1.3.2 List of Courses that include experiential learning through project work/field work/internship during A.Y. 2023-24

Sr. No.	Program name	Class	Name of the Course that include experiential learning through project work/field work/internship	Course code
1	Computer Engineering	SE	Project Based Learning II	210258
2	Computer Engineering	TE	Internship	310255
3	Computer Engineering	BE	Project Stage I	410248
4	Computer Engineering	BE	Project Stage II	410256
5	CIVIL Engineering	BE	Project Stage I	401005
6	CIVIL Engineering	BE	Project Stage II	401015
7	CIVIL Engineering	SE	Project Based Learning	201017
8	CIVIL Engineering	TE	Internship	301016
9	Mechanical Engineering	TE	Internship/Mini project *	302055
10	Mechanical Engineering	BE	Project Stage-II	402051
11	Mechanical Engineering	BE	Project Stage-I	402046
12	Mechanical Engineering	SE	Project Based Learning II	202052
13	Basic Engineering	FE	Project Based Learning I	110013
14	MBA	SY	Summer Internship Project	303- GC 13
15	MCA	FY	Mini Project	ITC11,ITC21
16	MCA	SY	Internship	ITC41
17	Artificial Intelligence and Data Science	SE	Project Based Learning II	217533

Dr. Soumitra Das
Incharge Principal

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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?

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

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310255: Internship**

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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 and Presentation Skills
Team Work
Creativity
Planning and Organizational skills
Adaptability
Analytical Skills
Attitude and 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 following recommended parameters-
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	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	3	1	1	1	1	2	1	1
CO2	1	2	2	2	3	2	1	1	1	2	2	1
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
Fourth Year of Computer Engineering (2019 Course)
410248: Project Work Stage I

Teaching Scheme:	Credit	Examination Scheme:
Practical:02Hours/Week	02	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 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, Pune BE (Civil Engineering) 2019 Pattern (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**	**TW**	**PR**	**OR**	**TUT**	**Total**
401001	Foundation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401002	Transportation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401003	Elective III	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401004	Elective IV	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401005	Project Stage I	--	04	--	--	--	50	--	50	100	--	01	--	02	--	03
401006	Transportation Engineering **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401007	Elective III **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401008	Elective IV **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401009	Computer Programming in Civil Engineering	01	02	--	--	--	50	--	--	50	--	02	--	--	--	02
401010	Audit Course I **Stress Management by Yoga / Communication Etiquette in Workplaces**	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**13**	**12**	**01**	**120**	**280**	**150**	**--**	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade																	

Elective III and IV

S N	Course Code	Elective III: Course Name	Course Code	Elective IV: Course Name
01	401003 a	Coastal Engineering	401004 a	Air Pollution and Control
02	401003 b	Advanced Design of Concrete Structures	401004 b	Advanced Design of Steel Structures
03	401003 c	Integrated Water Resources Planning & Management	401004 c	Statistical Analysis and Computational Method
04	401003 d	Finite Element Method	401004 d	Airport and Bridge Engineering
05	401003 e	Data Analytics	401004 e	Design of Prestressed Concrete Structures
06	401003 f	Operation Research	401004 f	Formwork and Plumbing Engineering

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**	**TW**	**PR**	**OR**	**TUT**	**Total**
401011	Dams and Hydraulics Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401012	Quantity Surveying, Contracts and Tenders	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401013	Elective V	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401014	Elective VI	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401015	Project Stage II	--	10	--	--	--	100	--	50	150	--	03	--	02	--	05
401016	Dams and Hydraulics Structures **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401017	Quantity Surveying, Contracts and Tenders **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401018	Elective V **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401019	Audit Course II **Social Responsibility / Human Rights**	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**16**	**01**	**120**	**280**	**150**	**--**	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																

Elective V and VI

S N	Course Code	Elective V: Course Name	Course Code	Elective VI: Course Name
01	401013 a	Earthquake Engineering	401014 a	TQM and MIS
02	401013 b	Structural Design of Bridges	401014 b	Advanced Transportation Engineering
03	401013 c	Irrigation and Drainage	401014 c	Geo Synthetic Engineering
04	401013 d	Design of Precast and Composite Structures	401014 d	Structural Design of Foundations
05	401013 e	Hydropower Engineering	401014 e	Green Structures and Smart Cities
06	401013 f	Structural Audit and Retrofitting of Structures	401014 f	Rural Water Supply and Sanitation

Savitribai Phule Pune University, Pune TE (Civil Engineering) 2019 Pattern (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**	**TW**	**PR**	**OR**	**TUT**	**Total**
301001	Hydrology and Water Resources Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301002	Water Supply Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301003	Design of Steel Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301004	Engineering Economics and Financial Management	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301005	Elective I	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301006	Seminar	--	--	01	--	-	50	--	--	50	--	--	--	--	01	01
301007	Hydrology and Water Resources Engineering **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301008	Water Supply Engineering **Lab**	--	02	--	--	--	--	50	--	50	--	--	01	--	--	01
301009	Design of Steel Structures **Lab**	--	04	--	--	--	--	--	50	50	--	--	--	02	--	02
301010	Elective I **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301011	Audit Course I: Professional Ethics and Etiquettes/ Sustainable Energy Systems	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**15**	**10**	**02**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**02**	**01**	**02**	**01**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade																	

Elective I: 301005

S N	Course Code	Course Name
01	301005 a	Advanced Fluid Mechanics and Hydraulic Machines
02	301005 b	Research Methodology and IPR
03	301005 c	Construction Management
04	301005 d	Advanced Concrete Technology
05	301005 e	Matrix Methods of Structural Analysis
06	301005 f	Advanced Mechanics of Structures

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**	**TW**	**PR**	**OR**	**TUT**	**Total**
301012	Waste Water Engineering	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301013	Design of RC Structures	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301014	Remote Sensing and GIS	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301015	Elective II	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301016	Internship	--	--	--	--	--	100	--	--	100	--	04	--	--		04
301017	Waste Water Engineering **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
301018	Design of RC Structures **Lab**	--	04	--	--	--	--	--	50	50	--		--	02	--	02
301019	Remote Sensing and GIS **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301020	Elective II **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301021	Audit Course II: Leadership and Personality Development/ Industrial Safety	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**10**	**01**	**120**	**280**	**200**	**--**	**100**	**700**	**12**	**06**	**--**	**03**	**--**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																	

Elective II: 301015

S N	Course Code	Course Name
01	301015 a	Advanced Engineering Geology with Rock Mechanics
02	301015 b	Soft Computing Techniques
03	301015 c	Advanced Surveying
04	301015 d	Advanced Geotechnical Engineering
05	301015 e	Architecture and Town Planning
06	301015 f	Solid Waste Management

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.

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.

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** **[08 Hr.]**

(Based on load and stress condition studied in Unit I to Unit V)

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!", 3rd Ed, Morgan and Claypool Publishers
2. Michael Margolis, "Arduino Cookbook", 2nd Ed, O'Reilly Media
3. Hughes Edward, "Electrical and Electronic Technology", Pearson Education
4. Ashfaq Husain, "Electric Machines", 3rd Ed, Dhanpat Rai & Sons
5. Bhattacharya S. K., "Electrical Machine", 3rd 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", 2nd Ed, CRC Press

Reference Books

1. Deshmukh Ajay, "Microcontrollers Theory and Applications", Tata McGraw Hill
2. Massimo Banzi, "Getting Started with Arduino", 2nd 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", 5th 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

For

First Year
Bachelor of Engineering
(Choice Based Credit System)

(2019 Course)

(With Effect from Academic Year 2019-20)

TABLE -1 First Engineering _Structure for Semester-I														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credits**			
		Theory	**Practical**	**Tutorial**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
107001	Engineering Mathematics-I	03	--	01	30	70	25	--	--	125	03	--	01	04
107002/ 107009	Engineering Physics / Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
102003	Systems in Mechanical Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
111006	Workshop[@]	--	02	--	--	--	--	25	--	25	--	01	--	01
	Total	16	10	01	150	350	25	125	--	650	16	05	01	22
101007	Audit Course 1[&]	02	Environmental Studies-I											
Induction Program : 2 weeks at the beginning of semester-I and 1 week at the beginning of semester-II														
TABLE -2 First Engineering_ Structure for Semester-II														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credits**			
		Theory	**Practical**	**Tutorial**	**ISE**	**ESE**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
107008	Engineering Mathematics-II	04	--	01	30	70	25	--	--	125	04	--	01	05
107002/ 107009	Engineering Physics/ Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
102012	Engineering Graphics [Ω]	01	02	01	--	50	25		--	75	01	01		02
110013	Project Based Learning[§]	--	04	--	--	--	25	50	--	75	--	02	--	02
	Total	15	12	02	120	330	75	125	--	650	15	05	02	22
101014	Audit Course 2[&]	02	Environmental Studies-II											
107015		--	Physical Education-Exercise and Field Activities											

Instructions:

- PR/Tutorial must be conducted in three batches per division.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Every Student should appear for Engineering Physics, Engineering Chemistry, Engineering Mechanics, Basic Electrical Engineering, Basic Electronics Engineering, Programming and Problem solving during the year.
- College is allowed to distribute Teaching workload of subjects Engineering Physics, Engineering Chemistry, Basic Electrical Engineering, Basic Electronics Engineering, Engineering Mechanics, Programming and Problem solving in semester I and II dividing number of FE divisions into two appropriate groups.
- Assessment of tutorial work has to be carried out as term-work examination. Term-work Examination and Practical Examination at first year of engineering course **shall be internal continuous assessment only.**

Ω 1 Credit for Engineering Graphics theory has to be awarded on the basis of End semester examination of 50 marks while 1 credit of tutorial and practical **shall be awarded on internal continuous assessment only**.

@ Credit for the course of workshop practical is to be awarded on the basis of continuous assessment / submission of job work.

§ 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 a load 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 for Environmental Studies and II (As per D.O.No.F.13-1/2000 (EA/ENV/COS-I) dated 14 May, 2019) is mandatory but non-credit course. Examination has to be conducted at the end of Sem I & II respectively for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.

Audit course for Physical education is mandatory non-credit course. Examination has to be conducted at the end of Semester for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.

Guidelines for Induction Program

Induction programme for first year students is introduced to familiarize them to the new environment and encourage them to look beyond classrooms. Objective is to help new students adjust and feel comfort-able 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 the beginning of semester-I and 1 week at the beginning of semester-II)**.

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

- Physical Activity-This would involve a daily routine of physical activity with games and sports.
- Creative Arts: - Every students would chose one skill related to the arts whether visual arts or performing arts.
- 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 20-22 students with a faculty mentor each. This can be implemented through group discussion and real life activities rather than lecturing.
- Familiarization with College, Department, 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 points such as library, canteen, gymkhana etc. They should be shown their department.
- Literary Activity :-Literary Activity would compass reading book, writing a summery, debating, checking play etc.
- Proficiency modules :- The modules can be designed to overcome some critical lacunas that students might have like English Speaking, Computer familiarity etc.
- Lectures by Eminent People:- The lectures of Eminent people to be organized to expose the student to social activity public life.
- Visit to local Area:-A couple of visits to the landmark of the city or a hospital are orphanage could be organized.
- Extracurricular activities in College:-The new students should be introduced to the extracurricular activities at the College.
- Feedback and Report on the program:-Students should be asked to give their mid program Feedback and a each group of 20-22 students should be asked to prepare a single report on their experience of the program.

To Summarize the above activity the sequence of activities can be planned as given below :

- Address by Principal, HOD's and other functionaries and welcome the new students along with their parents.
- The branch wise allocation of students to be done and a group of 20-22 students is to farmed along with one faculty as mentor.
- A detail time table of various activities is to be prepared and displayed for all students. The timetable should give details of location and details of faculty in charge of the activity.
- The visit to local areas can be arranged on Saturdays.

The various activities to be carried out can be divided into three phases :-

1. Initial phase:- Which may induce Address by Principal, HOD's and other functionaries College and Dept Visit, interaction with parents Forming of students group and assigning of mentor mentee.
2. Regular Phase:- This phase may include the activities such as creative arts / universal

Human values Games & Sports in the morning session and in the afternoon session. Literary activities, Proficiency module, Lectures & workshop, Extra curricular Activities can be scheduled.

3. Closing Phase:- This phase may include taking feed back of students, preparation of Report by each group, Test of creative Arts, Human Values can be taken.

These are summarized guidelines given to the student inducing induction programme (SIP) Please refer SIP Manual published by AICTE for detail guidelines [2].

Savitribai Phule Pune University

First Year Engineering (2019 Course)

107001 – Engineering Mathematics – I

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 3 Hrs./Week	**04**	**In-Semester Exam :30 Marks**
TUT : 1 Hr/Week		**End-Semester Exam :70 Marks**
		TW :25 Marks

Prerequisites:
Differentiation, Integration, Maxima and Minima, Determinants and Matrices.

Course Objectives:
To make the students familiarize with concepts and techniques in Calculus, Fourier series and Matrices. 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 (COs): The students will be able to learn
CO1: Mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems.
CO2: the Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems.
CO3: to deal withderivative of functions of several variables that are essential in various branches of Engineering.
CO4: to apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function.
CO5: the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems

Course Contents

Unit I: Differential Calculus: (08 Hrs.)
Rolle's Theorem, Mean Value Theorems, Taylor's Series and Maclaurin's Series, Expansion of functions using standard expansions, Indeterminate Forms, L' Hospital's Rule, Evaluation of Limits and Applications.

Unit II: Fourier Series (08 Hrs.)
Definition, Dirichlet's conditions, Full range Fourier series, Half range Fourier series, Harmonic analysis, Parseval's identity and Applications to problems in Engineering.

Unit III: Partial Differentiation (08Hrs.)
Introduction to functions of several variables, Partial Derivatives, Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative, Change of Independent variables

Unit IV: Applications of Partial Differentiation (08 Hrs.)
Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

Unit V: Linear Algebra-Matrices, System of Linear Equations (08 Hrs.)
Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in Engineering.

Unit VI: Linear Algebra-Eigen Values and Eigen Vectors, Diagonaliztion (08 Hrs.)
Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonaliztion of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations.

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 & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Linear Algebra –An Introduction, Ron Larson, David C. Falvo (Cenage Learning, Indian edition)

Tutorial and Term Work:

i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.

ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on performance and continuous internal assessment.

107002: Engineering Physics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week	**05**	**In-Semester :30 Marks**
PR: 02 Hr/Week		**End-Semester :70 Marks**
		PR :25 Marks

Prerequisite Courses, if any:
Fundamentals of: optics, interference, diffraction polarization, wave-particle duality, semiconductors and magnetism

Companion Course, if any: Laboratory Practical

Course Objectives:
To teach students basic concepts and principles of physics, relate them to laboratory experiments and their applications

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

CO1: Develop understanding of interference, diffraction and polarization; connect it to few engineering applications.

CO2: Learn basics of lasers and optical fibers and their use in some applications.

CO3: Understand concepts and principles in quantum mechanics. Relate them to some applications.

CO4: Understand theory of semiconductors and their applications in some semiconductor devices.

CO5: Summarize basics of magnetism and superconductivity. Explore few of their technological applications.

CO6: Comprehend use of concepts of physics for Non Destructive Testing. Learn some properties of nanomaterials and their application.

Course Contents

Unit I **Wave Optics** **(08 Hrs)**

Interference

- Introduction to electromagnetic waves and electromagnetic spectrum
- Interference in thin film of uniform thickness (with derivation)
- Interference in thin film wedge shape (qualitative)
- Applications of interference: testing optical flatness, anti-reflection coating

Diffraction

- Diffraction of light
- Diffraction at a single slit, conditions for principal maxima and minima, diffraction pattern
- Diffraction grating, conditions for principal maxima and minima starting from resultant amplitude equations, diffraction pattern
- Rayleigh's criterion for resolution, resolving power of telescope and grating

Polarization

- Polarization of light, Malus law
- Double refraction, Huygen's theory of double refraction
  Applications of polarization: LCD

Unit II **Laser and Optic Fibre** **(08 Hrs)**

Laser

- Basics of laser and its mechanism, characteristics of laser
- Semiconductor laser: Single Hetro-junction laser
- Gas laser: CO_2 laser
- Applications of lasers: Holography, IT, industrial, medical

Optic Fiber

- Introduction, parameters: Acceptance Angle, Acceptance Cone, Numerical Aperture
- Types of optical fiber- step index and graded index
- Attenuation and reasons for losses in optic fibers (qualitative)
- Communication system: basic building blocks

Advantages of optical fiber communication over conventional methods.

Unit III **Quantum Mechanics** **(08 Hrs)**

- De-Broglie hypothesis
- Concept of phase velocity and group velocity (qualitative)
- Heisenberg Uncertainty Principle
- Wave-function and its physical significance
- Schrodinger's equations: time independent and time dependent
- Application of Schrodinger's time independent wave equation - Particle enclosed in infinitely deep potential well (Particle in RigidBox)
- Particle in Finite potential well (Particle in Non Rigid box) (qualitative)
- Tunneling effect, Tunneling effect examples (principle only): Alpha Decay, Scanning Tunneling Microscope, Tunnel diode
- Introduction to quantum computing

Unit IV **Semiconductor Physics** **(08 Hrs)**

- Free electron theory (Qualitative)
- Opening of band gap due to internal electron diffraction due to lattice Band theory of solids
- Effective mass of electron Density of states
- Fermi Dirac distribution function
- Conductivity of conductors and semiconductors
- Position of Fermi level in intrinsic and extrinsic semiconductors (with derivations based on carrier concentration)
- Working of PN junction on the basis of band diagram
- Expression for barrier potential (derivation)
- Ideal diode equation
- Applications of PN junction diode: Solar cell (basic principle with band diagram) IV Characteristics and Parameters, ways of improving efficiency of solar cell
- Hall effect: Derivation for Hall voltage, Hall coefficient, applications of Hall effect

Unit V **Magnetism and Superconductivity** **(8Hrs.)**

Magnetism

- Origin of magnetism
- Classification of magnetism on the basis of permeability (qualitative)
- Applications of magnetic devices: transformer cores, magnetic storage, magneto-optical recording

Superconductivity

- Introduction to superconductivity; Properties of superconductors: zero electrical
- resistance, critical magnetic field, persistent current, Meissner effect
- Type I and Type II superconductors
- Low and high temperature superconductors (introduction and qualitative)
- AC/DC Josephson effect; SQUID: basic construction and principle of working; Applications of SQUID
- Applications of superconductors

Unit VI **Non Destructive Testing and Nanotechnology** **(8 Hrs.)**

Non Destructive Testing

- Classification of Non-destructive testing methods
- Principles of physics in Non-destructive Testing
- Advantages of Non-destructive testing methods
- Acoustic Emission Testing
- Ultrasonic (thickness measurement, flaw detection)
- Radiography testing

Nanotechnology

- Introduction to nanotechnology
- Quantum confinement and surface to volume ratio
- Properties of nanoparticles: optical, electrical, mechanical

Applications of nanoparticles: Medical (targeted drug delivery), electronics, space and defense, automobile

Books & Other Resources:

Text Books:

1. Engineering Physics, Avadhanulu, Kshirsagar, S. Chand Publications
2. A textbook of optics – N Subrahmanyam and BriLal , S. Chand Publications
3. Engineering Physics, Gaur, Gupta, Dhanpat Rai and Sons Publications

Reference Books:

1. Fundamentals of Physics, Resnick and Halliday (John Wiley and Sons)
2. Optics, Jenkins and White (Tata Mcgraw Hill)
3. Principles of Physics, Serway and Jewett (Saunders college publishing)
4. Introduction to Solid State Physics, C. Kittel (Wiley and Sons)
5. Principles of Solid State Physics, H. V. Keer, New Age International
6. Laser and Non-Linear Optics, B. B. Laud (Oscar publication)
7. Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni (Capital Publishing Company

Guidelines for Instructor's Manual

Lab manual is expected to cover following points:

1. Engineering Program Outcome (Graduate Attribute) and which attributes will be covered during practical
2. List of experiments to be performed with mention of objectives and outcome of the experiment

Guidelines for Student's Lab Journal

Student's lab journal is expected to cover:

1. List of experiments to be performed with mention of objectives and outcome of the experiment.
2. Instructions to students for performing the experiments
3. Precautions for each experiment
4. Write up of experiment (Preferably mentioning significance of experiment).

Guidelines for Lab /TW Assessment

1. The distribution of weightage of term work marks should be informed to students before start of the semester.
2. Term work assessment should be on continuous basis. At frequent intervals students are expected to inform about their progress/lagging.

Guidelines for Laboratory Conduction

1. DO's and DONT'S, along with precautions, are need to be displayed at prominent location in laboratory
2. Students should be informed about DO'S and DON'T and precautions before performing the experiment

Suggested List of Laboratory Experiments (<u>Any eight</u>)

Sr.	Experiment
1	Experiment based on Newton's rings (determination of wavelength of monochromatic light, determine radius of curvature of plano-convex lens)
2	To determine position of diffraction minima by studying diffraction at a single slit
3	To determine unknown wavelength by using plane diffraction grating
4	To find out Resolving power of Diffraction Grating/Telescope
5	To verify Malus Law
6	Any experiment based on Double Refraction (Determination of refractive indices, identification of types of crystal)
7	Any Experiment based on Laser (Thickness of wire, determination of number of lines on grating surface)
8	An experiment based on optic fibers
9	To study IV characteristics of Solar Cell and determine parameters (fill factor and efficiency)
10	To determine band gap of given semiconductor
11	To determine Hall coefficient and charge carrier density
12	Temperature dependence characteristics of semiconductor laser
13	To find out Magnetic susceptibility of given material
14	Ultrasonic Interferometer: Determination of velocity of ultrasonic waves in given liquid and find its compressibility
	Suggested Demonstration Experiments
1	Michelson interferometer
2	Half shade Polarimeter
3	Determination of absorption coefficient of sound of given material
4	Temperature dependence
5	Brewster's law
6	Measurement of sound pressure level

102003 - Systems in Mechanical Engineering		
Teaching Scheme: **TH : 3 Hrs./week** **PR : 2 Hrs./Week**	**Credits** **04**	**Examination Scheme:** **In-Semester :30 Marks** **End-Semester :70 Marks** **PR :25 Marks**

Course Objectives:

1. To identify the sources of energy and their conversions
2. To explain the basic concept of engineering thermodynamics and its application
3. To understanding the specifications of vehicles
4. To get acquainted with vehicle systems
5. To introduce manufacturing processes applying proper method to produce components
6. To be able to select and compare domestic appliances

Course Outcomes

On completion of the course, learner will be able to

CO1: Describe and compare the conversion of energy from renewable and non-renewable energy sources

CO2: Explain basic laws of thermodynamics, heat transfer and their applications

CO3: List down the types of road vehicles and their specifications

CO4: Illustrate various basic parts and transmission system of a road vehicle

CO5: Discuss several manufacturing processes and identify the suitable process

CO6: Explain various types of mechanism and its application

Course Contents

Unit I **Introduction of energy sources & its conversion** **(06 Hrs)**

Energy sources: Thermal energy, Hydropower energy, Nuclear energy, Solar energy, Geothermal energy, Wind energy, Hydrogen energy, Biomass energy and Tidal energy. Grades of Energy. (*Numerical on efficiency calculation of thermal power plant*)

Energy conversion devices: Introduction of pump, compressor, turbines, wind mills etc (*Simple numerical on power and efficiency calculations)*

Unit II **Introduction to Thermal Engineering** **(06Hrs)**

Laws of thermodynamics, heat engine, heat pump, refrigerator *(simple numerical)*

Modes of heat transfer: conduction, convection and radiation, Fourier's law, Newton's law of cooling, Stefan Boltzmann's law. *(Simple numerical)*

Two stroke and Four stroke engines (Petrol, Diesel and CNG engines). Steam generators.

Unit III **Vehicles and their Specifications** **(04 Hrs)**

Classification of automobile. Vehicle specifications of two/three wheeler, light motor vehicles, trucks, buses and multi-axle vehicles. Engine components (Introduction). Study of engine specifications, comparison of specifications of vehicles. Introduction of Electric and Hybrid Vehicles. Cost analysis of the Vehicle.

Unit IV **Vehicle systems** **(08 Hrs)**

Introduction of chassis layouts, steering system, suspension system, braking system, cooling system and fuel injection system and fuel supply system. Study of Electric and Hybrid Vehicle systems. Study of power transmission system, clutch, gear box (Simple Numerical), propeller shaft, universal joint, differential gearbox and axles. Vehicle active and passive safety arrangements: seat, seat belts, airbags and antilock brake system.

Unit V **Introduction to Manufacturing** **(06 Hrs)**

Conventional Manufacturing Processes: Casting, Forging, Metal forming (Drawing, Extrusion, etc.), Sheet metal working, Metal joining, etc. Metal cutting processes and machining operations- Turning, Milling and Drilling, etc.

Micromachining. Additive manufacturing and 3D Printing. Reconfigurable manufacturing system and IOT, Basic CNC programming**:** Concept of Computer Numerical Controlled machines.

Unit VI Engineering Mechanisms and their application in Domestic Appliances (6Hrs.)

Introduction to Basic mechanisms and equipment: Pumps, blowers, compressors, springs, gears, Belt-Pulley, Chain-Sprocket, valves, levers, etc. Introduction to terms: Specifications, Input, output, efficiency, etc.

Applications of: Compressors - Refrigerator, Water cooler, Split AC unit; Pumps - Water pump for overhead tanks, Water filter/Purifier units; Blower - Vacuum cleaner, Kitchen Chimney; Motor - Fans, Exhaust fans, Washing machines; Springs - Door closure, door locks, etc.; Gears - Wall clocks, watches, Printers, etc.; Application of Belt-Pulley/Chain-Sprocket - Photocopier, bicycle, etc.; Valves - Water tap, etc.; Application of levers - Door latch, Brake pedals, etc.; Electric/Solar energy - Geyser, Water heater, Electric iron, etc. (simple numerical on efficiency calculation)

Books & Other Resources

Text Books

1. Nag, P. K., "Engineering Thermodynamics," Tata McGraw-Hill Publisher Co. Ltd.
2. Chaudhari and Hajra, "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers, Mumbai
3. Agrawal,Basant and Agrawal, C. M., (2008), "Basics of Mechanical Engineering", John Wiley and Sons, USA
4. Rajput, R.K., (2007), "Basic Mechanical Engineering", Laxmi Publications Pvt. Ltd.
5. Pravin Kumar, (2018), " Basic Mechanical Engineering, 2nd Ed.", Pearson (India) Ltd.
6. Moran, M. J., Shapiro, H. N., Boettner, D. D., and Bailey, M. "Fundamentals of Engineering Thermodynamics", Wiley
7. Surinder Kumar, (2011), "Basic of Mechanical Engineering", Ane Books Pvt. Ltd. New Delhi

Reference Books

1. Khan, B. H., "Non Conventional Energy Sources, Tata McGraw-Hill Publisher Co. Ltd.
2. Boyle, Godfrey, "Renewable Energy",2nd Ed., Oxford University Press
3. Khurmi, R.S. ,and Gupta, J. K.,"A Textbook of Thermal Engineering", S. Chand & Sons
4. Incropera, F. P. and Dewitt, D.P., (2007), "Fundamentals of Heat and Mass Transfer, 6th Ed., John Wiley and Sons, USA
5. Groover,Mikell P., (1996), "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Prentice Hall, USA
6. Norton, Robert L., (2009), "Kinematics and Dynamics of Machinery", Tata McGrawHill
7. Cleghorn, W. L., (2005), "Mechanisms of Machines", Oxford University Press
8. Juvinal, R. C., (1994), "Fundamentals of Machine Component Design", John Wiley and Sons, USA
9. Ganeshan, V., (2018), "Internal Combustion Engines", McGraw Hill
10. Anderson, Curtis Darrel and Anderson,Judy, (2010), "Electric and Hybrid Cars: A History", 2nd Ed., McFarland

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.

- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.
- Relevance of practical in real life /industry

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.
- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, and understanding.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

The student shall complete the following activity as a term work.

Sr. No.	Activity
1.	**Group A: Industry / Workshop / Showroom Visit:** The visit of students is mandatory, to provide awareness and understanding of the course.
2.	**Group B: Assignments:** The student shall complete the following assignments on: i. Energy sources (Minimum one assignment on Conventional and one on Non-conventional sources) ii. Vehicle specifications and systems in passenger car iii. Electric vehicle specifications and its systems iv. Domestic appliances viz. refrigerator, air-conditioner, washing machine, cold storage
3.	**Group C: Experiments:** The student shall complete the following (**any four)** experiments: i. Demonstration of power train system in the vehicle ii. Demonstration of vehicle systems (automobile chassis, steering system, suspension system, braking system - Any Two) iii. Demonstration of energy conversion devices iv. Demonstration of additive manufacturing / rapid prototyping techniques v. Demonstration of CNC

103004: Basic Electrical Engineering		
Teaching Scheme: **TH : 03 Hr/week** **PR : 02 Hr/Week**	**Credits** **04**	**Examination Scheme:** **In-Semester : 30 Marks** **End-Semester : 70 Marks** **PR : 25 Marks**

Prerequisite Courses, if any: Engineering physics**,** electron theory, electricity, potential and kinetic energy

Course Overview: This course aims at enabling students of all Engineering Branches to understand the basic concepts of electrical engineering. This course is designed to provide knowledge of fundamentals and various laws in electromagnetic and magnetic circuits, electrostatics. The steady state analysis of AC and DC circuits, and its applications transformer, batteries and different energy conversion techniques are also included in this course.

Course Objectives:

1. To introduce fundamental concepts, various laws-principles and theorems associated with electrical systems.
2. To impart basic knowledge of all electrical quantities such as current, voltage, power, energy, frequency along with different types of fields.
3. To provide knowledge about fundamental parameters such as resistance, inductance and capacitance and magnetic circuits, AC and DC circuits.
4. To provide knowledge of the concepts of transformer, different energy conversions techniques.

Course Outcomes:

At the end of course students will be able to

CO1: Differentiate between electrical and magnetic circuits and derive mathematical relation for self and mutual inductance along with coupling effect.

CO2: Calculate series, parallel and composite capacitor as well as characteristics parameters of alternating quantity and phasor arithmetic

CO3: Derive expression for impedance, current, power in series and parallel RLC circuit with AC supply along with phasor diagram.

CO4: Relate phase and line electrical quantities in polyphase networks, demonstrate the operation of single phase transformer and calculate efficiency and regulation at different loading conditions

CO5: Apply and analyze the resistive circuits using star-delta conversion KVL, KCL and different network theorems under DC supply.

CO6: Evaluate work, power, energy relations and suggest various batteries for different applications, concept of charging and discharging and depth of charge.

Course Contents

Unit I **Electromagnetism**: (**6Hrs**)

Review: resistance, emf, current, potential, potential difference and Ohm's law

Electromagnetism: Magnetic effect of an electric current, cross and dot conventions, right hand thumb rule, nature of magnetic field of long straight conductor, solenoid and toroid. Concept of mmf, flux, flux density, reluctance, permeability and field strength, their units and relationships. Simple series magnetic circuit, Introduction to parallel magnetic circuit(Only theoretical treatment), comparison of electric and magnetic circuit, force on current carrying conductor placed in magnetic field, Fleming's left hand rule. Faradays laws of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced e.m.f., self and mutual inductance, coefficient of couplings. Energy stored in magnetic field.

Unit II **Electrostatics and AC Fundamentals** **(6 Hrs)**

A) Electrostatics: Electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance. Capacitor, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors (no derivation) and time constant. **(2Hrs)**

B) AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of cycle, Period, frequency, instantaneous, peak(maximum), average and r.m.s. values, peak factor and form factor. Phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasor. **(4Hrs)**

Unit III **Single Phase AC Circuits** **(06 Hrs)**

Study of AC circuits consisting of pure resistance, pure inductance, pure capacitance, series R-L, R-C and R-L-C circuits, phasor diagrams, voltage, current and power waveforms, resonance in series RLC circuits, concept of impedance, concept of active, reactive, apparent, complex power and power factor, Parallel AC circuits (No numericals), concept of admittance

Unit IV **Polyphase A.C. Circuits and Single phase Transformers** **(06 Hrs)**

A) Polyphase A.C. Circuits: Concept of three-phase supply and phase sequence. Balanced and unbalanced load, Voltages, currents and power relations in three phase balanced star-connected loads and delta-connected loads along with phasor diagrams. **(3Hrs)**

B) Single phase transformers: principle of working, construction and types, emf equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. Descriptive treatment of autotransformers. **(3Hrs)**

Unit V **DC Circuits:** **(06 Hrs)**

Classification of electrical networks, Energy sources – ideal and practical voltage and current sources, Simplifications of networks using series and parallel combinations and star-delta conversions, Kirchhoff's laws and their applications for network solutions using loop analysis, Superposition theorem, Thevenin's theorem.

Unit VI **Work, Power, Energy and Batteries** **(06 Hrs)**

A) Work, Power, Energy: Effect of temperature on resistance, resistance temperature coefficient, insulation resistance, conversion of energy from one form to another in electrical, mechanical and thermal systems. (**4Hrs**)

B) Batteries : Different types of batteries (Lead Acid and Lithium Ion), construction, working principle, applications, ratings, charging and discharging, concept of depth of charging, maintenance of batteries, series -parallel connection of batteries **(2Hrs)**

Books & Other Resources:

Text Books:

1. V.D. Toro, Principles of Electrical Engineering, Prentice Hall India, 1989
2. D. P. Kothari, I.J. Nagrath, Theory and Problems of Basic Electrical Engineering, PHI Publication
3. V.K. Mehta, RohitMehata Basic Electrical Engineering, S Chand Publications
4. B.L. Theraja, A text book on electrical technology Vol-I

Reference Books:

1. H Cotton, Electrical technology, CBS Publications
2. L. S. Bobrow, ―Fundamentals of Electrical Engineering‖, Oxford University Press, 2011.
3. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
4. D. C. Kulshreshtha, ―Basic Electrical Engineering‖, McGraw Hill, 2009.

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.
- Relevance of practical in real life /industry

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 Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, understanding .
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Suggested List of Laboratory Experiments/Assignments

Group A

Following **eight** practical are compulsory

1. To study safety precautions while working on electrical systems, handling of various equipment's such as multimeter, ammeters, voltmeters, wattmeter's, real life resistors, inductors and capacitors
2. To calculate and measure of charging and discharging of capacitor and observe the response on storage oscilloscope.
3. To measure steady state response of series RL and RC circuits on AC supply and observations of voltage and current waveforms on storage oscilloscope.
4. To derive resonance frequency and analyze resonance in series RLC circuit.
5. To verify the relation between phase and line quantities in three phase balanced star delta connections of load.
6. To determine efficiency and regulation of transformer by direct loading test of a single phase transformer.
7. To verify KVL and Superposition theorem.
8. To verify Thevenin's theorem in a DC network

Group B

From following **minimum two** practical are compulsory

1. To measure insulation resistance of electrical equipment's/cable using Megger
2. To demonstrate different types of electrical protection equipments such as fuses, MCB, MCCB, ELCB.
3. To measure of earth resistance at substation earthing using fall of potential method with IS 3043 standard.
4. To study of LT and HT electricity bills.

110005: Programming and Problem Solving		
Teaching Scheme: **TH: 03 Hrs/Week** **PR : 02 Hrs/Week**	**Credits** **04**	**Examination Scheme:** **In-Semester : 30 Marks** **End-Semester : 70 Marks** **PR : 25 Marks**

Prerequisite Courses, if any: students are expected to have a good understanding of basic computer principles.

Companion Course, if any: Programming and Problem Solving Laboratory (110005)

Course Objectives:

Prime objective is to give students a basic introduction to programming and problem solving with computer language Python. And to introduce students not merely to the coding of computer programs, but to computational thinking, the methodology of computer programming, and the principles of good program design including modularity and encapsulation.

1. To understand problem solving, problem solving aspects, programming and to know about various program design tools.
2. To learn problem solving with computers
3. To learn basics, features and future of Python programming.
4. To acquaint with data types, input output statements, decision making, looping and functions in Python
5. To learn features of Object Oriented Programming using Python
6. To acquaint with the use and benefits of files handling in Python

Following Fields are applicable for courses with companion Laboratory course

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

CO1: Inculcate and apply various skills in problem solving.

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

CO3: Exhibit the programming skills for the problems those require the writing of well-documented programs including use of the logical constructs of language, Python.

CO4: Demonstrate significant experience with the Python program development environment.

Course Contents

Unit I Problem Solving, Programming and Python Programming (07 Hrs)

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,

Program Design Tools: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms.

Basics of Python Programming: Features of Python, History and Future of Python, Writing and executing Python program, Literal constants, variables and identifiers, Data Types, Input operation, Comments, Reserved words, Indentation, Operators and expressions, Expressions in Python.

Unit II Decision Control Statements (08 Hrs)

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. Other data types- Tuples, Lists and Dictionary.

Unit III **Functions and Modules** **(08 Hrs)**

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.

Unit IV **Strings** **(07 Hrs)**

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 V **Object Oriented Programming** **(08 Hrs)**

Programming Paradigms-monolithic, procedural, 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 object, class variables and object variables, public and private members, class methods.

Unit VI **File Handling and Dictionaries** **(07 Hrs)**

Files: Introduction, File path, Types of files, Opening and Closing files, Reading and Writing files. Dictionary method. **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).

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 ISBN-10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL

Reference Books:

1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st edition, ISBN-10: 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

Programming and Problem Solving Laboratory

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), 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 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.

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 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 coding style, proper indentation and comments.

Use of open source software and recent version 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.

Suggested List of Laboratory Experiments/Assignments
(Any 6 to 8 laboratory assignments)

Sr. No.	Problem Statement Write Program in Python (with function/class/file, as applicable)
1.	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.
2.	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.
3.	To accept N numbers from user. Compute and display maximum in list, minimum in list, sum and average of numbers.
4.	To accept student's five courses marks and 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 distinction. If aggregate is 60>= and <75 then the grade if 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.
5.	To check whether input number is Armstrong number or not. An Armstrong number is an integer with three digits such that the sum of the cubes of its digits is equal to the number itself. Ex. 371.
6.	To simulate simple calculator that performs basic tasks such as addition, subtraction, multiplication and division with special operations like computing x^y and x!.

7.	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
8.	To accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these two numbers.
9.	To accept a number from user and print digits of number in a reverse order.
10.	To input binary number from user and convert it into decimal number.
11.	To generate pseudo random numbers.
12.	To accept list of N integers and partition list into two sub lists even and odd numbers.
13.	To accept the number of terms a finds the sum of *sine* series.
14.	To accept from user the number of Fibonacci numbers to be generated and print the Fibonacci series.
15.	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
16.	To copy contents of one file to other. 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.
17.	To count total characters in file, total words in file, total lines in file and frequency of given word in file.
18.	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”
19.	Create class STORE to keep track of Products (Product Code, Name and price). Display menu of all products to user. Generate bill as per order.
Mini-Projects	
20.	Calculator with basic functions. Add more functionality such as graphic user interface and complex calculations.
21.	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.
22.	Use raspberry pi/or similar kit and python for- • Room Temperature Monitoring System • Motion Detection System • Soil Moisture Sensor • Home Automation System • A robot • Smart mirror or a smart clock. • Smile Detection using Raspberry Pi Camera
23.	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.

111006 -Workshop Practice

Teaching Scheme:	Credits	Examination Scheme:
PR : 2 Hrs/Week	01	PR : 25 Marks

Course Objectives:

1. To understand the construction and working of machine tools and functions of its parts.
2. To develop the skill through hands-on practices using hand tools, power tools, machine tools in manufacturing and assembly shop leading to understanding of a production processes.
3. To understand workshop layout and safety norms.

Course Outcomes:

CO1: Familiar with safety norms to prevent any mishap in workshop.
CO2: Able to handle appropriate hand tool, cutting tool and machine tools to manufacture a job.
CO3: Able to understand the construction, working and functions of machine tools and their parts.
CO4: Able to know simple operations (Turning and Facing) on a centre lathe.

Note

1. The demonstration of machine tools to be conducted by **teaching** faculty.
2. Minimum eight experiments to be conducted out of 10.

Guidelines for Instructor's Manual

Instructor manual shall contain:

- The production drawing of a job with all linear and geometric dimensions, Raw material, size and shape, allowances provided.
- List of tooling required.
- Process plan to complete the job.
- General safety instructions.

Guidelines for Student's Lab Journal

i. Student has to maintain a workshop diary consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job and time schedule.
ii. Student has to maintain one file for write ups based on demonstration of machine tools and safety norms

Guidelines for LAB/TW Assessment

Term work assessment shall be based on the timely completion of jobs, quality of job, skill acquired, and maintain of workshop diary and brief write-ups on illustrations/sketches of demonstrated parts/mechanisms/machine tools etc.

Guidelines for Laboratory Conduction

i. 1st on importance of workshop practical and shop floor safety norms
ii. 2nd to 6th Sessions are about demonstration of machine tools (Any 4)
iii. 7th to 9th on making utility job (Any 2)
iv. 10th& 11th session on preparation of workshop layout and safety norms.

Suggested List of Laboratory Experiments/Assignments

Sr. No.	List of Experiments
1.	Mandatory briefing on shop-floor safety
2.	**Demonstration and working of centre lathe** Demonstration on various functions of lathe parts: Headstock, Tailstock, Carriage, Lead screw, All geared Mechanism, Apron mechanism etc.
3.	**Demonstration of Lathe operations:** Step turning and facing, drilling operation on a Mild Steel cylindrical job on centre lathe. Understanding the concept of speed, feed and depth of cut.

4.	**Demonstration of Drilling machine** Demonstration on construction of Radial drilling machine, Tool holding devices, Concept of speed, feed and depth of cut.
5.	**Demonstration on Milling machine** Demonstration on construction, table movements, indexing and tooling of milling machine.
6.	**Demonstration of Shaper/Grinding machine (Any one)** Shaper: Crank and slotted link mechanism, Work feed mechanism Grinding: Surface grinder/Cylindrical grinding machine, Mounting of grinding wheel
7.	**Term work includes one job of Carpentry** Introduction to wood working, kinds of woods, hand tools & machines, Types of joints, wood turning. Pattern making, types of patterns and its allowances.
8.	**Term work to include one job involving fitting** to size, male-female fitting with drilling and tapping operation on Mild Steel plate; Introduction to marking, cutting and sawing, sizing of metal, shearing, Concept of fits and interchangeability, selection of datum and measurements.
9.	**Term work to include one utility job preferably using sheet metal** (e.g. Tray, Funnel etc.) with riveting/welding/brazing/soldering (at least one temporary and one Permanent joint either using resistance welding/Arc welding); Introduction to sheet metal operations: punching, blanking, bending, drawing.
10.	**Prepare a Layout of Workshop** To prepare a work shop layout.
11.	**Collection of information about safety norms** in any one of the following type of industry:Metalworking/Chemical/Cement/Pharmaceuticals/Defense/Atomic energy/Aerospace /Marine/Construction/Railway etc.

Reference/Text Books

1. John, K. C., (2010),"Mechanical Workshop Practice, Prentice Hall Publication, New Delhi
2. Hazra and Chaudhary, Workshop Technology-I & II, Media promoters & Publisher Pvt. Ltd.

TH:02 Hrs./week — **101007: Environmental Studies-I (Mandatory Non-Credit Course)**

Course Objectives:

1. To explain the concepts and strategies related to sustainable development and various components of environment.
2. To examine biotic and abiotic factors within an ecosystem, to identify food chains, webs, as well as energy flow and relationships.
3. To identify and analyze various conservation methods and their effectiveness in relation to renewable and nonrenewable natural resources.
4. To gain an understanding of the value of biodiversity and current efforts to conserve biodiversity on national and local scale.

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

CO1:Demonstrate an integrative approach to environmental issues with a focus on sustainability.

CO2: Explain and identify the role of the organism in energy transfers in different ecosystems.

CO3: Distinguish between and provide examples of renewable and nonrenewable resources & analyze personal consumption of resources.

CO4: Identify key threats to biodiversity and develop appropriate policy options for conserving biodiversity in different settings.

Course Contents

Unit I **Introduction to environmental studies** **(02 Hrs)**

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.

Unit II **Ecosystems** **(06 Hrs)**

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit III **Natural Resources: Renewable and Non-renewable Resources** **(08 Hrs)**

Land Resources and land use change; Land degradation, soil erosion and desertification.

Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water: Use and over-exploitation of surface and ground water, floods droughts, conflicts over water (international & inter-state).

Heating of earth and circulation of air; air mass formation and precipitation.

Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit IV **Biodiversity and Conservation** **(08 Hrs)**

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity; In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Suggested Readings:

1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology.
   Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

107008 – Engineering Mathematics – II

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 4 Hrs./Week	**05**	**In-Semester : 30 Marks**
TUT : 1 Hr./Week		**End-Semester : 70 Marks**
		TW : 25 Marks

Prerequisites:

Integration, Differential Equation, Three-dimensional coordinate systems

Course Objectives:
To make the students familiarize with Mathematical Modeling of physical systems using differential equations advanced techniques of integration, tracing of curve, multiple integrals and their applications. 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 (COs): The students will be able to learn

CO1: the effective mathematical tools for solutions of first order differential equations that model physical processes such as Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.

CO2: advanced integration techniques such as Reduction formulae, Beta functions, Gamma functions, Differentiation under integral sign and Error functions needed in evaluating multiple integrals and their applications.

CO3: to trace the curve for a given equation and measure arc length of various curves.

CO4: the concepts of solid geometry using equations of sphere, cone and cylinder in a comprehensive manner.

CO5: evaluation of multiple integrals and its application to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.

Course Contents

Unit I: First Order Ordinary differential Equations (09 Hrs.)

Exact differential equations, Equations reducible to exact form. Linear differential equations, Equations reducible to linear form, Bernoulli's equation.

Unit II: Applications of Differential Equations (09 Hrs.)

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.

Unit III: Integral Calculus (09 Hrs.)

Reduction Formulae, Beta and Gamma functions, Differentiation Under Integral Sign and Error functions.

Unit IV: Curve Tracing (09 Hrs.)

Tracing of Curves – Cartesian, Polar and Parametric curves, Rectification of curves.

Unit V: Solid Geometry (09 Hrs.)

Cartesian, Spherical polar and Cylindrical coordinate systems, Sphere, Cone and Cylinder.

Unit VI: Multiple Integrals and their Applications (09 Hrs.)

Double and Triple integrations, Change of order of integration, Applications to find Area, Volume, Mass, Centre of Gravity and Moment of Inertia.

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)

Tutorial and Term Work:

i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students) per division.

ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on

performance and continuous internal assessment.

107009: Engineering Chemistry

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 04 Hrs/week	**05**	**In Semester : 30 Marks**
PR : 02 Hrs/Week		**End Semester: 70 Marks**
		PR : 25 Marks

Prerequisite Courses, if any:
Types of titrations, volumetric analysis, structure property relationship, types of crystals, periodic table, classification and properties of polymers, electromagnetic radiation, electrochemical series

Companion Course, if any: Laboratory Practical

Course Objectives:

1. To understand technology involved in analysis and improving quality of water as commodity.
2. To acquire the knowledge of electro-analytical techniques that facilitates rapid and precise understanding of materials.
3. To understand structure, properties and applications of speciality polymers and nano material.
4. To study conventional and alternative fuels with respect to their properties and applications.
5. To study spectroscopic techniques for chemical analysis.
6. To understand corrosion mechanisms and preventive methods for corrosion control.

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

CO1: Apply the different methodologies for analysis of water and techniques involved in softening of water as commodity.

CO2: Select appropriate electro-technique and method of material analysis.

CO3: Demonstrate the knowledge of advanced engineering materials for various engineering applications.

CO4: Analyze fuel and suggest use of alternative fuels.

CO5: Identify chemical compounds based on their structure.

CO6: Explain causes of corrosion and methods for minimizing corrosion.

Course Contents

Unit I Water Technology (08Hrs)

Impurities in water, hardness of water: Types, Units and Numericals. Determination of hardness (by EDTA method using molarity concept) and alkalinity, numericals. Ill effects of hard water in boiler - priming and foaming, boiler corrosion, caustic embrittlement, scale and sludge.

Water treatment: i) Zeolite method and numericalsii) Demineralization method. Purification of water: Reverse osmosis and Electrodialysis.

Unit II Instrumental Methods of Analysis (08Hrs)

Introduction: Types of reference electrode (calomel electrode), indicator electrode (glass electrode), ion selective electrode: ion selective membranes such as solid membrane, enzyme based membrane and gas sensing membrane.

[A] Conductometry: Introduction, conductivity cell, conductometric titrations of acid versus base with titration curve.

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

Unit III **Engineering Materials** **(08Hrs)**

A] Speciality polymers: Introduction, preparation, properties and applications of the following polymers:

1. Engineering Thermoplastic: Polycarbonate,
2. Bio-degradable polymers: Poly (hydroxybutyrate-hydroxyvalanate),
3. Conducting Polymer: Polyacetylene,
4. Electroluminescent polymer: Polyphenylenevinylene,
5. Polymer composites: Fiber reinforced plastic (FRP)- Glass reinforced and Carbon reinforced polymer composite

[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 **Fuels** **(08Hrs)**

Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel),

Calorific value (CV): Higher calorific value (HCV) and Lower calorific value (LCV), Determination of Calorific value: Principle, construction and working of Bomb calorimeter and Boy's gas calorimeter and numericals,

Solid fuel: Coal: Analysis of Coal-Proximate and Ultimate analysis, numericals,

Liquid fuel: Petroleum: Refining of petroleum /crude oil and composition, boiling range and uses of various fractions,

Gaseous fuel: Composition, properties and applications of CNG. Hydrogen gas as a future fuel

Alternative fuels: Power alcohol and biodiesel.

Unit V **Spectroscopic Techniques** **(08Hrs)**

[A]UV-Visible Spectroscopy:

Introduction, interaction of electromagnetic radiation with matter, statement of Beer's law and Lambert's law, absorption of UV radiation by organic molecule leading to different electronic transitions, terms involved in UV-visible Spectroscopy- chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift, Instrumentation and basic principle of single beam spectrophotometer, applications of UV-visible spectroscopy.

[B] Infra red Spectroscopy:

Introduction, Principle of IR Spectroscopy, types of vibrations: Stretching (symmetric and asymmetric) and bending (scissoring, rocking, wagging and twisting), conditions of absorption of IR radiations, vibration of diatomic and polyatomic molecules. Instrumentation with block diagram. Parts of IR spectrum, fundamental group region, fingerprint region, applications of IR spectroscopy.

Unit VI **Corrosion Science** **(08Hrs)**

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, galvanic cell corrosion, concentration cell corrosion, Factors influencing rate of corrosion. Methods of corrosion control and prevention: cathodic and anodic protection, metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, cladding, electroplating, cementation.

Books & Other Resources:

Text Books:

1. Engineering Chemistry by O .G. Palanna, Tata Magraw Hill Education Pvt. Ltd.
2. Textbook of Engineering Chemistry by Dr. S. S. Dara, Dr. S. S. Umare, S. Chand & Company Ltd.
3. Textbook of Engineering Chemistry by Dr. Sunita Rattan, S. K. Kataria& Sons Publisher

Reference Books:

1. Engineering Chemistry, Wiley India Pvt. Ltd.
2. Inorganic Chemistry, 5 ed by Shriver and Atkins, Oxford University Press
3. Basic Concept of Analytical Chemistry, 2ed , S. M. Khopkar, New Age-International Publisher
4. Instrumental Methods of Chemical Analysis, G. R. Chatwal& S. K. Anand, Himalaya Publishing House
5. Spectroscopy of organic compounds, 2 ed, P. S. Kalsi, New Age-International Ltd., Publisher
6. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, jayadevSreedhar, Wiley Eastern Limited

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 $CuSO_4$/$FeSO_4$/ $KMnO_4$, verify Beer's law and find unknown concentration of given sample.
5. Titration of a mixture of weak acid and 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 iron plate using electroplating.
10. Preparation of biodiesel from oil.
11. Colloidal synthesis of 2-6 or 3-5 semiconductor quantum dots nanoparticles

104010:Basic Electronics Engineering

Teaching Scheme:	**Credits**	**Examination Scheme**
TH : 03 Hrs./week	**04**	**In - Semester : 30 Marks**
PR : 02 Hrs./week		**End - Semester : 70 Marks**
		PR : 25 Marks

Course Objectives:

1. The principle of electronics and working principle of PN junction diode and special purpose diodes.
2. The functioning of transistors like BJT, MOSFETs and OPAMP.
3. Basics of various logic gates, digital circuits and their applications.
4. Working and functions of various electronic instruments.
5. The operating principles and applications of various active and passive sensors.
6. Basic principles of communication systems.

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

CO1: Explain the working of P-N junction diode and its circuits.

CO2: Identify types of diodes and plot their characteristics and also can compare BJT with MOSFET.

CO3: Build and test analog circuits using OPAMP and digital circuits using universal/basic gates and flip flops.

CO4: Use different electronics measuring instruments to measure various electrical parameters.

CO5: Select sensors for specific applications.

CO6: Describe basic principles of communication systems.

Course Contents

Unit I **Introduction to Electronics** **(08Hrs)**

Evolution of Electronics, Impact of Electronics in industry and in society.

Introduction to active and passive components, P-type Semiconductor, N-type Semiconductor. Current in semiconductors(Diffusion and Drift Current)

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

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

Unit II **Transistor and OPAMP** **(07Hrs)**

Bipolar Junction Transistor : Construction, type, Operation, V-I Characteristics, region of operation, BJT as switch and CE amplifier

Metal Oxide Semiconductor Field Effect Transistors (MOSFET): Construction, Types, Operation, V-I characteristics, Regions of operation, MOSFET as switch & amplifier.

Operational amplifier: Functional block diagram of operational amplifier, ideal operational amplifier, Op-amp as Inverting and Non inverting amplifier

Unit III **Number System and Logic Gates** **(07Hrs)**

Number System:- Binary, BCD, Octal, Decimal, Hexadecimal their conversion and arithmetic, De-Morgan's theorem.

Basic Gates:- AND, OR, NOT, Universal Gate- XOR, XNOR, Half adder, Full adder

Flip Flop's SR, JK, T and D

Introduction to Microprocessor and Microcontroller (Only block diagram and explanation)

Unit IV **Electronic Instrumentation** **(06Hrs)**

Electronic Instruments: Principles and block diagram of digital multimeter, Function Generator, Digital Storage Oscilloscope (DSO) Power scope, AC/DC power supply, Auto transformer, Analog ammeter and voltmeter.

Unit V **Sensors** **(07Hrs)**

Classification of a sensors, Active /Passive Sensors, Analog/Digital Sensors, Motion Sensors (LVDT, Accelerometer), Temperature Sensors (Thermocouple, Thermistor, RTD), Semiconductor Sensors(Gas Sensors), Optical Sensors (LDR), Mechanical Sensors (Strain Guage, Load Cell, Pressure sensors), Biosensors. (Working Principle and one application).

Unit VI **Communication Systems** **(07Hrs)**

Basic Communication System: Block Diagram, Modes of Transmission, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Allotment of frequency band for different applications, Block Diagram of AM and FM Transmitter and receiver,

Mobile Communication System: Cellular concept, Simple block diagram of GSM system.

Books & Other Resources:

Text Books:

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

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.

List of Laboratory Experiments/Assignments

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 Diode, BJT, MOSFETs, various IC packages e) Switches & Relays
2.	**Measurements using various measuring equipments:** a) Set up CRO and function generator for measurement of voltage, frequency b) Obtain the phase shift between to signals using CRO with the help of Lissagous pattern. c) Measure voltage, resistance using digital multimeter. Also use multimeter to check diode, BJT
3.	**V-I characteristics of:** a) P-N Junction Diode **(Study the datasheet of typical PN junction diode 1N 400X)** b) Zener Diode **(Study the datasheet of typical Zener diode 1N 4148)**
4.	**Rectifier circuits:** a) Implement half wave, full wave and bridge rectifier using diodes b) Observe the effect of capacitor filter on rectifier output
5.	**Frequency response of MOSFET:** a) To plot frequency response of BJT amplifier.**(Simulation)** b) To plot frequency response of MOSFET amplifier.**(Simulation)**
6.	**Linear applications of Op-amp:** Build inverting and non-inverting amplifier using op-amp **(Study the datasheet of typical Op-Amp 741)**
7.	**Test and verify the truth tables of:** a) Basic and Universal Gates **(Study the data sheet of respective IC's)** b) Half / Full Adder c) RS/JK/T/D flip flop
8.	**Study of transducers : (Any 3)**
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 guidelines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

- The laboratory assignments/experiments are to be submitted by student in the form of journal.
- Journal consists of Certificate, table of contents, and handwritten write-up for each experiment.
- Each experiment should consist of :
  - ✓ Title.
  - ✓ Objectives.
  - ✓ Problem Statement, Outcomes
  - ✓ Hardware / Software (If any) requirements.
  - ✓ Concept.
  - ✓ Experimental procedure / Setup.

- ✓ Observation table
- ✓ Conclusion.

Guidelines for Laboratory Conduction

- All the experiments mentioned in the syllabus are compulsory.
- Use of open source software and recent version is to be encouraged.

Guidelines for Lab /TW Assessment

- Continuous assessment of laboratory work is 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 lab assignment / experiment assessment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.
- The parameters for assessment is to be known to the students at the beginning of the course.

101011: Engineering Mechanics

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 3 Hrs./week	**04**	**In-Semester : 30 Marks**
PR : 2 Hrs./Week		**End-Semester : 70 Marks**
		PR : 25 Marks

Prerequisite Courses, if any: 12th Physics, Maths

Course Objectives:

1. To impart knowledge about force systems and methods to determine resultant centroid and moment of inertia
2. To teach methods to calculate force of friction
3. To impart knowledge to determine reaction of beams, calculate member forces in trusses, cables and frames using principles of equilibrium
4. To teach space force systems
5. To train students to solve problems related to particle mechanics using principles of kinematics, kinetics and work power energy

Course Outcomes:

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

CO1: Determine resultant of various force systems

CO2: Determine centroid, moment of inertia and solve problems related to friction

CO3: Determine reactions of beams, calculate forces in cables using principles of equilibrium

CO4: Solve trusses, frames for finding member forces and apply principles of equilibrium to forces in space

CO5: Calculate position, velocity and acceleration of particle using principles of kinematics

CO6: Calculate position, velocity and acceleration of particle using principles of kinetics and Work, Power, Energy

Course Contents

Unit I Resolution and Composition of Forces (07Hrs)

Principle of statics, Force system, Resolution and composition of forces, Resultant of concurrent forces. Moment of a force, Varignon's theorem, resultant of parallel force system, Couple, Equivalent force couple system, Resultant of parallel general force system

Unit II Distributed Forces and Friction (06Hrs)

Moment of area, Centroid of plane lamina and wire bends, Moment of Inertia.

Friction- Laws of friction, application of friction on inclined planes Wedges and ladders friction Application to flat belt

Unit III **Equilibrium** **(06Hrs)**

Free body diagram Equilibrium of concurrent, parallel forces in a plane Equilibrium of general forces in a plane Equilibrium of three forces in a plane, Types of beams, simple and compound beams, Type of supports and reaction,

Forces in space, Resultant of concurrent and parallel forces in a space, Equilibrium of concurrent and parallel forces in a space.

Unit IV **Analysis of Structures** **(06 Hrs)**

Two force member, Analysis of plane trusses by Method of joints Analysis of plane trusses by method of section, Analysis of plane frames, Cables subjected to point load multi force member.

Unit V **Kinematics of Particle** **(06 Hrs)**

Kinematics of linear motion- Basic concepts Equation of motion for constant acceleration Motion under gravity, Variable acceleration motion curves.

Kinematics of curvilinear motion- Basic Concepts Equation of motion in Cartesian coordinates Equation of motion in path coordinates Equation of motion in polar coordinates Motion of projectile.

Unit VI **Kinetics of Particle** **(06Hrs)**

Kinetics- Newton's Second Law of motion Application of Newton's Second Law.

Work, power, energy, conservative and non-conservative forces Conservation of energy for motion of particle, Impulse, Momentum, Direct central impact. Coefficient of restitution, Impulse Momentum principle of particle.

Books & Other Resources:

Text Books:

1. Vector Mechanics for Engineers, by F. P. Beer and E. R. Johnson, McGraw-Hill Publication
2. Engineering Mechanics by R. C. Hibbeler, Pearson Education

Reference Books:

1. Engineering Mechanics by S. P. Timoshenko and D. H. Young, McGraw- Hill publication
2. Engineering Mechanics by J. L. Meriam and Craige, John Willey
3. Engineering Mechanics by F L Singer, Harper and Rowe publication
4. Engineering Mechanics by A. P. Boresi and R. J. Schmidt, Brooks/Cole Publication

Laboratory Course

Guidelines for Instructor's Manual

An instruction manual with aim, objective, apparatus, procedure and calculations to be performed for each experiment to be provided for students called as Lab Manual. Every year problems for assignment should be changed. It is advisable to give different data to different batches

Guidelines for Student's Lab Journal

Journal should be hand written

Guidelines for Lab /TW Assessment

Each and every experiment should be assessed and given mark out of 10. Finally the marks can be converted as per given in the structure.

Guidelines for Laboratory Conduction

Divide the students of a batch in groups of not more than 4 students and ask each group to take readings separately followed by calculations for each experiment. After every experiment faculty should sign the lab manual of readings of every student in the batch

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
	1. Verification of law of parallelogram of forces/polygon of forces. 2. To determine support reaction of simple/compound beams. 3. Determination of coefficient friction of belt/inclined plane. 4. To determine forces in the members of space force system. 5. To study the curvilinear motion. 6. Determination of coefficient of restitution.
	Group B
	Assignment of five problems on every unit to be solved during practical
	Group C
	Any two assignments of the following by graphical method using any drawing software. a) To determine the resultant of general force system. b) To determine unknown forces of concurrent force system c) To determine the forces in the member of the plane truss d) To determine velocity and acceleration of particle from given s-t diagram.

102012: Engineering Graphics		
Teaching Scheme: **TH : 01 Hr/week** **PR : 02 Hrs/Week** **TUT : 01 Hr/Week**	**Credits** **02**	**Examination Scheme:** **End-Semester : 50 Marks** **TW : 25 Marks**

Course Objectives

1. To acquire basic knowledge about engineering drawing language, line types, dimension methods, and simple geometrical construction.
2. To draw conic sections by various methods, involutes, cycloid and spiral.
3. To acquire basic knowledge about physical realization of engineering objects and shall be able to draw its different views.
4. To visualize three dimensional engineering objects and shall be able to draw their isometric views.
5. To imagine visualization of lateral development of solids.
6. To acquire basic knowledge about the various CAD drafting software's and its basic commands required to construct the simple engineering objects.

Course Outcomes

On completion of the course, learner will be able to

CO1: Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.

CO2: Construct the various engineering curves using the drawing instruments.

CO3: Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.

CO4: Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.

CO5: Draw the development of lateral surfaces for cut section of geometrical solids.

CO6: Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools.

Course Contents

Unit I Fundamentals of Engineering Drawing (01 Hrs)

Need of Engineering Drawing and design, Sheet layout, Line types and dimensioning and simple geometrical constructions

Unit II Introduction to 2D and 3D computer aided drafting packages (02 Hrs)

Evolution of CAD, Importance of CAD, Basic Commands - Edit, View, Insert, Modify, Dimensioning Commands, setting and tools etc. and its applications to construct the 2D and 3D drawings

Unit III Engineering Curves (01 Hr)

Introduction to conic sections and its significance, various methods to construct the conic sections. Helix for cone and cylinder , rolling curves (Involutes , Cycloid) and Spiral

Unit IV Orthographic Projection (02 Hrs)

Principle of projections, Introduction to First and Third angle Projection methods, Orthographic projection of point, line, plane, solid and machine elements/parts

Unit V Isometric Projection (03 Hrs)

Introduction to isometric projection, oblique projection and perspective projection. Draw the isometric projection from the given orthographic views

Unit VI Development of Lateral Surfaces (03 Hrs)

Introduction to development of lateral surfaces and its industrial applications. Draw the development of lateral surfaces for cut section of cone, pyramid, prism etc.

Books & Other 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", Chartor 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

6. Jensen, C., Helsel, J. D., Short, D. R., (2008), "Engineering Drawing and Design", McGraw-Hill International, Singapore

Guidelines for Laboratory Conduction

Tutorial Session

Can be utilized to teach the basic commands of any drafting package, by using this knowledge students shall be able to complete the five assignments on the CAD software. (Minimum 2 problems in each assignment)

Assignment 1: Construct any Engineering Curve using any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment4 :Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session).

Assignment 5: Draw the development of lateral surface of a solid/ truncated solid.

Practical Session

Draw minimum two problems on each assignment on the A3 size drawing sheet.

Suggested List of Laboratory Experiments/Assignments

Assignment 1: Construct any Engineering Curve by any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment 4: Draw the development of lateral surface of a solid/ truncated solid

Assignment 5: Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session.)

110013: Project Based Learning

Teaching Scheme:	**Credits**	**Examination Scheme:**
PR: 04 Hrs/Week	**02**	**PR : 50 Marks**

Preamble:

For better learning experience, along with traditional classroom teaching and laboratory learning; project based learning has been introduced with an objective to motivate students to learn by working in group cooperatively to solve a problem.

Project-based learning (PBL) is a student-centric pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Problem 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.

Course Objectives:

1. To emphasizes learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent learning by problem solving with social context.
3. To engages students in rich and authentic learning experiences.
4. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes:

CO1: Project based learning will increase their capacity and learning through shared cognition.
CO2: Students able to draw on lessons from several disciplines and apply them in practical way.
CO3: Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Group Structure:

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

- There should be team/group of 5 -6 students
- A supervisor/mentor teacher assigned to individual groups

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 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, analyze, 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 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.

Group may demonstrate their knowledge and skills by developing a 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 the all activities are to be record and regularly, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor (you may call it PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment, evaluation and weightage:

- Idea Inception **(5%)**
- Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product **(50%)** (Individual assessment and team assessment)
- Documentation (Gathering requirements, design & 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, mentorand project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

References:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com
- www.wikipedia.org
- www.howstuffworks.com

101014: Environmental Studies-II

TH: 02 Hr/week **Mandatory Non-Credit Course**

Course Objectives:

1. To provide a comprehensive overview of environmental pollution and the science and technology associated with the monitoring and control.
2. To understand the evolution of environmental policies and laws.
3. To explain the concepts behind the interrelations between environment and the development.
4. To examine a range of environmental issues in the field, and relate these to scientific theory.

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

CO1: Have an understanding of environmental pollution and the science behind those problems and potential solutions.

CO2: Have knowledge of various acts and laws and will be able to identify the industries that are violating these rules.

CO3: Assess the impact of ever increasing human population on the biosphere: social, economic issues and role of humans in conservation of natural resources.

CO4: Learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in applied situations such as careers that may involve environmental problems and/or issues.

Course Contents

Unit V **Environmental Pollution** **(08 Hrs)**

Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution

Nuclear hazards and human health risks

Solid waste management: Control measures of urban and industrial waste

Pollution case studies.

Unit VI **Environmental Pollution** **(07 Hrs)**

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities& agriculture.Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto Protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context

Unit VII **Human Communities and the Environment** **(06 Hrs)**

Human population and growth; Impacts on environment, human health and welfares.

Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit VIII **Field work** **(05 Hrs)**

- Visit to an area to document environmental assets; river/forest/flora/fauna, etc.
- Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river Delhi Ridge, etc

Suggested Readings:

1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology, Sunderland: Sinauer Associates, 2006
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

5. It is NOT MANDATORY for a learner to opt for Alternative Study Credit Courses. However, Faculty members may advise a student to enroll for Alternative Study Credit Course(s) after a methodical assessment of the relevant competencies of the student.
6. Institutes may stipulate additional criteria for students desirous to take up Alternative Study Credit Courses.
7. **A MINIMUM of 60% of the total credits earned by a learner through ASCC shall either be from MOOCs or from Professional Certification Programmes**.
8. Thus a learner may skip all Generic Elective (GE - IL) courses and skip all Subject Elective (SE - IL) courses and earn the required 22 credits entirely through ASCC.
9. The same TYPE of ASCC can be opted for multiple number of times. Norms for the same are prescribed in the relevant section later in this syllabus document. For e.g. A student may undertake 11 "Professional Certification Programs" and earn 22 credits or complete 11 MOOCS and earn 22 Credits.
10. ASCC shall be executed in online study mode / field work or project mode / certification mode.
11. A faculty guide shall be assigned for such courses. The faculty shall oversee the progress of the learner as well as evaluate the learner for 50 marks / 2 credits.
12. The learner shall select the ASCC that he/she desires to opt for and submit an outline of the proposed study relevant to the course. The faculty guide shall approve the proposal after considering the nature of the work, learning effort required, desired outcomes and comprehensive coverage of the topic.
13. There is no defined syllabus for the ASCC courses. Institutes shall define the syllabus and announce the same on the website.
14. Since ASCC is a guided self study course 40 - 45 hours of work shall be equivalent to one credit. The faculty shall oversee the progress of the learner as well as evaluate the learner for 50 marks / 2 credits.
15. The start date of the ASCC such as Professional Certifications shall be after the admission date for the MBA programme and the end date of the ASCC shall be within 6 months of the start date of the ASCC, but before the completion of Sem IV.
16. The list of ASCC is provided in Annexure I.

5.7 Combination of Options: A learner may opt for any combination of earning the 22 credits assigned to Generic Elective (GE - IL) courses and Subject Elective (SE - IL) courses through

e) Generic Elective (GE - IL) courses
f) Subject Elective (SE - IL) courses
g) Open Elective Courses
h) Major + Minor specialization combination
i) Foundation Courses
j) Enrichment Courses
k) Alternative Study Credit Courses

SUBJECT TO THE minimum and maximum limits of credits prescribed and, subject to institutional norms and guidelines, issued from time to time.

6.0 Summer Internship Project: At the end of Second Semester each student shall undertake a Summer Internship Project (SIP) for a **minimum of 8 weeks**. For SIP, 1 credit is equivalent to minimum 40-45 hours of effective work. SIP shall have 6 credits. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.

The SIP may or may not have a Functional Focus, i.e. the student may take up a SIP in his/her intended area of specialization or in any other functional area of management. **Ideally the SIP should exhibit a cross-functional orientation.**

SIP can be carried out in a

1. Corporate Entity
2. NGO
3. SME
4. Government Undertaking
5. Cooperative Sector.

SIP may be

1. a research project – based on primary / secondary data
2. may be an operational assignment involving working by the student on a given task/assignment/project/ etc. in an organization / industry.

It is expected that the SIP shall sensitize the students to the demands of the workplace and apply conceptual knowledge in practice..

Semester I					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Java Programming	IT11	3	50	25
2	Data Structure and Algorithms	IT12	3	50	25
3	Object Oriented Software Engineering	IT13	3	50	25
4	Operating System Concepts	IT14	3	50	25
5	Network Technologies	IT15	3	50	25
6	Open Course 1	OC11	1		25
7	Open Course 2	OC12	1		25
	*** Practicals**				
8	Practical	IT11L	5	50	75
9	Mini Project	ITC11	5	50	75
	Soft Skills				
10	Soft Skills - I	SS11	1		25
			28	**350**	**350**

Semester II					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Python Programming	IT21	3	50	25
2	Software Project Management	IT22	3	50	25
3	Optimization Techniques	MT21	3	50	25
4	Advanced Internet Technologies	IT23	3	50	25
5	Advanced DBMS	IT24	3	50	25
6	Open Course 3	OC21	1		25
7	Open Course 4	OC22	1		25
	*** Practicals**				
8	Practical	IT21L	5	50	75
9	Mini Project	ITC21	5	50	75
	Soft Skills				
10	Soft Skills - II	SS21	1		25
			28	**350**	**350**

Savitribai Phule Pune University
Second Year of Artificial Intelligence and Data Science (2020 Course)
217533: Project Based Learning II

Home

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

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%)
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 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.

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- 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?

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,

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- 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	PO 7	PO 8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	2