Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

(An Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Mechanical Engineering

Syllabus

Final Year B. Tech.
Mechanical Engineering

(Pattern 2023)

(w.e.f. AY: 2026-27)

Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

Vision

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

Mission

1. To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards cocreation of knowledge.
3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

Department of Mechanical Engineering,

VPKBIET Baramati

Vision

To inculcate learning culture in students and faculties to meet the current and future technological challenges of industry and society

Mission

1. To impart the students with fundamental knowledge of mechanical engineering.
2. To provide practical exposure by promoting students for training and internship in related industries.
3. Holistic development of the students by inculcating ethical and moral values towards the society and environment.
4. To develop association with premier educational institutions, industries and alumni for enhancement of faculty skill.

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Final Year (B. Tech.) Mechanical Engineering
2023 Pattern w.e.f. AY: 2026-2027

SEMESTER-VII																
Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IJOT	ME23401 PR	Internship/On-job Training	-	24	-	100	-	-	100		150	350	-	12	-	12
EEMC	HS23402 TH	Entrepreneurship Development	3	-	-	30	-	70	-	-	-	100	3	-		4
EEMC	HS23402 TUT	Entrepreneurship Development	-	-	1	-	-	-	-	-	30	30	-	-	1	
RM	HS23403 TH	Research Methodology and IPR	3	-	-	30	-	70	-	-	-	100	3	-	-	4
RM	HS23403 TUT	Research Methodology and IPR	-	-	1	-	-	-	30	-	-	30	-	-	1	
AEC	HS23404 TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
AEC	HS23404 TUT	Public Speaking and Aptitude	-	-	1	-	-	-	-	-	30	30	-	-	1	
	Total		7	24	3	200	-	140	130	-	210	680	7	12	3	22

Dr. S. C. Mahadik
Academic Coordinator

Dr. M. S. Lande
Head of Department

28/03/2026
Dr. S. M. Bhosle
Dean Academics

Dr. A. H. Kolekar
Controller of Examination

Dr. S. B. Lande
Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

Principal

VPKBIET BARAMATI
Affiliated to S.P.P.U. Pune Id No./PU/PN/Engg./152/2000
PUNE (MS.)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Final Year (B. Tech.) Mechanical Engineering
2023 Pattern w.e.f. AY: 2026-2027

SEMESTER-VIII																
Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	ME23411TH	Computer Aided Design & Manufacturing	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME23411PR	Computer Aided Design & Manufacturing	-	2	-	-	-	-	-	30	-	30	-	1	-	
PEC	ME23412X TH	Programme Elective IV Course	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PEC	ME23412X PR	Programme Elective IV Course	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	ME23413X TH	Programme Elective V Course	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PEC	ME23413X PR	Programme Elective V Course	-	2	-	-	-	-	-	-	30	30	-	1	-	
PROJ	ME23414PR	Project	-	8	-	-	-	-	80	-	50	130	-	4	-	4
MDM	MD230XXTH	Multidisciplinary Minor	2	-	-	20	20	50	-	-	-	90	2	-	-	3
MDM	MD230XXPR	Multidisciplinary Minor	-	2	-	-	-	-	20	-	-	20	-	1	-	
OE	OE230XX	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	2
Total			12	16	-	50	80	280	100	30	110	650	12	8	-	20

List of Programme Electives

Code	Programme Elective IV Course	Code	Programme Elective V Course
ME23412A	Mechatronics	ME23413A	Automobile & Electric Vehicle
ME23412B	Product Design & Development	ME23413B	Material Handling System Design
ME23412C	Computational Fluid Dynamics	ME23413C	Heating Ventilation & Air Conditioning

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Multidisciplinary Minor (MDM) Subjects			
AI23051	AI & Machine Learning	ET23053	Internet of Things
AI23052	Data Science	CE23051	Waste Management
AI23053	Generative AI	CE23052	Green Building & Smart Cities
CO23051	Cloud Computing	ME23051	Introduction to 3D Printing Technologies
CO23052	High Performance Computing	ME23052	Introduction to Robotics & Automation
CO23053	Computer Graphics & Gaming	EL23051	Solar Technology
IT23051	Cyber Security	EL23052	Industrial Automation
IT23052	Full Stack Development	GS23051	Nanotechnology
ET23051	Embedded Systems	GS23052	Linear Algebra and Statistics
ET23052	Drone Technology		
Open Electives (OE) Subjects			
OE23001	Digital Marketing	OE23011	Biotechnology
OE23002	Professional Leadership	OE23012	International Relations
OE23003	Organizational Behavior	OE23013	Universal Human Values
OE23004	Industrial Management	OE23014	Education Technology
OE23005	Disaster Management	OE23015	Design Thinking
OE23006	Energy Economic & Management	OE23016	Financial Literacy for Bharat#
OE23007	Operation Research	OE23017	Sustainability & Climate Change
OE23008	Intellectual Property Rights	OE23018	Agriculture Technology
OE23009	Cyber Laws	OE23019	Architectural Technology
OE23010	Bioinformatics		

Academic Coordinator | Head of Department | Dean Academics | Principal

Head
Department of Mechanical Engineering
VPKBIET Baramati - 413133

Principal
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Vidyanagari, Baramati-413133

ME23401- INTERNSHIP		
Teaching Scheme:	**Credits: 12**	**Examination Scheme:**
TH: 00 Hrs./Week **PR: 24 Hrs./Week**	**Practical : 12**	**CAA: 100 Marks**
		Termwork: 100 Marks
		Oral: 150 Marks

Prerequisites:

Students should have successfully completed Semester VI of the Engineering program.

Course Objectives:

- To learn and practice hands-on technical skills.
- To provide opportunities for acquiring, comprehending, and refining practical technical proficiencies.
- To gain exposure to professional industrial practices and environments.
- To understand how real-world factors like cost, society, and management affect a company.
- To cultivate ethical principles aligned with professional and societal standards.

Course Outcomes:

CO 1. Understand how people in the industry approach and solve problems.

CO 2. Learn how to write clear and effective technical reports.

CO 3. Work effectively and professionally as part of a team.

CO 4. Learn to pick the right tools and technology to solve a given problem.

CO 5. Analyze various career opportunities and decide career goals.

CO 6. Demonstrate abilities of a responsible professional and use ethical practices in day-to-day life.

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.

Internship work identification process should be initiated in the VI semester in coordination with training and placement cell/ industry institute cell. This will help students to start their internship work on time.

Student can take internship work in the form of the following but not limited to:

1. Working for consultancy/ research project,

2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation

Council/ startups cells of institute /

3. Learning at Departmental Lab/ Institutional workshop,

4. Development of new product/ Business Plan/ registration of start-up,

5. Industry / Government Organization Internship,

6. Internship through Internshala,

7. In-house product development, intercollegiate, inter department research internship under Research lab/group, micro/small/medium enterprise/online internship,

8. Research internship under professors, IISC, IIT's, Research organizations,

9. NGOs or Social Internships, rural internship,

10. Participate in open source development.

Duration:

Internship is to be completed after semester 6 and before commencement of semester 8 of at least 14 to 20 weeks; and it is to be assessed and evaluated in semester 7.

Guidelines for students

1. All B.Tech Mechanical students are required to undergo an internship for a minimum duration of **14–16 weeks.** Students must **obtain a Final Year - Bonafide Certificate through the college office, which is mandatory** for commencing the internship.

2. Student must submit application form with all documents and Undertaking forms to department IIIC Coordinator through mentor

3. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.

4. All students should compulsorily follow the rules and regulations as laid by industry.

5. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.

6. Student should follow all ethical practices and SOP of industry.

7. Students have to take necessary health and safety precautions as laid by the industry.

8. Student should contact his /her academic guide from college on weekly basis to communicate the progress.

9. Each student has to prepare internship report in consultation with the academic guide.

Internship Diary / Internship Workbook

1. All B.Tech Mechanical students must maintain a daily diary **in the format prescribed by the college**, documenting Observations, tasks performed, information gathered, and any suggestions.
2. The diary should include relevant sketches, drawings, or diagrams based on daily observations.
3. The industry supervisor or section in-charge must **verify and sign the diary every week.**
4. Students must present the diary to the **Faculty Mentor during each industry visit** for verification and ratification.
5. Upon completion of the internship, students must submit the following to the Institute:

- Student's Daily Diary (as per college format)
- Internship Report
- Attendance Record
- Evaluation Sheet duly signed and stamped by the industry

6. The diary will be evaluated based on **regularity of entries, completeness, and adherence to the prescribed format.**

Internship Report

1. All B.Tech Mechanical Students must prepare a **comprehensive internship report** in the **format prescribed by the department**, covering observations, tasks performed, and key learning outcomes.
2. Students may consult the **Industry Supervisor** and **Faculty Mentor** to obtain specific topics or problem statements to be included in the report.
3. Students should use the **daily diary** as a reference while preparing the report, as it already contains detailed information recorded during the internship.
4. The completed report must be **signed by the Industry Supervisor and Faculty Mentor** before submission to the department.
5. The internship report will be evaluated based on the following criteria:

- Originality of content
- Adequacy and purposefulness of the write-up
- Organization, formatting, quality of sketches/drawings, writing style, and

language

- Variety and relevance of the learning experiences documented
- Linkage of practical applications with theoretical concepts learned in coursework

Evaluation Guidelines:

Every B.Tech Mechanical student is required to prepare and maintain documentary proofs of the activities done by him/her as internship diary or as workbook. The evaluation of these activities will be done by Department IIIC Coordinator / faculty mentor or Industry Supervisor/Appointed External Examiner 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.)

Component	Marks
A. Continuous Assessment Activity	100
B. Term-Work (Internship Report)	100
C. Oral Examination / Viva	150
TOTAL	**350**

1. Continuous Assessment (100 Marks): Evaluation includes attendance, discipline, workplace behavior, and the quality of the learning diary or logbook. Mid-semester progress presentations and structured industry supervisor feedback form an integral part of the continuous review process.

2. Term-Work (100 Marks): Assessment covers the structure and completeness of the internship report, technical depth, problem-solving ability, and reflection on skills developed. Supporting evidence—drawings, screenshots, certificates, and attendance records—is verified, along with a plagiarism check to ensure originality.

3. Oral Examination / Viva (150 Marks): Evaluation focuses on understanding of tasks performed, application of engineering concepts, clarity of communication, industry relevance, and the ability to respond logically during interaction with examiners. Joint assessment by internal and external examiners ensures transparency and fairness.

Internship Evaluation Scheme (Total: 350 Marks)

Component	Marks	Evaluation Basis	Mode of Assessment / Evaluator
A. Continuous Assessment (100 Marks)			
Attendance, Discipline & Professionalism	20	Regularity, punctuality, adherence to workplace culture	Attendance record + Industry Supervisor note
Diary / Logbook	20	Weekly reflection of tasks, learning outcomes, challenges	Logbook review by Faculty Mentor
Mid-Semester Progress Presentation	20	Presentation on tasks performed, tools/technologies learned, contributions	Faculty review (in consultation with Industry Supervisor)
Industry Supervisor Feedback	40	Attitude, initiative, teamwork, professional conduct	Structured feedback form
Subtotal (A)	**100**		
B. Term-Work (Internship Report)- (100 Marks)			
Internship Report (Structure & Completeness)	20	Cover page, acknowledgement, organization profile, objectives, methodology, tasks, outcomes, conclusion	Faculty Panel Evaluation
Technical Content & Problem Solving	30	Depth of technical work, relevance to discipline, engineering application	Faculty Panel
Skill Development Reflection	20	Technical/professional skills, tools learned, employability skills (NEP focus)	Faculty Panel
Evidence & Annexures	15	Screenshots, codes, drawings, certificates, datasheets, attendance logs	Faculty Panel
Plagiarism / Originality	15	Minimum 80% originality; no copy-paste	Plagiarism check + Faculty review
Subtotal (B)	**100**		
C. Presentation & Oral Examination / Viva (150 Marks)			

Understanding of Work Done	30	Explanation of tasks performed, process understanding, technical depth	Internal + External Examiners
Application of Knowledge	30	Linkage with curriculum, application of engineering concepts	Viva Panel
Soft Skills & Communication	30	Presentation skills, clarity, professional conduct	Viva Panel
Industry Relevance & Employability	30	Awareness of industry practices, teamwork, adaptability	Viva Panel (Industry input)
Q&A Interaction	30	Logical reasoning and accuracy of responses	Viva Panel
Subtotal (C)	**150**		
Total A+B+C	**350**		

Feedback from internship supervisor

Post internship, faculty coordinator/Mentor should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership

Reference:

1. https://internship.aicte-india.org/
2. Circular No. 29-2024 Internship Cell- BOD Link_15022024.pdf
3. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

HS23402- ENTREPRENEURSHIP DEVELOPMENT		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **TUT: 01 Hrs./Week**	**Theory : 03** **Tutorial : 01**	**CAA: 30 Marks**
		End-Semester Exam: 70 Marks
		Oral Exam: 30 Marks

Course Outcomes:

On completion of the course, learner will be able to

CO1: Understand the fundamentals of entrepreneurship, the entrepreneurial mindset, traits, and the role of entrepreneurs in economic development.

CO2: Explain the growth of entrepreneurship in India and analyze the role of institutional support systems and government initiatives.

CO3: Apply design thinking principles and innovation strategies in product/service selection and development.

CO4: Conduct market and feasibility studies and prepare a comprehensive business plan.

CO5: Develop strategies for enterprise management, risk handling, funding acquisition, and incubation support.

CO6: Analyze the startup ecosystem and evaluate real-world entrepreneurial case studies.

Course Contents

Unit-1: Introduction to Entrepreneurship
Introduction to Entrepreneurship, Concept and Definitions of Entrepreneur and Entrepreneurship, Objectives of Entrepreneurship Development, Phases of Entrepreneurship Development, Role of Entrepreneurship in Economic Development, The Entrepreneurial Mindset, Characteristics and Traits of Entrepreneurs, Entrepreneurship Skills.
Unit-2: Entrepreneurial Growth in India
Sources of Entrepreneurship in India, Entrepreneurial Development Programmes (EDPs): Concept, Need and Phases, Institutions Conducting EDPs in India, Role of Key Institutions: Maharashtra Centre for Entrepreneurship Development, National Institute for Micro, Small and Medium Enterprises, Prime Minister Employment Generation Programme, Directorate of Industries, Khadi and Village Industries Commission.
Unit-3: Design Thinking and Product Selection

Design Thinking, Technology Readiness Levels (TRL), Product/Service Selection Process Product/Service Life Cycle, New Product/Service Development Process, Mortality Curve, Creativity and Innovation in Product/Service Development and Modification.

Unit-4: Market Study and Business Plan Preparation

Market Study Procedures: Questionnaire Design, Sampling Techniques, Market Survey, Data Analysis. Feasibility Study, Forms of Ownership, Capital and Budgeting, Feasibility Report Preparation and Evaluation Criteria, Business Plan Preparation.

Unit-5: Managing Enterprise

Unique Selling Proposition (USP), Identification and Development of Marketing Plan, Policy Making and Strategic Planning, Risk Management and Calculated Risk-Taking, Angel Investors and Venture Capitalists, Incubation Centers: Role and Procedure.

Unit-6: Startup Ecosystem and Case Studies

Concept of Startup Ecosystem, Components of Startup Ecosystem, Role of Government, Investors, Incubators, and Accelerators, Case Studies of Successful Startups/Entrepreneurs, Lessons from Startup Success and Failures.

Text Books:

1. Entrepreneurship Development – Dr. K. Natarajan & Prof. E. Gordon, Himalaya Publishing House.
2. Introduction to Entrepreneurship Development – Abhik Kumar Mukherjee & Shaunak Roy, Oxford University Press.
3. Entrepreneurship Development – Dr. J. Ravi, Manglam Publications.
4. The Dynamics of Entrepreneurial Development and Management – Vasanth Desai, Himalaya Publishing House.

Reference Books:

1. Entrepreneurship – Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, McGraw-Hill.
2. Entrepreneurship Development and Small Business Enterprises – Poornima M. Charanthimath, Pearson Education.
3. Entrepreneurship Development – S. L. Gupta & Arun Mittal, International Book House.
4. Management and Entrepreneurship Development – Sudha G. S., Indus Valley Publication.

HS23403- RESEARCH METHODOLOGY AND IPR		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **TUT: 01 Hrs./Week**	**Theory : 03** **Tutorial : 01**	**CAA: 30 Marks**
		End-Semester Exam: 70 Marks
		Termwork: 30 Marks

Prerequisites: Project based learning of all subjects, Fundamental laws and principles of all subjects, Soft and communication skills.

Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

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

CO1. Formulate a research problem for engineering and technology domain.

CO2. Analyze the available literature for given research problem and understand different techniques of data collection.

CO3. Investigate the statistical and reliability methods of preliminary data analysis and present the results in graphical form.

CO4. Understand the importance of technical writing and presentation skills.

CO5. Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.

CO6. Realize the importance of patents, trademark and copyright and follow research ethics.

Course Contents

Unit-1: Introduction	**[07 Hrs.]**

Introduction, Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific method, Research process, Criteria of good research, Problems encountered in India for good research, Formulation of research hypotheses, Search for causation, Format for research proposal, Funding for the proposal, Different funding agencies, Framework for the planning.	
Unit-2: Literature Review	**[07 Hrs.]**
Definition of literature and literature survey, Significance of literature survey, Sources of literature, Elements and objectives of literature survey, Styles of literature survey, Strategies of literature survey, Searching the existing literature, Reviewing the selected literature, Writing about the literature reviewed and gap identified, literature analysis, data collection, and interpretation.	
Unit-3: Preliminary Data Analysis	**[07 Hrs.]**
Testing of hypothesis- concepts and testing, Review of theory of reliability, Hazard models, System reliability. Data presentation skills, Features of statistical analysis, Histogram, bar charts, Pie charts, 2D & 3D plots, Interpolation & extrapolation techniques, Curve fitting.	
Unit- 4: Technical Writing and Presentation	**[07 Hrs.]**
Effective technical writing, thesis writing, research proposal writing, research paper writing. Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing a research report, Precautions for writing research reports, Presentation skills, tools for technical writing and presentation. Plagiarism, avoiding plagiarism, Research ethics, Tools for plagiarism checking, technical writing and presentation.	
Unit 5: Intellectual Property Rights	**[07 Hrs.]**
Introduction and significance of intellectual property rights, Types of Intellectual Property Rights, Copyright and its significance, Introduction to patents and its filing, Introduction to patent drafting, Best practices in national and international patent filing, Copyrightable work examples.	
Unit-6: Patent Rights	**[07 Hrs.]**

Patents and its basics, Patentable items, Designs, Process of filing patent at national and international level, Process of patenting and development, Technological research and patents, innovation, Patent and copyright international intellectual property, Procedure for grants of patents, Need of specifications, Types of patent applications, Provisional and complete specification, Patent specifications and its contents, Trade and copyright.

Text Books:

1. Ranjit Kumar (2005), 2nd edition, Research Methodology: A Step by Step Guide for beginners (Pearson Education).
2. C. K. Kothari (2004), 2nd edition, Research Methodology Methods & Techniques (New Age International, New Delhi).
3. T. Ramappa (2016), 2nd edition, Intellectual Property Rights-Law in India (Asia Law House, Hyderbad).

Reference Books:

1. Louis Cohen, Manion, Morrison and Routledge (2017), 8th edition, Research Methods in Education (Taylor & Francis Group- Cambridge University Press India Pvt. Ltd.).

2. John Best and James Kahn (1998), 8th edition, Research in Education (Prentice Hall of India Pvt. Ltd.).

3. Stuart Melville and Wayne Goddard (2001), Research Methodology: An Introduction for Science and Engineering Students. (Juta & Co Ltd.).

4. Benjamine Niebel and Alan Draper (1974), Product Design and Process Engineering, (McGraw Hill International Publishers).

5. Halbert D. J. (2007), 2nd edition, Resisting Intellectual Property (Taylor and Francis Ltd.).

6. Robert P. Merges, Peter S. Menell, Mark A. Lemley (2016), Intellectual Property in New Technological Age (Stanford Public Law Working Paper No. 2780190, Elsevier Publishers).

The term work should consist of following assignments.

1. **Literature Review:** Collect the existing literature on any research idea in engineering/technology and identify the research gap. (Performed in a group of **three or four students**)

2. **Report and Seminar Presentation:** Prepare a research proposal based on the identified research gap, which may serve as a basis for the project work. The report should be checked for plagiarism and language quality (e.g., using Grammarly or equivalent tools), and the idea should be presented. (Performed in a group of **three or four students**)
3. **Blank Format of Research Proposal:** Identify national and international funding agencies and prepare/print the blank format of a research proposal of any one agency, for understanding proposal structuring relevant to research work. (Performed in a group of **three or four students**)
4. **Citation and Referencing Styles:** Write a report on different citation and referencing styles adopted by various publishers, facilitating proper documentation of the research work.
5. **IPR Case Study:** Write a report on a case study of any existing patent/copyright/trademark, providing insight into intellectual property aspects related to project development.
6. **Journal Study:** Collect information on any one peer-reviewed journal and write a report covering abstracting and indexing, H-index, SJR rating, impact factor, aims and scope, and submission guidelines.

HS23404- PUBLIC SPEAKING AND APTITUDE		
Teaching Scheme Theory 1 Hr. / Week Tutorial 1 Hr. / Week	**Credits: 02** Theory Credit: 1 Tutorial Credit: 1	**Examination Scheme** **CAA:** 40 Marks **Oral:** 30 Marks

Course Objectives:

1. To develop effective public speaking styles through conversational and communication skills and also enhance speaking skills by focusing on body language and understanding the situational requirements for effective public speaking
2. To develop students' quantitative, logical and analytical abilities required to solve aptitude-based problems commonly encountered in competitive examinations and also enhance their problem-solving speed, decision-making ability and logical reasoning skills

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

1. Communicate effectively in various public speaking situations and deliver organised and engaging speeches with appropriate body language, voice modulation and confident speech techniques
2. Apply appropriate quantitative, logical, and reasoning strategies to efficiently solve numerical aptitude, data interpretation, and logical reasoning problems with improved speed and accuracy in placement and competitive examination contexts and apply rapid analytical, logical and decision-making strategies to solve time-bound problems with improved accuracy and efficiency

Course Contents:

Unit 1: Essentials and Art of Public Speaking (6 Hours)

Sentence Mastery (Sentence Structure + Subject–Verb Agreement), Verb Tense Control (Past / Present / Future Tenses), Functional Usage (Prepositions + Common Errors & Correct Usage), Verbal & Non-Verbal Communication, Active Listening Skills, Public Speaking & Presentation Skills, Confidence Building, Interpersonal Skills & Relationship Building, Teamwork & Collaboration, Body Language & First Impression, Professional Email, Message & Business Writing, Time Management & Prioritization, Interview Skills & Group Discussion, Workplace Etiquette &

Professional Behavior, Emotional Intelligence & Anxiety Control, Stress Management & Work-Life Balance, LinkedIn Profile & Resume Writing, Mock Interviews & Feedback
Unit 2: Quantitative Aptitude (6 Hrs) Number System, Percentages, Ratio & Proportion, Profit, Loss & Discount, Averages, Time, Speed & Distance, Time & Work + Pipes, Simple & Compound Interest (Basic), Data Interpretation (DI), Data Sufficiency, Seating Arrangement (Linear & Circular), Blood Relations, Coding–Decoding, Syllogisms, Statement–Assumption / Argument

Textbooks & Other Resources:

1. King, Dale. Effective Communication Skills: The Nine-Keys Guidebook for Developing the Art of Persuasion through Public Speaking, Social Intelligence, Verbal Dexterity, Charisma, and Eloquence, Hamatea Publishing Studio, 2020
2. King, Patrick. How to Speak Effectively: Master Communication Skills, Public Speaking and Influence | Improve Conversations, Confidence, and Social and Professional Presentations, and Making an Impact on People, Penguin, 2024
3. Tuhovsky, Tuhovsky. *Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking: 9 (Positive Psychology Coaching),* Createspace Independent Publishing, 2015
4. Aggarwal. R.S., Quantitative Aptitude for Competitive Examinations, S Chand and Company Ltd. 2025

ME23411- COMPUTER AIDED DESIGN & MANUFACTURING		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR: 02 Hrs./Week**	**Theory : 03** **Practical: 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
		Practical Exam : 30 Marks

Prerequisites:

Students should have prior knowledge of Engineering Mathematics (matrices, differential equations), Mechanics and Strength of Materials (stress–strain, equilibrium), basics of Computer Programming (C/Python/MATLAB), and introductory concepts of CAD and Manufacturing processes.

Objectives:

1. Understand **mathematical foundations of geometric modeling** including curves and surfaces.
2. Apply **geometric transformations and coordinate system mapping** for engineering graphics and design.
3. Learn the **basic principles, formulation, and applications of Finite Element Analysis (FEA)** in 1D and 2D problems.
4. Acquire knowledge of **Computer Aided Manufacturing (CAM) systems** and CNC machine fundamentals.
5. Develop skills in **manual CNC part programming** for turning and milling operations.
6. Explore **Automation concepts, Group Technology, FMS, and CAPP** for modern manufacturing systems.

Course Outcomes:

On completion of the course, learner will be able to

CO1: Represent and construct **analytical and synthetic curves and surfaces** (Bezier, B-spline, NURBS) for CAD applications.

CO2: Perform **2D geometric transformations and projections** to manipulate engineering models.

CO3: Formulate and solve **basic 1D and 2D FEA problems** (springs, shafts, trusses, CST elements) including stiffness matrix assembly and boundary conditions.

CO4: Explain the **working principles and programming structure** of CNC machines (lathe and milling).

CO5: Write and simulate **FANUC CNC part programs** for turning, milling, and drilling operations using interpolation and canned cycles.

CO6: Understand the basic concepts of **Generative CAD and Artificial Intelligence in design**, and explain their role in generating optimized design solutions and modern product development applications.

Course Contents

Unit-1: Geometric Modeling	**[06 Hrs.]**
Curves: Curve representation - Cartesian and Parametric space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity (C0, C1 & C2), 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.	
Unit-2: Geometric Transformation	**[06 Hrs.]**
Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear, Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D objects with a maximum of 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-3: Finite Element Analysis (FEA)	**[06 Hrs.]**
Introduction : Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, meshing, p and h formulation, Advantages and disadvantages of FEM [Only theory] One-Dimensional Problem: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Temperature Effects. [Theory + Numerical – composite shaft, spring elements in series and parallel] Trusses: Introduction, 2D Trusses, Assembly of Global Stiffness Matrix [Numerical limited to 4X4 matrix].	

Unit- 4: 2D Finite Element Analysis	[06 Hrs.]

Types of 2D elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain Constant Strain Triangles (CST), Pascal's triangle , primary and secondary variables, properties of shape functions. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), Overview of axi-symmetric elements.

Unit 5: Computer Aided Manufacturing	[06 Hrs.]

Introduction to Computer Aided Manufacturing (CAM), Definition and scope of CAM Importance of CAM in modern manufacturing, CAM in Industry 4.0 and Smart Manufacturing, CAD-CAM integration, Process flow from design to manufacturing, Horizontal and vertical integration, Role of CAM in PLM (Product Lifecycle Management).

Unit-6: Generative CAD and AI in Design	[06 Hrs.]

Introduction to Generative CAD:
Concept of generative design, evolution from traditional CAD modeling to generative CAD. Advantages and limitations of generative design in modern product development.
Generative Design Workflow:
Definition of design space, loads, boundary conditions, material selection and manufacturing constraints. Generation of multiple design alternatives and selection of optimal design.
Artificial Intelligence in Design:
Introduction to the role of Artificial Intelligence in engineering design. AI-assisted design exploration, data-driven design methods, and automated design generation.
AI-Based Design Tools:
Overview of modern AI-enabled design tools such as Autodesk Fusion 360 and SolidWorks.
Applications:
Applications of generative CAD and AI-assisted design in automotive, aerospace, biomedical devices and additive manufacturing.

Text Books:

1. S.S. Rao, The Finite Element Method in Engineering, Elsevier, ISBN: 9780128166470
2. David Hutton, Fundamentals of Finite Element Analysis, McGraw-Hill, ISBN: 9780072922363
3. J.N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill, ISBN: 9780071267618
4. Ibrahim Zeid, CAD/CAM: Theory and Practice, McGraw-Hill, ISBN: 9780071073387
5. P.N. Rao, CAD/CAM: Principles and Applications, McGraw-Hill, ISBN: 9780070681934

Reference Books:

1. O.C. Zienkiewicz & R.L. Taylor, The Finite Element Method, Butterworth-Heinemann, ISBN: 9781856176330
2. Robert D. Cook, Concepts and Applications of Finite Element Analysis, Wiley, ISBN: 9780471356059
3. Thomas H. Cormen et al., Introduction to Algorithms, MIT Press, ISBN: 9780262033848
4. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, ISBN: 9780134605468
5. P.Radhakrishnan, S. Subramanyan & V. Raju, CAD/CAM/CIM, New Age International, ISBN: 9788122431679

Web References (NPTEL)

1. https://onlinecourses.swayam2.ac.in/nou25_me10/preview

2. https://onlinecourses.nptel.ac.in/noc22_me43/preview

3. https://onlinecourses.swayam2.ac.in/cec24_ma21/preview

Guidelines for Lab /TW Assessment

Practical (Minimum 8 Practical must be performed, 8 and 9 are compulsory and any 6 from 1 to 7)

1. 1D Bar Element – Structural Linear Analysis
2. Stress and deflection analysis of 2D truss (FEA).
3. Plate/Shell Element – Structural Linear and Non-Linear Analysis
4. Stress and deflection analysis of Beam (FEA).
5. Modal Analysis – Spring -Mass system, simply supported/Cantilever beam, etc.
6. Thermal Analysis – Static/Transient Analysis
7. Coupled Analysis- (Structural + Thermal)
8. Tool path generation and simulation for Turning – Grooving and Threading with help of suitable software.
9. Tool path generation and simulation for Milling – Facing, Pocketing, Contouring and drilling, etc. with help of suitable software.
10. Demonstration of Generative Design using CAD Software.

Course Activity

Mini Project: "Design → Analysis → Manufacturing Simulation"

- **Task:** Students will

1. **Model simple component** (e.g., a connecting rod, bracket, or gear blank) using CAD software.

2. **Perform FEA** to check stresses/displacements using CST elements or truss elements.

3. **Generate a basic CNC part program** (turning or milling) for the same component.

4. **Prepare a short CAE/CAM report** including geometric modeling steps, FEM results, and CNC code.

ME23412A- MECHATRONICS		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR: 02 Hrs./Week**	**Theory: 03** **Practical: 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites:

Basics of Electrical and Electronics Engineering

Objectives: The course aims to:

1. To introduce the fundamentals of mechatronic systems with emphasis on sensors and actuators.
2. To understand block diagram representation and system integration.
3. To gain knowledge of data acquisition systems, ADC/DAC, and microcontroller basics.
4. To develop skills in PLC programming and industrial automation.
5. To learn modelling and analysis techniques for mechatronic systems.
6. To study PID and continuous control system concepts relevant to mechatronics applications.

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

CO1: Identify and classify various sensors and actuators used in mechatronic systems.

CO2: Construct block diagrams to represent mechatronic subsystems.

CO3: Explain the working of data acquisition systems, ADC/DAC, and microcontrollers.

CO4: Develop ladder logic programs for simple PLC-based automation tasks.

CO5: Model and analyze mechatronic systems mathematically.

CO6: Apply PID control system concepts for the stability and performance evaluation of mechatronic systems.

Course Contents

Unit-1: Introduction to Sensors and Actuators	**[06 Hrs.]**
Sensors: principles, classification, performance characteristics, Measurement of displacement, position, proximity, velocity, acceleration, force, torque, pressure, temperature, flow. Signal conditioning (basic), · Actuators: Electric (DC/AC motors,	

stepper, servo), Pneumatic, Hydraulic, Piezoelectric.

Unit-2: Block Diagram Representation	**[06 Hrs.]**

Basic block diagram representation of mechatronic systems, Open loop and closed loop systems, Functional elements and their interconnections, System examples: Pick and place, CNC machine, automated washing machine, Transfer functions and block diagram reduction, System response and time constants.

Unit-3:Data Acquisition and Microcontroller System	**[06 Hrs.]**

Fundamentals of data acquisition (DAQ), Sampling, quantization, aliasing (basic concepts), ADC (Successive Approximation), DAC (Weighted Resistor), Role of microcontrollers in mechatronics (very brief introduction).

Unit- 4: PLC Programming	**[06 Hrs.]**

Introduction to PLC hardware and software, Input/output modules, interfacing, Basics of ladder logic programming, Simple program for PLC simulation (traffic light control, motor start/stop sequence), Examples: elevator system, bottle filling station. Latching; Timers, Counters; PLC control of Mechatronics systems involving timing and counting operations.

Unit 5: Modelling and Analysis of Mechatronic System	**[06 Hrs.]**

Mathematical modelling of mechanical, electrical, fluid, and thermal systems, Stability concept (Routh-Hurwitz criterion), Time response analysis (first-order and second-order systems), Simulation of mechatronic systems (using MATLAB/Simulink or Automation Studio), and Case study: modelling of a simple electro-mechanical system.

Unit 6: Control System – PID and Continuous Controllers	**[06 Hrs.]**

Introduction to continuous control systems in mechatronics, Proportional (P), Integral (I), Derivative (D) controllers and their effects, PID control system: design, tuning methods, response analysis and Applications of PID control in mechatronic systems (e.g., motor speed, temperature and flow). Manual tuning of PID control, Ziegler–Nichols method.

List of Experiments (08 Total)

1. Study and calibration of displacement sensor.
2. Experiment on measurement of temperature using a suitable sensor.
3. Study of load/displacement/position sensor with signal conditioning circuit.
4. Study of stepper motor/servo motor characteristics.

5. PLC Programming and Simulation – Traffic Light Control (Simple ON/OFF sequence, 3 lights with timers).

6. PLC Programming and Simulation – Automatic Water Tank Level Control (using two level sensors and a pump motor).

7. Modeling and analysis of a mechanical system and its verification using suitable simulation software.

8. PID control of Mechanical System using suitable simulation software.

Textbooks:

1. Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education.

2. C.D. Johnson, Process Control Instrumentation Technology, Pearson Education.

Reference Books:

1. Alciatore D. and Histand M., Introduction to Mechatronics and Measurement Systems, McGraw-Hill.

2. M.D. Ramchandran, Introduction to Control Engineering: Modelling, Analysis and Design, New Age International.

3. D.K. Anand & R.B. Zuniga, Introduction to Control Systems, McGraw-Hill.

Web References:

1. **NPTEL (IITs) Mechatronics Courses:** https://onlinecourses.nptel.ac.in/noc21_me27/preview
2. **MIT Open Course Ware – Mechatronics:** https://ocw.mit.edu/courses/2-737-mechatronics-fall-2014/
3. **All About Circuits (Sensors & Actuators):** https://www.allaboutcircuits.com/
4. **Siemens PLC Learning Resources:** https://new.siemens.com/global/en/products/automation/industry/automation-system-simatic/learning.html
5. **Arduino Official Documentation (for microcontrollers):** https://docs.arduino.cc/
6. **Control Tutorials for MATLAB & Simulink (PID and System Analysis):** http://ctms.engin.umich.edu/

Course Activity :(Any 1 out of 5)

1. Mini project: Development of a PLC-based automation setup.
2. Case study presentation on an industrial mechatronic system (e.g., CNC machine, robotic arm).
3. Seminar on emerging sensors/actuators used in smart manufacturing.

4. Report on simulation-based modelling of mechatronic systems.
5. NPTEL Certification for Mechatronics or its equivalent subject.

ME23412B- PRODUCT DESIGN AND DEVELOPMENT		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR: 02 Hrs./Week**	**Theory: 03** **Practical: 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites

Engineering Drawing and CAD, Manufacturing Processes, Materials and Mechanical Design Industrial product development practices.

Course Objectives

1. To introduce students to the systematic process used in industrial product development.
2. To develop an understanding of customer-driven product design and market analysis.
3. To train students in concept generation, evaluation and selection techniques.
4. To familiarize students with digital design tools, manufacturing considerations and engineering drawings.
5. To introduce design validation, product costing and industrial approval processes.
6. To expose students to modern quality planning tools used in industry.

Course Outcomes

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

CO1: Explain the stages involved in industrial product design and development.

CO2: Identify customer requirements and translate them into engineering specifications.

CO3: Generate and evaluate multiple product concepts using structured design tools.

CO4: Develop product models and engineering drawings considering manufacturing and assembly requirements.

CO5: Apply design verification methods and understand industrial product validation procedures.

CO6: Use quality planning and risk analysis tools for robust product development.

Course Content

Unit-1: Fundamentals of Product Design and Development	**[06 Hrs.]**
Introduction to Product Design and Development, Engineering Design Process, Product Development Concepts, Factors Affecting Product Design, Product Development Models, Team-Based Product Development, Product Success and Failure.	
Unit-2: Market Study and Product Requirement Definition	**[06 Hrs.]**
Product and Market Understanding, Customer Requirement Analysis, Innovation and Design Approaches, Design Information Sources, Product Planning, Technology Forecasting, Customer Need Translation.	
Unit-3: Concept Generation and Selection	**[06 Hrs.]**
Idea Generation Techniques, Product Strategy, Concept Evaluation, Decision Making Tools, Concept Feasibility Analysis, Functional Modelling.	
Unit- 4: Product Architecture and Detailed Design	**[06 Hrs.]**
Digital Product Design, Product Architecture, Engineering Drawing for Product Definition, Bill of Materials, Dimensioning and Tolerancing, Design for Production, Human Factors and Design Review	
Unit 5: Design Verification and Product Validation	**[06 Hrs.]**
Engineering Analysis Tools, Simulation Driven Design, Rapid Prototyping, Product Approval and Certification, Manufacturing Planning, Industrial Decision Making, Industrialization, Product Costing and Validation, Production Approval	
Unit-6: Robust Product Development	**[06 Hrs.]**
Robust Design Concepts, Quality Planning Tools, Cost Optimization, Product Data Management, Industrial Case Studies	

Text Books:

1. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
2. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000.
3. How Products are made by Jocqueline L. Longe

4. Creating Innovative products Using Total Design by Don Clausing and Ron Andrade
5. Metrics and Case Studies for Evaluating engineering designs by Jay Alan Moody
6. Understanding Engineering Design by Richard Birmingham
7. Designing for quality by Robert H. Lochner
8. New Product development by Barclay Z. Dann P. Holroyd
9. Developing an Ergonomics Processes by Alison Heller

Reference Books:

1. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education Inc.
2. Grieves, Michael, Product Lifecycle Management McGraw Hill
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub.
4. Karl Ulrich, product design and development, TMH.

Web References (NPTEL)

1. **Product Design and Development – IIT Roorkee**
   https://nptel.ac.in/courses/112107217
2. **Product Design and Manufacturing – NPTEL**
   https://onlinecourses.nptel.ac.in/noc26_me49/preview
3. **Design Practice – IIT Kanpur**
   https://onlinecourses.nptel.ac.in/noc22_me29/preview
4. **Manufacturing Guidelines for Product Design – IIT Roorkee**
   https://onlinecourses.nptel.ac.in/noc22_me56/preview
5. **Product Design using Value Engineering – IIT Roorkee**
   https://nptel.ac.in/courses/112107282
6. **Design for Manufacture and Assembly (DFMA) – IIT Guwahati**
   https://nptel.ac.in/courses/107103012

Course Activity (10 Marks)

Product Development Activity

1. Students shall select a simple existing product used in daily life and identify major limitations or problems in its current design.
2. Collect feedback from at least five users and list the important customer requirements for improving the product.

3. Perform basic benchmarking by comparing the selected product with two similar products available in the market or online.
4. Generate at least two alternative design concepts using brainstorming and select the best concept using a simple decision table.
5. Prepare a final concept sketch with a brief description of materials and manufacturing method, and submit a detailed report of the activity.

Practical / Laboratory Work (2 Hours per Week) – Oral 30 Marks

List of Practical / Laboratory Experiments (Minimum 08)

1. Study of an existing product to understand its working principle, components, applications and design limitations.
2. Market survey and product benchmarking based on features, material, performance and cost.
3. Customer requirement identification and analysis using survey methods.
4. Concept generation using brainstorming, benchmarking or reverse engineering techniques.
5. Concept evaluation and selection using decision matrix or Pugh concept selection method.
6. Preparation of functional diagram and product architecture.
7. Product design development using hand sketches or CAD modelling and preparation of assembly and part drawings.
8. Preparation of Bill of Materials (BOM) and product documentation.
9. Design risk analysis using DFMEA.
10. Preparation of manufacturing process flow chart and basic cost estimation.

ME23412C- COMPUTATIONAL FLUID DYNAMICS		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR: 02 Hrs./Week**	**Theory : 03** **Practical : 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites: Fundamental knowledge of Fluid Mechanics and Heat Transfer; basic understanding of Thermodynamics; familiarity with Numerical Methods for solving equations.

Objectives:

1. To introduce the fundamentals of computational techniques for solving fluid flow and heat transfer problems.
2. To develop understanding of governing equations of fluid flow and their discretization using numerical methods.
3. To provide exposure to grid generation, boundary conditions, and solution methodologies used in CFD.
4. To enable students to analyze and interpret CFD results for internal and external flows as well as heat transfer applications.
5. To bridge theoretical knowledge with laboratory-based CFD simulations.

Course Outcomes:

On completion of the course, learner will be able to

CO1. Explain the governing equations of fluid flow and heat transfer along with associated assumptions.

CO2. Apply discretization techniques to simple fluid flow and heat transfer problems.

CO3. Demonstrate the ability to generate computational grids suitable for CFD analysis.

CO4. Analyze flow and thermal characteristics for canonical problems such as boundary layer flow, pipe flow, and lid-driven cavity.

CO5. Evaluate CFD results critically by comparing with analytical/experimental data.

CO6. Apply CFD tools to solve practical engineering problems and present results in a professional manner.

Course Contents

Unit-1: Fundamentals of CFD	**[6 Hrs.]**
Introduction to CFD, scope and applications, advantages and limitations. Governing equations of fluid flow: continuity equation, Navier–Stokes equations, and energy equation. Types of boundary conditions: inlet, outlet, wall, no-slip, symmetry, and periodic boundaries. Classification of partial differential equations (elliptic, parabolic, hyperbolic) and their physical significance in fluid flow and heat transfer problems.	
Unit-2: Discretization Techniques	**[7 Hrs.]**
Introduction to discretization and the need for numerical methods. Grid generation methods: structured, unstructured, and hybrid grids. Basics of Finite Difference Method (FDM), Finite Volume Method (FVM), and Finite Element Method (FEM). Discretization of one-dimensional diffusion and convection equations. Time discretization schemes: explicit and implicit methods. Concepts of stability, consistency, and convergence of numerical schemes.	
Unit-3: Solution Methods for Flow Problems	**[6 Hrs.]**
Methods of solving discretized equations for fluid flow. Pressure–velocity coupling algorithms: SIMPLE, SIMPLEC, and PISO methods. Application of CFD to boundary layer flows with simulation of boundary layer development over a flat plate. Fully developed flow through a pipe as a benchmark internal flow problem.	
Unit- 4: External and Internal Flows	**[7 Hrs.]**
Flow characteristics and governing equations for internal laminar flows. Fully developed laminar flow through a circular pipe: velocity profile, pressure drop, and friction factor. External flow over a circular cylinder: boundary layer separation, vortex shedding, and drag/lift characteristics. Introduction to turbulence effects and limitations of laminar flow assumptions. Comparison of analytical, experimental and CFD results for pipe flow and flow over a cylinder.	
Unit 5: Heat Transfer and Buoyancy-Driven Flows	**[6 Hrs.]**
Governing equations for buoyancy-driven flow, Boussinesq approximation, and boundary conditions for natural convection problems. CFD analysis of natural convection in a heated cavity: temperature distribution, flow circulation patterns, and heat transfer characteristics. Heat transfer in concentric pipes: fluid flow and thermal boundary layer development, temperature profiles, and Nusselt number evaluation. Applications of	

natural convection and internal heat transfer analysis in engineering systems.

Unit-6: Applications of CFD and Validation	**[6 Hrs.]**

Lid-driven cavity flow: benchmark problem, flow circulation patterns, use in validating numerical methods. Verification and validation in CFD: importance, methods, and comparison with experimental or analytical results. Sources of error in CFD simulations: discretization errors, modeling errors, and user-related errors. Best practices in CFD modeling: selection of boundary conditions, turbulence models, mesh refinement, and convergence criteria. Industrial applications of CFD in aerospace, automotive, thermal systems, and energy engineering.

Text Books:

1. Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Education.
2. Anderson, J.D., Computational Fluid Dynamics: The Basics with Applications, McGraw-Hill.
3. Patankar, S.V., Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing.
4. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House.
5. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education System.

Reference Books:

1. Ferziger, J.H. and Perić, M., Computational Methods for Fluid Dynamics, Springer.
2. Tu, J., Yeoh, G.H., and Liu, C., Computational Fluid Dynamics: A Practical Approach, Elsevier.
3. Tannehill, J.C., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Taylor & Francis.

Web References (NPTEL)

1. https://onlinecourses.nptel.ac.in/noc25_ch18/preview?utm_source=chatgpt.com
2. https://onlinecourses.nptel.ac.in/noc24_ae23/preview?utm_source=chatgpt.com

Course Activity

Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper.

Guidelines for Lab /TW Assessment

Practical (Minimum 8 Practical must be performed, 1 and 2 are compulsory and any 6 from 2 to 9)

1. Introduction to geometry creation for CFD analysis using basic shapes, sketching, Boolean operations, and CAD import.
2. Introduction to meshing for CFD analysis using structured, unstructured, and hybrid mesh with refinement techniques.
3. Numerical simulation and analysis of boundary layer over a flat plate
4. Fully developed flow through a pipe.
5. CFD analysis of flow over a circular cylinder.
6. CFD analysis of heat transfer in pin fin.
7. Numerical simulation and analysis of 2D square lid driven cavity.
8. CFD analysis of natural convection in a heated cavity.
9. CFD analysis of heat transfer through a concentric pipe

ME23413 A- AUTOMOBILE AND ELECTRIC VEHICLE		
Teaching Scheme:	**Credits: 03**	**Examination Scheme:**
TH:02 Hrs./Week **PR: 02 Hrs./Week**	**Theory : 02** **Practical : 01**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites

- Engineering Mechanics,
- Thermodynamics,
- Basics of Electrical & Electronics Engineering.

Course Objectives

1. To provide fundamental knowledge of conventional automobile systems and emerging EV technologies.
2. To analyze various subsystems like transmission, suspension, steering, and braking.
3. To study EV components such as batteries, motors, controllers, and charging infrastructure.
4. To introduce AI, IoT, and automation in smart and sustainable mobility.

Course Outcomes

At the end of the course, the student will be able to:

- **CO1:** Explain the construction and working of automobile subsystems.
- **CO2:** Analyze EV architecture, powertrains, batteries, and charging systems.
- **CO3:** Apply AI, IoT, and power electronics in vehicles.
- **CO4:** Evaluate future trends, sustainability challenges, and EV policies.

Course Contents

Unit 1: Automobile Systems & Vehicle Dynamics	**(07 Hrs.)**

- **Introduction to Automobiles:** Evolution of vehicles, classification (2W, 3W, 4W, heavy vehicles), vehicle layouts.
- **Transmission Systems:** Clutches (single plate, multi-plate, centrifugal), manual gearboxes, automatic transmissions (CVT, AMT, DCT), drive shafts, differentials.
- **Suspension Systems:** Leaf springs, coil springs, torsion bars, air suspension, independent suspension systems.
- **Steering Mechanisms:** Ackermann and Davis steering geometry, power steering, electronic steering.
- **Braking Systems:** Hydraulic brakes, disc & drum brakes, modern braking (ABS, EBD, traction control).
- **Vehicle Dynamics:** Traction, cornering forces, ride comfort, vehicle handling & stability control.

Unit 2: Electric Vehicle Architecture & Energy Storage	**(07 Hrs.)**

- **Introduction to EVs:** Classification – Battery Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV), Fuel Cell Electric Vehicles (FCEV).
- **EV Architecture:** Series, parallel, series-parallel hybrids; power flow control; comparison with ICE vehicles.
- **Energy Storage Systems:**
  - Batteries: Lead-acid, Nickel-Metal Hydride, Lithium-ion, Solid-state batteries.
  - Battery pack design, charging methods (slow, fast, ultra-fast, wireless).
  - Battery Management Systems (BMS): SOC, SOH estimation, cell balancing.
- **Alternative Storage:** Super capacitors, Hydrogen fuel cells – principle, working, challenges.

Unit 3: Electric Drive Systems & Power Electronics	**(07 Hrs.)**

- **Electric Machines for EVs:**
    - DC Motor, Induction Motor (IM), Brushless DC Motor (BLDC), Permanent Magnet Synchronous Motor (PMSM).
    - Torque-speed characteristics, selection criteria for EV applications.
- **Drive Systems:**
    - Motor controllers: DC-DC converters, inverters, regenerative braking.
    - Controller design for acceleration, regenerative braking, and cruise control.
- **Power Electronics in EVs:**
    - Converters: Buck, boost, bidirectional DC-DC converters.
    - Inverters: VSI, CSI, PWM techniques.
- **Thermal Management:** Cooling systems for motors, batteries, and electronics.

Unit 4: Smart & Sustainable Mobility (AI, IoT, Policy, Future Trends)	**(07 Hrs.)**

- **Artificial Intelligence in Vehicles:** Driver assistance systems (ADAS), autonomous driving levels (L1–L5), AI-based navigation, lane detection, object recognition.
- **Internet of Things (IoT):** Connected vehicles, predictive maintenance, V2V (Vehicle-to-Vehicle), V2I (Vehicle-to-Infrastructure), V2X (Vehicle-to-Everything).
- **EV Charging Infrastructure:** AC/DC charging, smart charging, battery swapping, wireless charging, grid integration, Vehicle-to-Grid (V2G).
- **Policy & Standards:**
    - Indian EV policy & FAME schemes,
    - Global standards: IEC, SAE, IEEE, Bharat EV charger norms.
- **Sustainability Issues:** Battery recycling, second-life applications, green hydrogen, life cycle analysis of EVs.
- **Future Mobility Trends:** Shared mobility, autonomous EVs, smart cities integration.

Textbooks & References

Textbooks

1. **Kirpal Singh**, *Automobile Engineering*, Vol. 1 & 2, Standard Publishers.
2. **M. L. Mathur & R. P. Sharma**, *Internal Combustion Engines*, Dhanpat Rai.
3. **James Larminie & John Lowry**, *Electric Vehicle Technology Explained*, Wiley.
4. **Sandeep Dhameja**, *Electric Vehicle Battery Systems*, Newnes.
5. **Muhammad H. Rashid**, *Power Electronics: Circuits, Devices, and Applications*, Pearson.

Reference Books

1. **Tom Denton**, *Electric and Hybrid Vehicles*, Routledge.
2. **Ibrahim Dincer**, *Sustainable Hydrogen Production and Utilization*, Elsevier.
3. **Wayne W. Saslow**, *Electric Vehicle Engineering*, Springer.
4. Government of India – *EV Policy & Bharat Stage Norms Documents*.

Course Activity (10 Marks)

Smart Vehicle Performance Prediction Using IoT, AI, and Data Analytics: Design a system that monitors and predicts the performance of automobiles and electric vehicles (EVs) using modern technologies like IoT, Artificial Intelligence (AI), Python, and MATLAB. The project should involve collecting real-time vehicle data, analyzing it, and predicting key performance metrics such as speed, battery efficiency, fuel consumption, engine temperature, or remaining driving range.

Practical's Any 8 Experiments

1. Braking Distance Calculator using Python.
2. Gear Ratio vs Vehicle Speed Simulation in MATLAB.
3. Battery Charge–Discharge Simulation in MATLAB.
4. EV Battery Monitoring using Arduino in Tinkercad.
5. Battery Aging and SOH Estimation using Python.
6. Motor Torque–Speed Characteristics Simulation in MATLAB.
7. Regenerative Braking Energy Recovery using Python.
8. PWM Motor Speed Control using Arduino in Tinkercad.

9. Condition Monitoring of Motor using Sensors in Tinkercad.
10. Smart Charging Profile Simulation in MATLAB.

ME23413B- MATERIAL HANDLING SYSTEM DESIGN		
Teaching Scheme:	**Credits: 03**	**Examination Scheme:**
TH:02 Hrs./Week **PR: 02 Hrs./Week**	**Theory : 02** **Practical : 01**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites: Fundamental knowledge of Mechanics of Material, Design of Machine Element, Transmission System Design.

Objectives:

1. To introduce the importance, objectives, and principles of material handling in manufacturing and logistics.
2. To provide knowledge about different types of material handling equipment such as hoists, cranes, conveyors, forklifts, and trucks with emphasis on safe operation.
3. To develop understanding of bulk and unit load handling systems, including modern storage and automated systems.
4. To enable students to analyze selection factors, design considerations, and cost aspects for choosing appropriate material handling systems.

Course Outcomes:

On completion of the course, learner will be able to

CO1: Define the objectives and principles of material handling, and **classify** different types of material handling systems.

CO2: Describe the working of cranes, hoists, conveyors, forklifts, and trucks, and explain safety aspects in their operation.

CO3: Differentiate between bulk and unit load handling systems and **illustrate** the applications of pallets, bins, AGVs, and modern storage systems (AS/RS).

CO4: Analyze the factors affecting equipment selection, apply basic design considerations, and evaluate the cost aspects of material handling systems.

Course Contents

Unit-1: Material handling system	**[06 Hrs.]**
Introduction to material handling, its objectives, importance in manufacturing and logistics, and the basic principles that guide efficient handling. It also includes the classification of handling methods such as manual, mechanized, and automated systems, along with the factors influencing the selection of material handling equipment.	
Unit-2: Material Handling Equipment – Hoisting & Conveying Devices	**[06 Hrs.]**
Introduction of material handling equipment, such as hoisting and conveying devices. working and applications of cranes, hoists, elevators, and various types of conveyors like belt, roller, chain, and screw conveyors. Forklifts and trucks used in industries are also introduced along with safety aspects related to hoisting and conveying operations.	
Unit-3: Bulk & Unit Load Handling Systems	**[06 Hrs.]**
Introduction bulk and unit load handling systems. Bulk material handling equipment such as hoppers, bins, bucket elevators, and pneumatic handling systems are discussed along with unit load handling devices like pallets, containers, and automated guided vehicles (AGVs). This unit also introduces storage systems such as racks, bins, shelving, warehouses, and modern automated storage and retrieval systems (AS/RS).	
Unit- 4: Design, Selection & Economics of Material Handling Systems	**[06 Hrs.]**
Selection, and economics of material handling systems. Key factors that influence equipment selection, such as material type, plant layout, cost, and safety. Design considerations like space, flexibility, and energy efficiency, along with basic cost analysis covering initial, operating, and maintenance costs. Case studies of material handling in manufacturing and logistics industries are included to provide practical exposure.	
Text Books: 1.Ray, A. (2008). *Introduction to Material Handling*. New Delhi: New Age International Publishers. 2.Sharma S.C (1995). Materials Management & Materials Handling New Delhi: Khanna Publishers.	
Reference Books:	

1. N. Rudenko, 'Material Handling Equipment', Peace Publishers
2. James M. Apple, 'Material Handling System Design', John-Wiley and Sons
3. John R. Immer, 'Material Handling' McGraw Hill
4. Colin Hardi, 'Material Handling in Machine Shops'. Machinery Publication Co. Ltd.,
5 .M .P. Nexandrn, 'Material Handling Equipment', MIR Publication,
6. C. R. Cock and J. Mason, 'Bulk Solid Handling', Leonard Hill Publication Co. Ltd.,
7. Spivakovsy, A.O. and Dyachkov, V.K., 'Conveying Machines', Volumes I and II, MIR Publishers,
8. Kulwiac R. A., 'Material Handling Hand Book', John Wiley Publication

Web References (NPTEL)

1. https://onlinecourses.nptel.ac.in/noc22_mm20/preview

Course Activity

Case Study Presentation:

Select one industry (automobile, warehouse, construction site, etc.) and present the material handling equipment used, with photos/diagrams and an explanation of working.

Guidelines for Lab /TW Assessment

Any One Design reports from following:

1. Design of cranes
2. Design of hoists
3. Design of elevators
4. Design of Conveyors

ME23413C- HEATING VENTILATION & AIR CONDITIONING		
Teaching Scheme:	**Credits: 03**	**Examination Scheme:**
TH:02 Hrs./Week **PR: 02 Hrs./Week**	**Theory : 02** **Practical : 01**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks
		Oral Exam: 30 Marks

Prerequisites:

Thermodynamics, Applied Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Objectives:

1. To understand and compare different refrigerants and Vapour Compression Cycle and to evaluate performance of VCC.

2. To understand vapour absorption cycle and to evaluate performance of Multistage compression and evaporator systems.

3. To understand the basic air conditioning processes on psychometric charts, human comfort

and to provide the knowledge of indoor and outdoor air quality requirements.

4. To study the ducts and its design for various comfort conditions and industrial air conditioning systems and to understand advanced A/C systems.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. EXPLAIN the properties, applications and environmental issues of different refrigerants and ANALYSE vapour compression systems.

CO2. EXPLAIN and ANALYSE vapour absorption and multi pressure refrigeration system used for refrigeration applications.

CO3. UNDERSTAND comfort conditions and ESTIMATE cooling load for air conditioning systems.

CO4.DESIGN air distribution system along with consideration of ventilation and infiltration and EXPLAIN the advanced Air conditioning systems.

Course Contents

Unit-1: Refrigerants and Vapour Compression Cycle	**[06 Hrs.]**

Refrigerants:

Classification of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, Alternative refrigerants, refrigerant: recovery reclaims, recycle and recharge.

Vapour Compression Cycle:

Working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC, actual VCC, methods of improving COP using flash chamber, sub-cooling, comparison of VCC with Reverse Carnot cycle.

Major components of refrigeration cycles: Types of Compressors, Evaporators, Condensers and Expansion valves.

Unit-2: Vapour Absorption and Multi Refrigeration Systems	**[06 Hrs.]**

Vapour absorption systems:

Introduction, Working of simple vapour absorption system (VAS), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li- Br absorption system, three fluid systems (Electrolux refrigeration), applications of VAS, comparison between VCC and VAC.

Safety Controls: LP/HP cut-off, Low temperature control, Frost control, Motor overload control, Oil pressure failure control. Capacity controls for different compressors.

Multi Refrigeration systems:

Multistage or Compound Systems: Need of multi staging, Two stage compression with flash gas removal, flash intercooler and complete multistage compression system.

Multi Evaporator Systems: Single compressor-individual expansion valve, Single compressor multiple expansion valve,

Individual compressor-multiple expansion valve, Individual compressor with compound compression and flash inter cooling. (Limited to two evaporators).

Ammonia-CO2 cascade cycle. (Only theoretical approach).

Unit-3: Psychrometry and Air conditioning	**[06 Hrs.]**

Introduction to air conditioning, psychrometric, psychrometric properties and terms, psychometric relations, Psychometric processes and its representation on psychometric chart, BPF of coil, ADP, SHF, RSHF, GSHF, ESHF, ERSHF and adiabatic mixing of two air streams.

Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements.

Heat load estimation: - Air conditioning, factors contributing to cooling load, heating & cooling load calculations.

Envelop Load estimation: Concept of sol-air temperature, Time lag & Decrement method and ETD or CLTD methods.

Unit-4: Ducts and Advanced Air Conditioning Systems	**[06 Hrs.]**

Ducts:

Air handling unit, Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design), Ventilation and infiltration.

Advanced Air Conditioning:

Working of summer, winter and all year round AC systems, all air system, all water system, air water System. Desiccant-Based Air Conditioning Systems: Introduction, Sorbents & Desiccants, Dehumidification, Liquid spray tower, Solid packed tower, Rotary desiccant dehumidifiers, Hybrid cycles, Solid desiccant Air-Conditioning (Theoretical treatment).

Evaporative Cooling Air Conditioning Systems, Thermal storage Air Conditioning systems, clean room Air Conditioning systems, Radiant cooling. (No numerical), Heat pumps and its different circuits.

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd, 1983
3. McQuiston, ― Heating Ventilating and air Conditioning: Analysis and Design‖ 6th Edition, Wiley India
4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi
5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi,1994.
6. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992
7. S.N.Sapali , Refrigeration and Air conditioning, Eastern Economy Edition.

Reference Books:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000.
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi.
4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications.
5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance.
6. ASHRAE & ISHRAE handbook
7. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGrawHill Publications.
8. Wilbert Stocker, Industrial Refrigeration, McGrawHill Publications.
9. ASHRAE, Air Conditioning System Design Manual, IInd edition, ASHRAE.

Web References (NPTEL)

1. https://onlinecourses.nptel.ac.in/noc25_me114/preview

2.https://onlinecourses.nptel.ac.in/noc24_me90/preview#:~:text=ABOUT%20THE%20COURSE:,Category%20:

3. https://onlinecourses.nptel.ac.in/noc21_me106/preview

Activity (Any one)

1. Use tools like mustimeters, refrigerant gauges, and airflow meters to inspect and test HVAC systems and components. Identify and troubleshoot problems such as refrigerant leaks or electrical failures.
2. Work on installing new HVAC systems, including ductwork and electrical components, in different settings.
3. Design complete duct systems and diffusers, using software like Revit MEP, to create comprehensive HVAC layouts.
4. Learn about the four main types of HVAC systems: split systems, hybrid systems, duct-free systems, and packaged heating and air systems.
5. Study the functions of HVAC systems in green buildings, including heating, ventilation, make-up air, cooling, and exhaust.

Guidelines for Laboratory Conduction /TW Assessment

The student shall complete the following activity as a Practical / Termwork

Complete eight experiments and two assignments.

The term work shall consist of minimum 6 experiments and 2 visits out of the following:

1. Test on vapour compression test rig
2. Trail on ice plant test rig and evaluation of EER.
3. Thermal analysis of refrigeration cycle using suitable software
4. Design of cold storage with process layout.
5. Trail on air conditioning test rig
6. Performance Simulation of Central Air-conditioning plant
7. Building heat load simulation using suitable software
8. Visit to Refrigeration or cold storage Plant
9. Visit to any air conditioning plant
10. Installation and servicing of split air conditioner
11. Trial on heat pump/ejector/cascade/desiccant/evaporative systems

ME23414- PROJECT		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
PR: 04 Hrs./Week	**Practical: 04**	**Termwork: 80 Marks**
		Oral: 50 Marks

Prerequisites: Project Based Learning, Internship/Mini Project, Laboratory works, Skill Development, Audit Courses, Industrial Visits.

Course Objectives:

1. To provide students with the opportunity to design and develop a complete system or subsystem in their area of interest, enabling them to acquire specialized skills.
2. To gain practical experience in transforming a novel idea or technique into a functional model or prototype by applying multi-disciplinary knowledge.
3. To cultivate the ability among students to work independently on a chosen topic, problem, or experimentation, and to develop independent thinking skills for drawing meaningful conclusions within the curriculum timeframe under faculty guidance.
4. To foster creative thinking and build confidence by planning, executing, and completing the project through systematic observations, discussions, and informed decision-making.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: IMPLEMENT systems approach for problem-solving and design.

CO2: CREATE and CONCEPTUALIZE a novel idea/technique into a product or prototype.

CO3: ANALYZE and INTEGRATE knowledge in a multi-disciplinary environment.

CO4: COLLABORATE effectively in a team and document all aspects of design work.

CO5: EMPLOY project management techniques for effective implementation.

CO6: EVALUATE and DEMONSTRATE the final product in terms of functionality, design ability, and manufacturability.

Course Contents

Project work in the eighth semester is an integral part of the Term Work. The project work shall be based on the knowledge acquired by the student during the graduation, internship and preferably it should meet and contribute towards the needs of the society.

1. Fabrication of product/testing setup of an experimentation unit/small equipment, in a group.

2. Experimental verification of principles used in Mechanical Engineering Applications

3. Projects having valid database, algorithm, and output reports, preferably software based.

4. Study projects are strictly not allowed.

Project Lab

1. There has to be a Project Lab in the department.

a. It consists of necessary tools required to do a project.

b. Previous projects and their components.

c. Common measuring instruments.

d. Previous years' project reports.

e. Project related books and Publications.

f. Proper linkage with central workshop and various laboratories.

Books and other resources

Web References:

1. SWAYAM-NPTEL Course.

2. MOOCs' Courses.

Guidelines for Project Execution

At the end of the VIth Semester

1. A group of 3-4 students shall be formed according to their suitability.

2. Students will interact with guides for scope and outline of the project.

3. A maximum of two groups will be given to a guide.

4. Guide and Project groups will be finalized at the end of sixth semester so that project work can be started at the start of Seventh semester.

During the VIIth Semester

1. Project topic Identification and Literature review is expected to be done during the VIIth semester.

2. Online Project Topic Identification Presentation is to be taken at the end of the VIIth semester, in which student groups will present their problem statement along with literature review related to the topic.

3. Students can prepare and submit a review paper to a reputed journal/conference based on the literature review completed.

4. Project activities in VIIth semester are to be executed in conjunction with the other courses Research Methodology (Termwork) and Internship.

During the VIIIth Semester

1. Project work/Fabrication/Experimentation is expected to be done in the Project Lab.

2. Projects must be executed in association with industrial experts/facilities.

3. Progress of project work is monitored regularly on weekly project slots/project day.

4. Regular interval presentations are to be arranged to review and assess the work.

5. Project work is monitored and continuous assessment is done by guides and authorities.

Activity

10 marks will be allocated for Participation activities. Students shall prepare and submit a review/research paper to a reputed journal/conference, and are encouraged to file a Patent or Copyright based on their project work. Evaluation will be based on quality, originality, and adherence to publication/IPR standards (10 marks).

Term Work

1. In Project, one topic approval presentation and two reviews shall be taken for total 30 marks (10 marks each)

2. Review I shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.

3. Review II shall be based on the complete project work in front of an expert panel from the department.

4. Evaluation committee shall consist of Guide, One Industry person OR One Faculty appointed by the Institution.

5. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.

● The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

● Recommended performance measure parameters may Include-Problem definition and scope

of the project, Literature Survey, Appropriate Engineering approach used, Exhaustive and Rational Requirement Analysis.

● Comprehensive Implementation - Design, modeling, documentation, Usability, Optimization considerations (Time, Resources, Costing), Thorough Testing, Project Presentation and Demonstration (ease of use and usability), Social and environment aspects.

● The term work under project submitted by students shall include work Diary; Work Diary to be maintained by a group and countersigned by the guide (weekly). The contents of work diary shall reflect the efforts taken by project group for;

a. Searching suitable project work

b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up the project.

c. Brief report of feasibility studies carried to implement the conclusion.

d. Rough Sketches/ Design Calculations

e. Synopsis

● The group should submit the synopsis in the following form.

i. Title of Project

ii. Names of Students

iii. Name of Guide

iv. Relevance

v. Present Theory and Practices

vi. Proposed work

vii. Expenditure

viii. References

● The synopsis shall be signed by each student in the group, approved by the guide (along with external guide in case of sponsored projects) and endorsed by the Head of the Department.

● Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Examination Scheme

1. Examination committee shall consist of Internal Examiner and External Examiner appointed by the Department. (External Examiner shall be a competent Industry/Research/Laboratory person.)

2. Soft copies of the project shall be shared with the examination committee well in advance

● During examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work.

● During the process of monitoring and continuous assessment & evaluation the individual and team performance is to be measured.

● The project term work shall be evaluated on the basis of reviews.

● The final presentation shall be taken in front of external examiner and to be evaluated

for 30 marks

15 marks for presentation (Oral, Written)

15 marks for quality of the project work

Presentation of Project Work

Presentation of work in the form of Project Report (s), Understanding individual capacity, Role & involvement in the project, Team Work (Distribution of work, intra-team communication and togetherness), Participation in various contests, Publications and IPR, Manuals (Project Report, Quick reference, System, Installation guide) among other parameters. Team members with guide information shall be added at the end of the report.

Project Report

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.

2. Plagiarism check is must, and certificate shall be attached in the report.

3. A group activity shall be presented in report.

4. Report copies shall be submitted in the department, one for Department and one for supervisor.

5. For standardization of the project reports the following format shall be strictly followed.

Page size: Trimmed A4

Top Margin: 1"

Bottom Margin: 1.32"

Left Margin: 1.5"

Right Margin: 1"

Para Text: Times New Roman 12-point font

Line Spacing: 1.15 Lines

Page Numbers: Right aligned at footer. Font 12 point Times New Roman

Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students shall attach a standard format of Certificate as described by the department.

2. Certificates shall be awarded to project groups and not individual students of the group.

3. Certificates shall have signatures of Guide, External Examiner, HOD and Principal.

Index of Report

1. Title Sheet

2. Certificate (Institution)

3. Certificate (Company, if sponsored by company)

4. Acknowledgement

5. Abstract of the Project

6. List of Figures

7. List of Photographs / Plates

8. List of Tables

9. Table of Contents

10. Introduction

11. Literature Survey / Theory

12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same

13. Observation Results

14. Discussion on Result and Conclusion

15. Student and Guide details. (A common photograph with project)

References:

References format MUST BE STANDARD – ASME, SAE or IEEE