamics of Planar Systems:** Dynamics of Planar systems, Geometry of masses, computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element, Simple applications of Forward and Inverse Dynamic Analysis	
Unit 5	**Kinematic Analysis of Spatial Systems**
Kinematics of Rigid bodies in Space: Reference frames for the location of a body in space, Euler angles and Euler parameters. Screw motion in space, Velocity, Acceleration and Angular Velocity, Relationship between the Angular Velocity Vector and the time derivatives of Euler parameters, Articulated Rigid Body Dynamics **Dynamic Analysis of Spatial Systems:** Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical, screw, etc). Equations of motion of constrained spatial systems	
Unit 6	**Spatial Multi Body Dynamics Motion Simulation and its Applications**
Computation of spatial generalized forces for external forces. Computation of reaction forces from Lagrange's multipliers, Recursive Inverse Dynamics Survey of Existing Kinematic and Multibody dynamics Simulation software, Varieties of Applications	

Books and other resources
Text Books: 1. Nikravesh, P.E., (2019), “Planar multibody dynamics: formulation, programming with MATLAB®, and applications,” CRC Press, ISBN: 9781138096127 2. Shabana, A.A., (2020), “Dynamics of Multobody Systems,” Cambridge University Press, ISBN: 9781108485647 3. Rao, J.S., (2011), “Kinematics of Machinery Through HyperWorks,” Springer, ISBN: 9789400711556 4. Haug, E.J., (1988), “Computer-Aided Kinematics and Dynamics of Mechanical Systems, Volume-I, Basic Methods,” Prentice Hall, ISBN: 9780205116690 5. Haug, E.J., (2021), “Computer-Aided Kinematics and Dynamics of Mechanical Systems, Volume-II, Modern Methods,” www.researchgate.net
References Books: 1. Wittenburg, J., (2012), “Dynamics of Systems of Rigid Bodies,” Vieweg+Teubner Verlag, ISBN: 9783322909435 2. Roberson, R.E., Schwertassek, R., (2012), “Dynamics of Multibody Systems,” Springer, ISBN: 9783642864667 3. Huston, R.L., (1990), “Multibody Dynamics,” Butterworth-Heinemann, ISBN: 9780409900415 4. Schielen, W., (1990), “Multibody Systems Handbook,” Springer, ISBN: 9783540519461 5. Rampalli, R., Ferrarotti, G. and Hoffmann, M., (2012), "Why Do Multi-Body System Simulation?," NAFEMS, ISBN: 9781874376545 6. Greenwood, D.T., (1987), “Principles of Dynamics,” Pearson, ISBN: 9780137099818 7. Moon, F. C., (2008), “Applied Dynamics with Applications to Multibody and Mechatronic Systems,” Wiley-VCH, ISBN: 9783527407514 8. Kane, T.R, Levinson, D.A., (1985), “Dynamics: Theory and Applications,” McGraw-Hill, ISBN: 9780070378469 9. de Jalon, J.C., Bayo, E., (2011), “Kinematic and Dynamic Simulation of Multibody Systems,” Springer, ISBN: 9781461276012 10. Jazar, R. N., (2011), “Advanced Dynamics: Rigid Body, Multibody, and Aerospace Applications,” John Wiley & Sons, ISBN: 9780470398357 11. Nandihal, P., Mohan, A., and Saha, S.K., (2021), “Dynamics of Rigid-Flexible Robots and Multibody Systems,” Springer, ISBN: 9789811627972 12. Shah, S., Saha, S.K., and Dutt, J.K., (2012), Dynamics of Tree-type Robotic Systems, Springer, ISBN: 9789400750050
Web References: • https://www.youtube.com/channel/UCN3-GeDjFM4A3muyhsS9mpQ

402051A: Process Equipment Design

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Design of Machine Elements

Course Objectives:

1. Understand the process flow diagrams (PFD) and design codes
2. Understand the content of piping and instrument diagrams (P&ID)
3. Understand the design of Cylindrical and Spherical Vessels and Thick Walled High Pressure Vessels
4. To enable students to apply the requirements of the relevant industry standards to the mechanical design of equipment's used in the process industry and above ground atmospheric storage

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **INTERPRET** the different parameters involved in design of process Equipments.

CO2. **ANALYZE** thin and thick walled cylinder

CO3. **DESIGN** cylindrical vessel, spherical vessel, tall vessels and thick walled high pressure vessels

CO4. **DESIGN** different process Equipments and select pump, compressor etc. and auxiliary services

CO5. **EVALUATE** Process parameters and their correlation

CO6. **APPLY** the concepts of process equipment design for specific applications

Course Contents

Unit 1	Process Design

Basic concepts in process design, block diagrams for flow of processes, material flow balance. Design pressures -–temperatures, design stresses, factory of safety, minimum shell thickness and corrosion allowance, weld joints efficiency, design loading, stress concentration and thermal stresses, failure criteria, optimization technique such as Lagrange's multiplier and golden section method, cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515

Unit 2	Piping design

Process Piping Design: Thin and thick walled cylinder analysis, pre stressing, Piping codes for design, construction and inspection, Piping flow diagrams and pipe work symbols, design of layout of water, steam and compressed air pipes work, Types of couplings

Unit 3	Thin and Thick Vessels

Design of Cylindrical and Spherical Vessels: Types and classes of vessels, types design of end closers, local stresses due to discontinuity or change of shape of vessel, vessel opening compensation, design of standard and non-standard flanges, design of vessels and pipes under external pressure, design of supports for process vessels

Design of Tall Vessels: Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column

Design of Thick Walled High Pressure Vessels: Thick walled cylinder analysis, pre stressing of thick cylinders, Design by various theories of failure, construction of these vessels with high strength steel and other special methods.

Unit 4	Process Equipment Design

Process Equipment Design: Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers, centrifuges. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipment's and auxiliary services, safety, etc., pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipe supports

Unit 5	Process Control

Process Control: Processes, Process parameters and their correlations, Fundamentals of process measurements and control modern control devices and other controls of major unit operation and processes.

Unit 6	Execution and Application of specific process Equipment Design

Execution: Planning, manufacture, inspection and erection of process equipment like pressure vessels, chimneys, ducting, heat exchangers, pulverizing equipment, etc. protective coatings, lining of Vessels

Application of specific process Equipment Design: Fuel pumping stations, fire extinguishers, HVAC, fume extraction systems with IOT and AI

Books and other resources

Text Books:

1. Process Equipment Design : By Dr. M.V. Joshi, Mc-Millan.
2. Process Equipment Design : By Browell and Young, John Wiley.
3. Plant Design and Economics : Max and TimasulausKalus – McGraw Hill.
4. Industrial Instrumentation servicing Hand Book : Cannel Grady, McGraw Hill.

References Books:

1. Handbook of Instrumentation and Control : Kellen Heward, McGraw Hill
2. Chemical Engineering Handbook: Perry John, McGraw Hill.
3. Chemical Equipment Design: B.C. Bhattacharya.
4. Industrial Pipe Work: D.N.W. Kentish, McGraw Hill.
5. Chemical Engineering: J.M. Coulson, Richardson, Sinnott Vol. VII, Maxwell, McMillan.
6. Pressure Vessel Design Hand Book: H. Bedna.
7. Dryden's outlines of Chemical Technology for the 2: By Roa M. Gopala, Sitting M., East West Press Pvt. Ltd., New Delhi.
8. Applied Process Design for Chemical and Petrochemical, Vol. I, II and III: By E.E. Ludwig, Gulf Publication Co., Houston.
9. Chemical Process Control: An Introduction to Theory and Practice: By Stephanopoulos G., Prentice Hall of India, New Delhi.
10. Chemical Process Equipment Selection and Design: By Stanley M.Walas, Butterworth-Heinemann Series in Chemical Engineering.
11. Process System Analysis and Control: By D.R. Coughanowr, McGraw Hill, New York.
12. Engineering Optimization: Theory and Practice: By Rao S.S., New Age Publishing Co., New Delhi.
13. Optimization of Chemical Processes: By Edgar T.F., Himmelblau D.M., McGraw Hill Book Co., New York.
14. Control Devices, Vol. I and II : Liptak
15. Analysis, synthesis and design of Chemical Processes : Richard Turton, Richard C. Bailie, Wallace B. Whiting, Josheph A. Shaewitz, Prentice Hall Int. Series in Physical and Chemical Science.

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402051B: Renewable Energy Technologies

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Systems in mechanical engineering, Applied Thermodynamics, Fluid mechanics, Heat transfer and Energy Engineering

Course Objectives:

1. To understand fundamentals, needs and scopes of renewable energy technologies.
2. To design and applications of solar thermal conversion systems.
3. To explain constructions, working and design of solar photovoltaic system used for domestic applications.
4. To design a wind energy system.
5. To study Wind farm and Solar Photovoltaic grid-connected Systems**.**
6. To describe biomass energy conversion systems.

Course Outcomes:

On completion of the course the learner will be able to;

1. **DESCRIBE** fundaments, needs and scopes of renewable energy systems.
2. **EXPLAIN** performance aspects of flat and concentric solar collectors along with applications.
3. **DESIGN** solar photovoltaic system for residential applications.
4. **DESIGN AND ANALYSIS** of wind energy conversion system.
5. **APPLY** Installation practices of Wind and Solar Photovoltaic Systems for grid connection.
6. **DETERMINE** performance parameters of bio-energy conversion systems.

Course Content

Unit 1 **Introduction to Renewable Energy Technologies**

Scenario of Renewable Energy Generation: Energy (and power) policies in the country, Energy supply and renewable energy programme during different plan periods. Renewable energy use and target in India, JNNSM policies and initiatives

Solar Energy Fundamentals: Solar Radiation and Measurement, Solar constant, Solar angles, day length, angle of incidence on tilted surface, Extra-terrestrial characteristic, Effect of earth atmosphere, Measurement and estimation on horizontal and tilted surfaces (numerical treatment on Solar angles and Measurements), Analysis of Indian solar radiation data and applications, Basics of solar cell, Forming the PN junction solar cells, Photo conversion efficiency, Theoretical limits

Wind Energy Fundamentals: Wind speed, Wind direction, Data measurement and analysis, Variation of wind speed with height and time, Wind potential assessment (numerical treatment), and wind resources worldwide and in India, wind energy forecast

Unit 2	**Solar Thermal Systems and Applications**

Solar thermal collectors: Flat plate collectors, Thermal analysis, Heat capacity effect, Testing methods, Evacuated tube collectors (ETC) analysis, its design and application, Numerical on flat plate collectors.

Solar Concentrating Collectors: types- line and point concentrator, tracking systems, theory of Concentrating collectors, parabolic trough collector, parabolic dish collector, Central receiver systems, concentrated Fresnel linear receiver (CFLR).

Solar thermal Applications: Solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning, solar pond, heliostat, solar furnaces, Solar thermal power generation.

Unit 3	**Solar Photovoltaic Systems**

Solar Cells and Modules: Classification of Solar cells, First generation: Single crystalline, Poly crystalline, Second Generation: Thin film, Cd-Te, CIGS, Third Generation: Polymer based, DSSC, Perovskites, Hybrid, Quantum Dots, Multi Junction Tandem cells, Inorganic and Hybrid cells, Different losses and mitigation, Factors Affecting Electricity Generated by a Solar cell, types of modules, PV panel and array, solar cell equation, Fill factor and maximum power, Shading and hot-spot formation.

Power Conditioning Equipment: Inverters, Regulators, Other Devices, System Analysis-Design Procedure, Design Constraints, selection of components, calculation of life cycle costing, payback time and Levelized Energy Cost (LEC) (Numerical treatment on- Designing solar PV system to find power consumption, Size the PV panel, Inverter and battery size, Solar charge controller size and costing for domestic applications only)

Recent PV market trends, Benchmark cost of different PV components

Unit 4	**Wind Energy Systems**

Components of wind turbines, Types of wind turbines- Horizontal axis and Vertical axis

Aerodynamics of wind turbines: Aerofoil sections and lift and drag coefficients, relative wind velocity, Power extraction from the wind energy, Wind power generation curve, Maximum power and Betz coefficient, Power Coefficient of a wind turbine (C_p), Axial thrust and torque developed by the turbine, Design tip speed ratio and solidity

Design parameters: Rotor axis rotation: Horizontal or Vertical, Rotor position - upwind and downwind of tower, Rotor Speed - constant or variable, Type of hub: rigid, teetering, hinged blades or gimballed, Number of blades, Tower Structure, Materials used for wind turbine components, calculation of life cycle costing, payback time and Levelized Energy Cost (LEC). Performance

evaluation of Wind energy system. Note: Numerical on aerodynamics, design parameters and payback estimation.	
Unit 5	**Design of grid connected Wind and Solar Photovoltaic Systems**
Wind Farm: Off-shore and on-shore wind farms, Small wind turbines special considerations and designs, testing, noise issues, Site selection and turbine spacing, rotor selection, ICT based monitoring and control of wind farms, Annual Energy Output (AEO) with numerical treatment, optimal placement of wind turbine in a wind farm, Wind power farm: installation operation and maintenance **Design of Wind Energy Conversion Systems:** Power control**:** stall, variable pitch, controllable aerodynamic surfaces and yaw control. Yaw Control: driven yaw, free yaw or fixed yaw **Design of Solar PV systems**: Site selection for solar photovoltaic plants, choice of module and their techno-economical characteristics, Series and parallel combination of PV array installation and output calculation with numerical treatment**,** off grid, on-grid, standalone system, grid interface. Enhancing array performance: cooling, concentrator, Solar PV tracking, effect of dust on PV and remedies, Installation of electrical and electronic components: array combiner box, inverter, Distribution boxes, safety devices, Maintenance procedure of solar photovoltaic plants, DPR preparation for roof-top and MW scale solar plants	
Unit 6	**Bio Energy Systems**
Bio-mass: Biomass types, Characteristics (Ultimate analysis, Proximate analysis, Calorific value, Physical Properties, Thermodynamic properties, Feedstock Handling Characteristic, Thermo-gravimetric analysis), Biomass estimation, Biomass formulation (Numerical Treatment). **Bio-fuel**: Introduction to bio-fuels, feedstocks for bio-fuel production, bio-diesel, bio-hydrogen, concept of bio-refinery **Thermo-chemical conversion**: Pyrolysis, Liquefaction and Gasification, Gasifier and types. Gas production, environmental effects, Producer gas utilization, Biomass integrated gasification/combined cycles systems (Numerical Treatment). **Bio-chemical Conversion:** Biodegradation, Aerobic Digestion, Anaerobic digestion; Biogas digester types and biogas utilization	
Books and other resources	
Text Books: 1. S P Sukhatme and J P Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 2017 2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Alpha Science, 2002	

3. Rabindra Satpathy, Venkateswarlu Pamuru, Solar PV power: Design, manufacturing and applications from sand to sand to systems.
4. B. H. Khan, Non-Conventional Energy Sources, Second Edition. Tata Mc-Graw Hill.
5. J. F. Manwell, J. G. McGowan and A. L. Rogers., Wind Energy Explained- Theory, Design and Application. John Wiley and Sons Ltd.
6. G. D. Rai, Energy Sources, Khanna Publications.
7. John R. Balfour, Introduction To Photovoltaic System Design (The Art and Science of Photovoltaics), Jones and Bartlett Publishers,
8. Michel C. Allard, Bioenergy Systems, Biological Sources and Environmental Impact, Nova Science Publishers, Inc.; UK ed. edition 2013.
9. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.
10. Meisam Tabatabaei, Biogas: Fundamentals, Process, and Operation (Biofuel and Biorefinery Technologies, Springer; 2018.

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1. G. N. Tiwari, Arvind Tiwari, Handbook of Solar Energy: Theory, Analysis and Applications, Springer, 27-Jun-2016 - Technology & Engineering.
2. S. Yang, H.A. El-Enshasy, N. Thongchul (Eds.), Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuels, Chemicals and Polymers, Wiley, 2013.
3. Handbook of Renewable Energy Springer; 1st ed. 2017.
4. Richard Jemmett, Methane Production Guide - How to Make Biogas. Three simple anaerobic digesters for home construction: Generate your own renewable energy from waste, RW Jemmett; 3rd edition (13 February 2011).
5. Wim Soetaert, Biofuels, Wiley, 2011.

Web Courses:

1. https://nptel.ac.in/courses/103103206
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Cost Analysis Of Energy Savings
Link: https://egyankosh.ac.in/bitstream/123456789/47587/1/Unit-3.pdf
National Electricity Plan
https://powermin.gov.in/en/content/national-electricity-plan-0
Report : https://powermin.gov.in/sites/default/files/uploads/NEP-Trans1.pdf
Economic & Financial Evaluation of Renewable Energy Projects
https://pdf.usaid.gov/pdf_docs/PNADB613.pdf
https://energypedia.info/wiki/The_Economics_of_Renewable_Energy
Analyzing The Falling Solar And Wind Tariffs: Evidence From India
https://www.adb.org/sites/default/files/publication/566266/adbi-wp1078.pdf
Mapping India's Energy Subsidies 2020
https://www.iisd.org/system/files/publications/india-energy-transition-2020.pdf
Jawaharlal Nehru National Solar Mission policies and initiatives:
Presentation: https://iitj.ac.in/CSP/material/JNNSM-Final.pdf
Report: https://mnre.gov.in/img/documents/uploads/file_f-1608040317211.pdf
Benchmark costs for Grid-connected Rooftop Solar PV systems:

https://www.yellowhaze.in/mnre-solar-benchmark-cost-2021-22/

Benchmark costs for Grid-connected Rooftop Solar Photo-voltaic systems for the financial year 2021-22

https://mnre.gov.in/img/documents/uploads/file_f-1629353920466.pdf

Installation & Maintenance of Solar Panel

https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on%20Installation%20&%20maintenance%20of%20Solar%20Panel(1).pdf

402051C: Automation and Robotics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Systems in Mechanical Engineering, Programming and Problem Solving, Basic Electronics Engineering, Engineering Mechanics, Solid Modeling and Drafting, Electrical and Electronics Engineering, Kinematics of Machinery, Mechatronics, Design of Transmission Systems

Course Objectives:

1. Introduce the need of Industrial Automation
2. Learn various types of Robots and the functional elements of Robotics
3. Identify and Judge application specific selection of Robot Drive Systems
4. Recognize various types End-effectors and Sensors used in Robotic Automation
5. Study the basic Mathematical Modeling Techniques of Robot
6. Understand the basics of Robot Programming and Robotic Applications

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** the basic concepts of Automation
CO2. **UNDERSTAND** the basic concepts of Robotics
CO3. **IDENTIFY** and **EVALUATE** appropriate Drive for Robotic Applications
CO4. **COMPARE** and **SELECT** End-effectors and Sensors as per Application
CO5. **DEVELOPE** the Mathematical Modeling Approaches of Robot
CO6. **EVALUATE** the fundamentals of robot programming and **CLASSIFY** the Applications

Course Contents

Unit 1	**Introduction to Automation**

Introduction: Automation in Production systems, Automated Manufacturing Systems, Reasons for Automation, Automation Principles and Strategies, USA (Use, Simplify & Automate) Principle, Automation Migration Principle, Types of Automation, Classification by Function/ Transfer Method, Automation using Hydraulic/Pneumatic Systems, Electrical/Electronic Systems and Automated Assembly Systems - Selection criteria, components, applications

Automated Assembly Systems: Types and Configurations, Part Feeding Devices, Part Orientation Devices, Part Conveying Devices, Feed tracks, Escapements and Part placing mechanism, Parts Delivery at workstations, Single-station and Multi-station Assembly Machines

Unit 2	Fundamentals of Robot Technology

Introduction: History, Definitions specified by Agencies, Classification and Applications, Laws of robotics, Specifications of robots, Flexible automation Vs. Robotics technology, Safety measures in robotics, Role of Robots in Automation

Robot Anatomy and configurations: Cartesian, Cylindrical, Polar, Articulated, SCARA, Pendulum Arm, Multiple Joint Arm, Parallel Manipulator, Work Envelope/Volume, Degree of Freedom associated with Robot Arm & Wrist, Joints & Joint Notification Scheme, Precision of Movement

Unit 3	Robot Drive Systems

Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC - Salient Features, Applications and Comparison of all these Drives, Micro actuators, Selection of drive, Power and Motion Transmission Systems for Robot, Motion Conversion, Determination of Power of motor, Types of Gearbox - Planetary, Harmonic, Cycloidal Gearbox and Gear Ratio, Variable Speed Arrangements

Unit 4	End-effectors & Sensors in Automation

End-effectors/Grippers/Tooling: Introduction, Types, Classification, Construction, Working, Selection and Design Considerations of End-Effectors/Grippers/Tooling Interface used in various Robotic Applications, Active and Passive Compliance

Sensors/Transducers: Introduction, Types, Classification, Construction, Working, Selection and Design Considerations of Transducers, Sensors, Resolvers, Encoders, Switches, Position/Range/Touch/Force/Torque/Safety Sensors and Transduces, Machine Vision System used in various Robotic Applications

Unit 5	Mathematical Modeling of Serial and Parallel Robots

Kinematics: General Mathematical Preliminaries on Vectors & Matrices, Link Equations and relationships, Direct Kinematics, Coordinate and Vector Transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Coordinate System, Inverse Kinematics of two joints/link manipulator, DH Parameters, Jacobian Transformation in Robotic Manipulation, Static Analysis

Dynamics: Direct Dynamics, Mass/Inertia and their Positions of links, Lagrangian/Eularian/Newtonian Approaches for formulation of equations of motion of planar two link/joint manipulator

Unit 6	Performance and Applications of Robots

Robot Performance and Economics: Introduction to Robotic Programming, Types of Robot Programming, Motion Programming, Simulation and Off-line Programming, Programming Examples such as Palletizing, Loading, Unloading, Material Handling, etc., Robot Economics, Functional Safety in Robotic Applications, Social Aspects of Robotics, Industry 4.0

Robots in Manufacturing Applications: Robot-based Manufacturing System, Robot Cell Design

Considerations and Selection of Robot

Robots in Non-manufacturing Applications: Field And Service Robotics, Mobile Robots, Wheeled, Legged, Tracked, Hybrid Terrestrial Mobile Robots, Unmanned Aerial Vehicle (UAV), Autonomous Underwater Vehicles (AUV), Humanoids, Robotic Assistive Technologies for Rehabilitation of Humans

Books and other resources

Text Books:

1. Groover, M. P., (2016), "Automation, Production Systems, and Computer-integrated Manufacturing," Pearson Education, ISBN: 9789332572492
2. Derby, S. J., (2004), "Design of Automatic Machinery," CRC Press, ISBN: 9780824753696
3. Deb, S. R., Deb, S., (2017), "Robotics Technology and Flexible Automation," McGraw Hill Education, ISBN: 9780070077911
4. Sandler, B. Z., (1999), "Robotics: Designing the Mechanisms for Automated Machinery," Academic Press/Prentice Hall, ISBN: 9780137816002
5. Tsai, L. W., (1999), "Robot Analysis: The Mechanics of Serial and Parallel Manipulators," Wiley-Interscience, ISBN: 9780471325932
6. Nagarajan, R., (2016), "Introduction to Industrial Robotics," Pearson Education India, ISBN: 9789332544802
7. Gupta, A. K., Arora, S. K., Westcott, J. R., (2016), "Industrial Automation and Robotics: An Introduction," Mercury Learning & Information, ISBN: 9781938549304

References Books:

1. Niku, S. B., (2020), "Introduction to Robotics, Analysis, Control, Applications," Wiley, ISBN: 9781119527626
2. Groover, M. P., Weiss, M., Nagel, R. N., Odrey, N. G., R.,Dutta, A., (2017), "Industrial Robotics - Technology ,Programming and Applications," McGraw Hill Education, ISBN: 9781259006210
3. Ray Asfahl, C., (1992), "Robots and Manufacturing Automation," Wiley, ISBN: 9780471553915
4. Koren, Y., (1985), "Robotics for Engineers," McGraw-Hill, ISBN: 9780070353992
5. Saha, S. K., (2017), "Introduction to Robotics" McGraw-Hill Education, ISBN: 9789332902800
6. Mittle, R., Nagrath, I., (2017), "Robotics and Control," McGraw Hill Education, ISBN: 9780070482937
7. Craig, J., (2021), Introduction to Robotics: Mechanics and Control, Pearson, ISBN: 9781292164939
8. Mike Wilson, M., (2014), "Implementation of Robot Systems: An introduction to robotics, automation, and successful systems integration in manufacturing," Butterworth-Heinemann, ISBN: 9780124047334
9. Spong, M. W., Hutchinson, S., Vidyasagar, M., (2020), "Robot Modeling and Control," Wiley, ISBN: 9781119523994
10. Siegwart, R., Nourbakhsh, I. R., Scaramuzza, D., (2011), "Introduction to Autonomous

Mobile Robots," The MIT Press, ISBN: 9780262015356
Web References: • Pratihar, D. K., (2019), "Robotics,: IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc19_me74/preview • Asokan, T., Ravindran, B., Vasudevan, K., (2020), "Introduction to Robotics," IIT Madras, https://onlinecourses.nptel.ac.in/noc20_de11/preview • www.roboanalyzer.com

402051D: Industrial Psychology and Organizational Behavior					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding psychology as natural science, Infancy and Preschool Years, Diversity and Social Interaction, zeal to contribute for individual, group, social and national development.

Course Objectives:

1. To develop an understanding of the nature, functioning and design of organization as social collectivities.
2. To orient the students to the application of principles of psychology in an industrial and organizational workplace
3. To demonstrate the understanding of job requirement and related fatigue, boredom and ways to handle it.
4. To develop the insights into performance management and understanding related improvement strategies.
5. To have an understanding of human behavior in groups and develop knowledge and skills in leadership, power, communication, negotiation and conflict management.
6. To develop the acumen to understand the organizational culture, change management and organizational development.

Course Outcomes

On completion of the course the learner will be able to;

CO1. **DEMONSTRATE** fundamental knowledge about need and scope of industrial - organizational psychology and behavior.

CO2. **ANALYZE** the job requirement, have understanding of fatigue, boredom and improve the job satisfaction.

CO3. **UNDERSTAND** the approaches to enhance the performance.

CO4. **KNOWLEDGE** of theories of organizational behavior, learning and social-system.

CO5. **UNDERSTAND** the mechanism of group behavior, various aspects of team, leadership and conflict management.

CO6. **EVALUATE** the organizational culture, manage the change and understands organizational development approaches.

Course Content

Unit 1	Industrial Psychology: Introduction

Introduction to Industrial Psychology, Brief History of Industrial Psychology, Nature, Scope and Problems, psychology as a science and areas of applications, Individual differences and their

evaluation, Role of heredity and environment, study of behavior and stimulus to response behavior, Types of individual differences, Scientific management and it's limitations **Hawthorne Studies**: Introduction, Hawthorne Studies, Implication of Hawthorne Studies, Criticisms of Hawthorne Studies, Relevance of Industrial psychology in era of Industry 5.0	
Unit 2	**Job Analysis and Industrial Fatigue**
Job Analysis and Evaluation, Employee Selection, Performance Evaluation, training and development **Industrial Fatigue**: Introduction, Concept and Meaning, Types of Industrial Fatigue, Causes of Fatigue, Contents, Fatigue Symptoms, Industrial Studies on Fatigue, Causes and Remedies of Industrial Fatigue, Effects of Industrial Fatigue **Industrial Boredom**: Introduction, Concept and Meaning, Causes and Remedies of Boredom, Effects of Boredom, Reducing Boredom	
Unit 3	**Performance Management**
Performance Management: Introduction, Concept and Meaning, Objectives of Performance Management, Process of Performance Management, Approaches to Performance Development, Methods of Performance Management Relevance of Leadership and supervision, Recruitment, Time and Stress Management, Occupational Health and Safety. Implication of Motivation Theories in Workplace, Factors Influencing Job Satisfaction, Reducing Dissatisfaction	
Unit 4	**Organizational Behavior: Introduction**
Concept of organization & organizational behavior, Organizational structure, factors affecting behavior in organizations, Theories of Organization - Classic Organizational Theory, Human Relations Theory, Contingency Theories, Models and Approaches of Organizational Behavior. Ethics and ethical behavior in organizations, Learning: meaning and definition, process and theories of learning, Understanding a social-system, Organizational Behavior in an Engineering Sector Organization	
Unit 5	**Group Behavior and Interpersonal Relationships**
Group Behavior: Groups: Concept and Classification, Stages of Group Development, Group Structure, Roles and Norms, Premise and Issues. Group Decision-Making: Group vs Individual, Groupthink and Groups Shift, Group Decision Making Techniques and Process **Team work**: meaning, concept, types, creating, an effective team **Leadership**: Functions and approaches; trait, behavioral and contingency models; characteristics of successful leaders; role of power in leadership **Interpersonal Relationships**: Understanding Self and Others, Developing Interpersonal	

Relationships, Transactional Analysis, Johari Window

Conflict Management: Concept, Causes, Types, Stages, Effects, Management of Conflicts

Unit 6	Organizational Culture, Change Management and Organizational Development

Organizational Culture: Concept, Dominant Culture, Strong vs Weak Cultures, Creating and Sustaining Culture, Employees Learning of the Culture, Creating a Customer-Responsive Culture.

Organizational Changes: Concept and Forces for Change, Managing Planned Changes, Resistance to Change, Approaches to Manage Organizational Change, Organizational Development, Culture-Boundedness of Managing the Change.

Organizational theory and development:
Organizational Theory: Classical organizational THEORY, Humanistic Theory, Open-System Theory
Organizational development: Need, models of Organizational change, Organizational development interventions

Books and other resources

Text Books:

1. Vikram Bisen and Priya, Indistrial Psychology, New Age Publication, 2010.
2. Michael Aamodt, Organizational/ Industrial Psychology, Wadsworth Cengage Learning, 2010
3. Robbins, S.P. Organizational Behaviour. Prenctice-Hall, latest edition.
4. Spector, P.E. Industrial and Organizational Psychology: Research and Practice. International Student Version. Latest Edition. Wiley.
5. Davis K. & Newstrom J.W., Human Behaviour at work, Mcgraw Hill International, 1985
6. Stephen P. Robbin & Seema Sanghi, Organizational behavior, Pearson, 2011
7. L.M. Prasad, Organizational behavior, S Chand & sons

References Books:

1. Blum M.L. Naylor J.C., Horper & Row, Industrial Psychology, CBS Publisher
2. Luthans Fred, Organizational Behaviour, McGraw Hill International.
3. Morgan C.t., King R.A.,John Rweisz & John Schoples, Introduction to Psychology, McHraw Hill, 1966
4. Schermerhorn J.R.Jr., Hunt J.G &Osborn R.N., Managing, Organizational Behaviour, John Willy
5. Arnold J., Robinson, Iran, T. and Cooper, Cary L, Work Psychology, Macmillan IndiaLtd.
6. Muchincky (2009). Psychology applied to work. New Delhi: Cengage.
7. Griffin, Ricky W: Organizational Behaviour, Houghton Mifflin co., Boston.
8. Ivancevich; John and Micheeol T. Matheson, Organizational Behaviour and Management, Tata McGraw-Hill, New Delhi.
9. Newstrom, John W. and Keith Davis: Organizational Behavior: Human Behavior at Work, Tata McGraw-Hill, New Delhi.
10. Steers Richard m. and J. Stewart black: Organizational Behavior, Hrper Collins college

Publishers, New York.
11. Sukla, Madhukar: Understanding Organizations: Organization Theory and Practice in India, Prentice Hall, New Delhi.

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Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402051E: Electric and Hybrid Vehicle					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Chemistry, Systems in Mechanical Engineering, Basic Electrical Engineering, Electrical and Electronics Engineering, Kinematics of Machinery, Computer Aided Engineering, Design of Transmission Systems

Course Objectives:

1. Introduce the concepts of electric vehicle and allied technologies
2. Learn the concept and types of hybrid electric vehicle
3. Identify and Judge application specific selection of Prime Movers, Energy Storage and Controllers required for e-vehicles
4. Recognize the e-Vehicle Configurations and Understand the Mechanics of vehicle movement
5. Design and Select the body frame with relevant suspension system and Testing of e-Vehicle as per Regulation/Licensing/Approval Organizations
6. Understand the Battery Charging techniques and management

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** the basics related to e-vehicle

CO2. **CLASSIFY** the different hybrid vehicles

CO3. **IDENTIFY** and **EVALUATE** the Prime Movers, Energy Storage and Controllers

CO4. **DISCOVER** and **CATAGORIZE** the Electric Vehicle Configuration with respect to Propulsion, Power distribution and Drive-Train Topologies

CO5. **DEVELOP** body frame with appropriate suspension system and **TESTING** of for e-Vehicles

CO6. **CLASSIFY** and **EVALUATE** Battery Charging techniques and management

Course Contents

Unit 1	**Introduction to Electric and Hybrid Vehicle**

History and evolution of Electric Vehicles, Comparison of Electric with Internal Combustion Engine Vehicles, Limitations of IC Engine Vehicles (ICEV), Exhaust Emission and Global warming, Environmental importance of Hybrid and Electric Vehicles, Overview of EV Challenges, Classification, Overview of EV Technologies, Advantages and Disadvantages, Economic and Environmental impacts of using Electrical Vehicles, Emerging Technologies for Electric Vehicle Drives, Case Studies of Two-Wheeler, Three-Wheeler, and Four-Wheeler Electric Vehicles,

Brief introduction to Autonomous and self-driving Vehicles	
Unit 2	**Hybrid Electric Vehicle**
Classification of HEV: Architecture, Construction, Working, Advantages and Limitations of Conventional and Gridable HEV, Classification of Conventional HEV, Types of Gridable HEV, Tractive force, Power and Energy requirements for standard drive cycles of HEV **Hybrid Electric Drive-Trains:** Basic concept of Hybrid Traction, introduction to various hybrid Drive-Train Topologies, Power flow Control in Hybrid Drive-Train Topologies, Fuel Efficiency Analysis **Control Strategy:** Supervisory Control, Selection of Modes	
Unit 3	**Prime Movers, Energy Storage and Controllers**
Brief introduction to Motors: Classification, Construction, Working, Control, Design criteria, Application and Design Examples, Selection of Motor, Structural Configuration of Motor Layout, Motor Safety and Maintenance, Motor Torque and Power Rating **Brief introduction to Energy Storage Systems:** Classification - Types and Packs, Construction, Working, Comparison and Selection, Principle of Operation, Units of Battery/Fuel Cell Energy Storage, Battery Performance Parameters Estimation, Battery/Cell Modeling, Traction Batteries and their Capacity Calculation and Power Rating for standard drive cycles, Lifetime and Sizing Considerations, Power and Efficiency, Characteristic Curves, Battery Cooling/Thermal Control and Protection, Battery Safety and Maintenance, Auxiliary battery, Hybridization of energy storage devices, Ultra capacitor and Ultra flywheel **Controllers:** Configuration based on power electronics, Torque/Speed Coupling, Speed and Torque Controllers, BCU, MCU, Speed Control for Constant Torque/Power Operation of all electric motors, Control Methods	
Unit 4	**Electric Vehicle Configuration and Mechanics of Vehicle Movement**
Electric Vehicle Configuration with respect to Propulsion and Power distribution: Unicycle, Two-Wheeler (Bicycle, Dicycle, Motorcycle, Scooter, Scooteretts, Mopeds and Underbone), Three-Wheeler, and Four-Wheeler Electric Vehicles, Steering and Propulsion Configuration, Placement of Motors, Battery and Motion Transmission Systems **Electric Drive-Trains:** Basic concept of Electric Traction, introduction to various Electric Drive-Train Topologies, Power flow Control in Electric Drive-Train Topologies, Fuel Efficiency Analysis, Mechanical Differential Vs. Electric Differential **Mechanics of Vehicle Movement:** General description of vehicle movement, Power train Components and Sizing, Wheels and Tires, Load calculation, Torque/Traction Calculations, Power Calculation, Effect of Rolling, Pitch & Yaw on velocity and moments, Rolling resistance and its equation, Aerodynamic Drag/Lift and its equation, Grading resistance, Road	

resistance, Acceleration resistance, Total driving resistance, Dynamic equation, Brake System	
Unit 5	**Electric Vehicle Design, Manufacturing, Testing & Homologation**
Frames and Suspension Design for varieties of Electric Vehicle Configuration: Introduction to Body loads, Driving dynamics and Comfort, Strength and Stiffness of chassis/frames, Types and constructional details of frames, Frame Materials, Frame building Problems, frame components, Front and Rear Suspension Systems, Panel meters and controls on Handle-bar/Dash-board, Body Manufacturing, Aesthetics and Ergonomics Consideration, Retrofitting and its associated Problems **Vehicle Testing & Homologation:** Need of vehicle Testing and Homologation, National/International Testing/Regulation/Licensing/Approval Organizations and their Standards (AIS) for e-Vehicles, Hierarchy of Testing, Conformity of Production tests, Crash test, Side Impact Test, Rollover Test, Impact Test, Track Testing	
Unit 6	**EV Charging Infrastructure Management**
Battery Charging: Basic Requirements for Charging System, Charging Methods and Standards, Converters, Charger Architectures, Grid Voltages, Frequencies and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Boost Converter for Power Factor Correction, Examples, Vehicle to Grid operation of EV's **Battery Management Systems:** Necessity of Battery Management Systems, Typical Structure of BMSs, Representative Products, Keypoints of BMSs in Future Generation, Hazard/Safety Management	
Books and other resources	
Text Books: 1. Iqbal Hussein, (2021), "Electric and Hybrid Vehicles: Design Fundamentals," CRC Press, ISBN: 9780367693930 2. Denton, Tom, (2020), "Electric and Hybrid Vehicles," 2nd Ed., Routledge, ISBN:9780367273248 3. John Lowry, James Larminie, (2012), "Electric Vehicle Technology Explained," Wiley, ISBN: 9781119942733 4. Knowles, Don, (2011), "Automotive Suspension & Steering Systems," Cengage learning, ISBN: 9781435481152 5. Malen, Donald E., (2011), "Fundamentals of Automobile Body Structure Design," SAE International, ISBN: 9780768021691 6. R. Krishnan, (2001), "Electric Motor Drives: Modeling, Analysis, and Control," Pearson, ISBN: 9780130910141 7. Mohammad Saad Alam, Reji Kumar Pillai, N. Murugesan, (2021), "Developing Charging Infrastructure and Technologies for Electric Vehicles," IGI Global/ Business Science Reference, ISBN: 9781799868583	
References Books: 1. Mehrdad Ehsani, Yimi Gao, Sefano Longo, Kambiz Ebrahimi, (2019), "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design," CRC Press,	

ISBN: 9780367137465
2. Tariq Muneer, Mohan Kolhe, Aisling Doyle, (2017), “Electric Vehicles: Prospects and Challenges,” Electric Vehicles: Prospects and Challenges, ISBN: 9780128030219
3. Sandeep Dhameja, (2001), “Electric Vehicle Battery Systems,”, Newnes, ISBN: 9780750699167
4. Bruno Scrosati, Jürgen Garche, Werner Tillmetz, (2015), “Advances in Battery Technologies for Electric Vehicles,” Woodhead Publishing, ISBN: 9781782423775
5. Shunli Wang, Carlos Fernandez, Yu Chunmei, Yongcun Fan, Cao Wen, Daniel-Ioan Stroe, Zonghai Chen, (2021), “Battery System Modeling,” Elsevier, ISBN: 9780323904728
6. Andrea, Davide, (2010), “Battery management systems for large lithium battery packs,”Artech House Publishers, ISBN: 9781608071043
7. Dixon, John C., (2009), “Suspension Analysis and Computational Geometry,” Wiley, ISBN: 9780470510216
8. Day, Andrew J., (2014), “Braking of Road Vehicles,” Butterworth Heinemann, ISBN: 9780123973146
9. Guiggiani, Massimo, (2018), "The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars," Springer, ISBN: 978-3319732190
10. Chen, Yong, (2021), “Automotive Transmissions: Design, Theory and Applications,” Springer, ISBN: 9789811567025
11. Bentley Publishers, (2002), “Bosch Automotive Handbook,” Bentley Publishers, ISBN: 0837610974
12. Prasad, Priya and Belwafa, Jamel E., (2004), “Vehicle Crashworthiness and Occupant Protection,” American Iron and Steel Institute Southfield, Michigan, www.roadsafellc.com
13. Macey, Stuart and Wardle, Geoff, (2008), “H-Point: The Fundamentals of Car Design & Packaging,” designstudio Press, ISBN: 9781933492377
14. Sulabh Sachan, Sanjeevikumar Padmanaban, and Sanchari Deb, (2022), “Smart Charging Solutions for Hybrid and Electric Vehicles,” Scrivener Publishing, ISBN: 9781119768951

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- Majhi, S. and Kumar, P., (2019), “Introduction to Hybrid and Electric Vehicles,” IIT Guwahati, http://nptel.ac.in/courses/108103009/
- https://evreporter.com/

402052: Mechanical Systems Analysis Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**02 Hrs.**	**Practical**	**01**	**Term Work**	**25 Marks**
				Oral	**25 Marks**

Prerequisites: Systems in Mechanical Engineering, All Mechanical Engineering subjects, Solid Modelling and Drafting, Computer Aided Engineering, Computational Fluid Dynamics, Computational Multi Body Dynamics, Project Based Learning -I,-II, Skill Development, Internship/Mini project, All Electives

Course Objectives:

1. Develop an understanding of the Systems Engineering Process and the range of factors that influence the product need, concept development, system's mathematical modelling, analysis, synthesis, simulation, design, validation, redesign, planning, production, evaluation and use of a system using manual calculation, mathematical modelling, computational tools to automate product development process.
2. Understand the concepts of and use the developed skills in last three and half year of engineering studies for the design, construction, fault-finding, diagnosis, performance analysis, maintenance, modification, and control of technological systems.
3. Acquire knowledge of new developments and innovations in technological systems to be carried forward to next stage of employment after passing your Undergraduate Degree Examination.
4. Develop an understanding of how technologies have transformed people's lives and can be used to solve challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.
5. Gain an awareness of quality and standards, including systems reliability, safety and fitness for the intended purpose.
6. Build yourself to face the challenges of future technologies and their associated Problems.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **DEVELOP** an understanding of the Systems Engineering Process and the range of factors that influence the product need, problem-specific information collection, Problem Definition, Task Specification, Solution Concept inception, Concept Development, System's Mathematical Modelling, Synthesis, Analysis, final solution Selection, Simulation, Detailed Design, Construction, Prototyping, Testing, fault-finding, Diagnosis, Performance Analysis, and Evaluation, Maintenance, Modification, Validation, Planning, Production, Evaluation and use of a system using manual calculation, computational tools to automate product development process, redesign from customer feedback and control of technological systems.

CO2. **ILLUSTRATE** the concepts and USE the developed skill-set of use of computational tools (FEA, CFD, MBD, FSI, CAE) to automate the complete product development process.

CO3. **EVALUATE** the knowledge of new developments and innovations in technological systems to carry forward to next stage of employment after passing your Undergraduate Degree Examination.

CO4. **APPRAISE** how technologies have transformed people's lives and can be used to **SOLVE** challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.

CO5. **PRIORITIZE** the concept of quality and standards, including systems reliability, safety and fitness for the intended purpose.

CO6. **INVENT** yourself to face the challenges of future technologies and their associated Problems.

Course Contents

Preamble:

Engineering is the application of science to develop, design, and produce logical and/or physical objects such as buildings, machines, or a computer program to fulfill a desired need or to achieve an objective. So the object or goal of engineering is a design. So Systems Engineering is the engineering of a system - it is the application of science to design a system.

This lab is intended for developing an analysis skill-set with logical reasoning expected by industries to solve their problems during Product (Hardware, Software and Services) Development Process as a part of Company's System Engineering to survive in the open competitive Market, where there is no Textbook available.

TERM WORK:

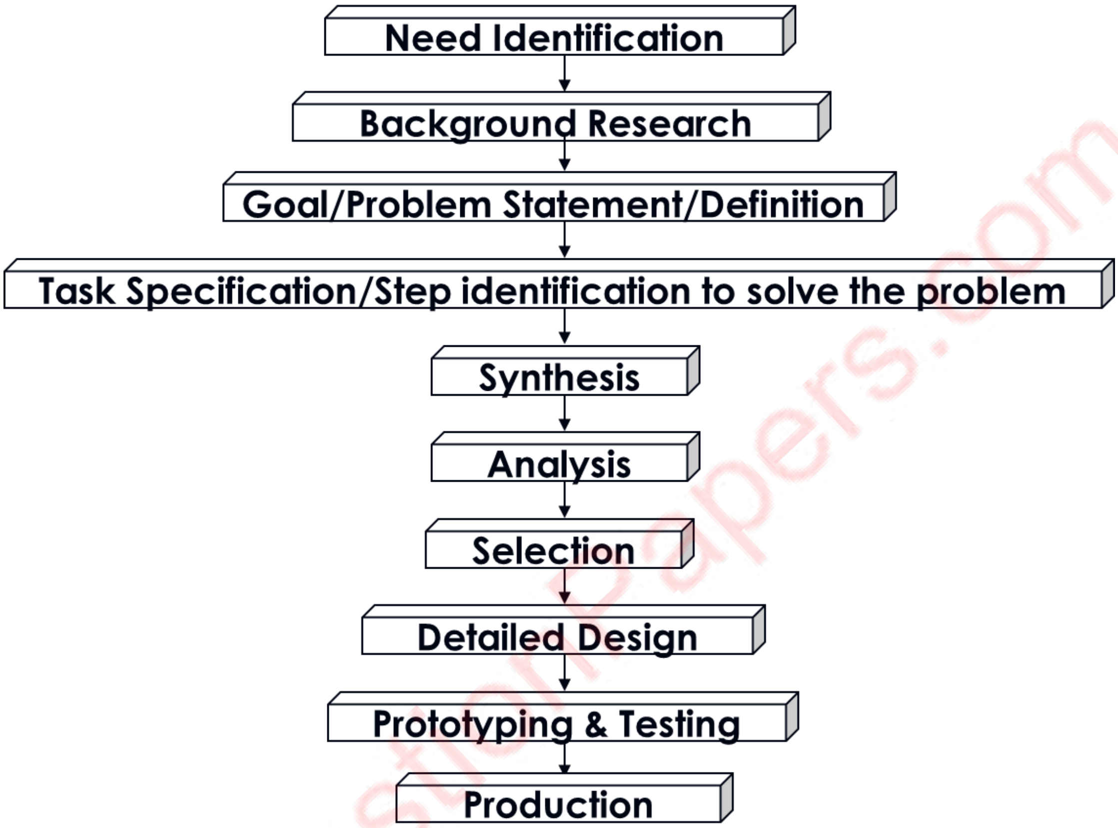
The term work shall consist of following **two parts**, each carry **equal weightage**:

A] Product based Case study

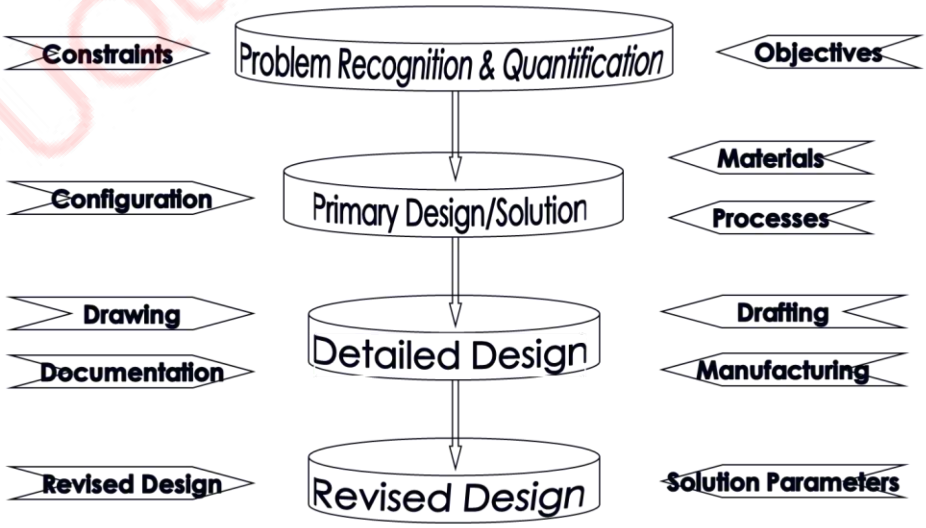
- **Individual student** will take up **one product based system analysis activity** by consultation with associated faculty and followed by development using available and learned computational tool. It will be in the form of Complete Report.

- The product can be but not limited to: any household product, Utility products, Hand/Process Tools/Equipments, Thermal Systems like, Heat exchangers, Mass production jigs/fixtures, robotics and automation products, etc.

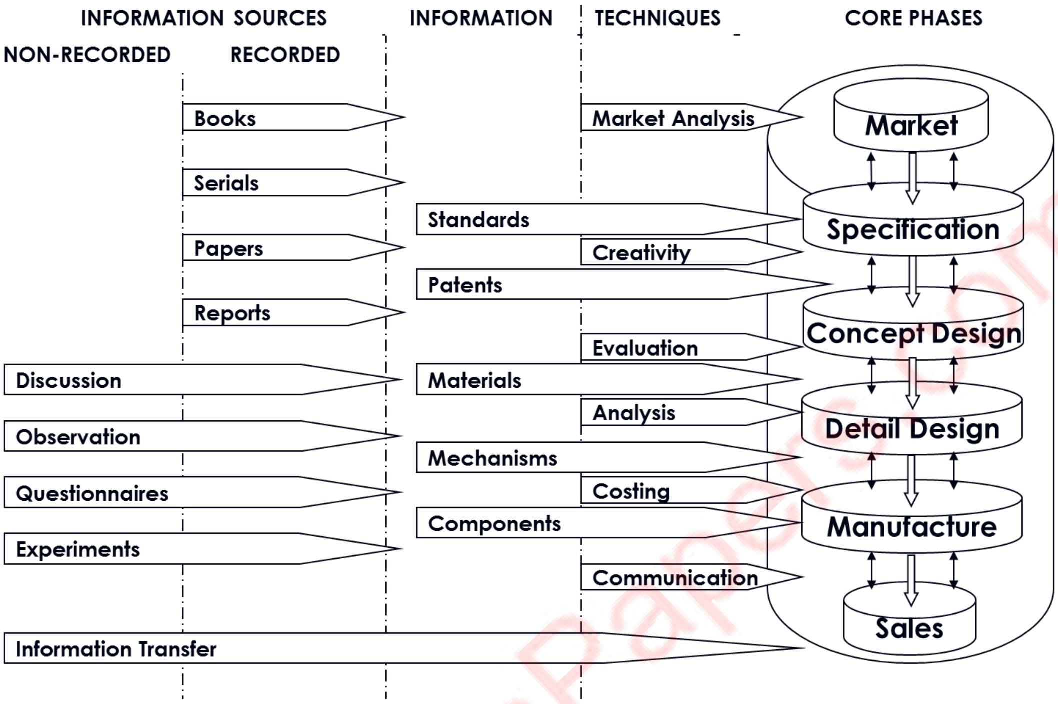
- Product Systems Analysis must follow following approach for developing the final prototype (Hardware, Software and Services).



- The Decision Making Approach with required inputs will be as follows:



- The Resources & flow of Information for System Analysis Activity for Product development must follow:



- **Demonstration by Faculty (guiding role) -** Faculty shall demonstrate complete design, analysis and synthesis of any one mechanical system from need to the end use comprising of deployment of appropriate analysis tool for modelling of the prototype. Philosophy must be told and demonstrated by faculty.

NOTE: This work should not be replication of your Project Work

B] List of Assignments (Any Five from each category)

- Following Assignment must be completely in a Computer Lab using Computational Fluid Dynamics and Multibody Dynamics Open source or Commercial Software:

B1) **CFD Assignments**

1. Numerical simulation and analysis of boundary layer over a flat plate (Blausius Equation)
2. Numerical simulation and analysis of boundary layer for a Developing flow through Pipe
3. Fully developed flow through a pipe
4. CFD Analysis of external flow: Circular Cylinder or Airfoil (NACA 0012)
5. CFD analysis of heat transfer in pin fin.
6. Numerical simulation and analysis of 2D square lid driven cavity.
7. Effect of Reynolds number on the vorticity patterns.
8. Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper. (Mandatory)

B2) **MBD Assignments**

Kinematic and Dynamic analysis of the following Multibody Systems:

1. Four bar mechanism/Slider crank mechanism
2. Cam and follower System
3. Serial Robot Manipulators
4. Parallel Robot Manipulators

5. Mobile Robot
6. Leg Mechanisms/Grippers Mechanisms
7. Automation/ Material Transporting Mechanism
8. Mini project on any practical application. Students should take a problem of their choice and verify the MBD solution with experimental data / research paper. (Mandatory)

Books and other resources

Text Books:

1. National Aeronautics and Space Administration, (2007), "NASA Systems Engineering Handbook," NASA, ISBN: 9780160797477
2. Space & Missile Systems Center, (2004), "SMC Systems Engineering Primer & Handbook: Concepts, Processes, and Techniques," SMC, U.S. Air Force
3. Oliver, D. W., Kelliher, T. P., Keegan, Jr., J. G., (1997), "Engineering Complex Systems With Models and Objects," McGraw-Hill, ISBN: 978-0070481886
4. Bi, Zhuming (2018), "Finite Element Analysis Applications: A Systematic and Practical Approach, Academic Press, ISBN: 9780128099520

References Books:

1. Rao, J.S., (2017), "Simulation Based Engineering in Fluid Flow Design," Springer, ISBN: 9783319463810
2. Tu, J., Yeoh, G-H. and Liu, C., (2018), "Computational Fluid Dynamics: A practical approach," Butterworth-Heinemann, ISBN: 9780081011270
3. Nikravesh, P.E., (2019), "Planar multibody dynamics: formulation, programming with MATLAB®, and applications," CRC Press, ISBN: 9781138096127
4. Rao, J.S., (2011), "Kinematics of Machinery Through HyperWorks," Springer, ISBN: 9789400711556

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a **Term Work Journal** and **Product based Case Study Report**

Important Note:
Term Work of the Student shall be evaluated based on the completion of individual **Product based Case study Report** and **Assignments**. Continuous evaluation by the faculty shall be done for the award of the credit associated with the course. No practical examination shall be conducted for the award of the credit.

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402053: Project (Stage II)					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**10 Hrs./Week**	**Practical**	**5**	**Term Work**	**100 Marks**
				Oral	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Laboratory works, Skill Development, Audit Courses, Industrial Visits, Project (Stage I)

Project Stage II is the extension of Project Stage I.

Course Objectives, Course Outcomes, Course Contents and Guidelines for Project Execution are same as that of Project Stage I

Term Work Evaluation

1. In Project Stage II, two reviews shall be taken for total 100 marks (50 marks each)
2. Review III shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.
3. Review IV shall be third party evaluation by Faculty/Student/Industry person/Alumni
4. Evaluation committee shall consist of Guide, One Industry person and One Faculty appointed by the Institution.
5. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.

Examination Scheme

1. Examination committee shall consist of Internal Examiner and External Examiner appointed by University. (External Examiner shall be a competent Industry/Research/Laboratory person. A list shall be provided by Board of Studies)
2. Well in advance soft copies of the project shall be shared with examination committee.

Presentation of Project Work

Presentation of work in the form of Project Report (s), Understanding individual capacity, Role & involvement in the project, Team Work (Distribution of work, intra-team communication and togetherness), Participation in various contests, Publications and IPR, Manuals (Project Report, Quick reference, System, Installation guide) among other parameters. Team members with guide information shall be added at the end of the report.

Project Report

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.
2. Plagiarism check is must, and certificate shall be attached in the report.
3. A group activity shall be presented in report.
4. Report copies shall be submitted in the department, one for university and one for supervisor.
5. For standardization of the project reports the following format shall be strictly followed.
   Page size: Trimmed A4
   Top Margin: 1"
   Bottom Margin: 1.32"
   Left Margin: 1.5"
   Right Margin: 1"
   Para Text: Times New Roman 12-point font
   Line Spacing: 1.15 Lines
   Page Numbers: Right aligned at footer. Font 12 point Times New Roman
   Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students shall attach a standard format of Certificate as described by the department.
2. Certificates shall be awarded to project groups and not individual students of the group.
3. Certificates shall have signatures of Guide, External Examiner, HOD and Principal.

Index of Report

1. Title Sheet
2. Certificate (Institution)
3. Certificate (Company, if sponsored by company)
4. Acknowledgement
5. Abstract of the Project
6. List of Figures
7. List of Photographs / Plates
8. List of Tables
9. Table of Contents
10. Introduction
11. Literature Survey / Theory
12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
13. Observation Results
14. Discussion on Result and Conclusion
15. Student and Guide details. (A common photograph with project)

402055: Audit Course VIII				
Teaching Scheme		**Credits**	**Examination Scheme**	
		Non- Credit		

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'

- If any of the following listed course is selected through Swayam/ NPTEL/ virtual platform, the minimum duration shall be of 8 weeks.
- However, if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.
- Students can join any online platform or can participate any online/offline workshop to complete the Audit course with prior-permission of mentor.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from Final year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level. The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself

List of Courses to be opted (Any one) under Audit Course
A. Managing Innovation **B.** Operations Management Note:-The title indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.
Using NPTEL Platform: (preferable)
NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in • Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course. • Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal. • After clearing the examination successfully; student will be awarded with a certificate.
Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary • During the course students will be submitting the online assignments/report/course completion certificate etc. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments/report/course completion certificate etc., the institute can mark as "Present" and the student will be awarded the grade AP on the mark-sheet.