SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Institute with Empowered Autonomy status
Affiliated to Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur, and Maharashtra
(INDIA)

PROGRAMME SCHEME & SYLLABI

of First Year as per National Education Policy (NEP)
(With effect from Academic Year 2024-25)

B. Tech. (MECHANICAL ENGINEERING)
2024-25

Published By

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Principal

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ISO 9001: 10035 CERTIFIED ORGANISATION

Department Vision (Revision in progress)

Department of Mechanical Engineering aims to inculcate in students, a flair for excellence to become technological leader in industry and society.

Department Mission (Revision in progress)

1. To create the learning environment that stimulates students & faculty to enhance the knowledge in Mechanical Engineering.
2. To prepare the students to carry out research intended to cater the needs of the industry and society.
3. To march ahead with dedication, zeal and with a system responsive to the needs of all the stakeholders.

Program Educational Objectives (Revision in progress)

1. The graduates shall be capable to accept challenges in engineering industries.
2. The graduates shall demonstrate core competency to design, analyze and evaluate various engineering systems.
3. The graduates shall be able to apply computational and professional skills in corporate world.
4. The program shall prepare the graduates for higher studies, entrepreneurship and create awareness about lifelong learning.

Program Outcomes

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Science, Engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, Formulate, Review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
4. **Conduct investigation of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receiveclear instructions.
11. **Project management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team to manage projects and in multidisciplinary environment.
12. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (Revision in progress)

1. Graduates will stand for design, production and operations in core mechanical domain andmanagement of interdisciplinary applications.
2. Graduates will be capable of carrying out the analysis of mechanical and allied systems and provide numerical and computer based solution.

Scheme of Teaching & Examination of Bachelor of Technology
(Mechanical Engineering)
Semester III

Sr. No	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MAT3001	Statistics for Engineers	2	0	0	2	50	50	100	2
2	MDM	MAP3001	Statistics for Engineers	0	0	2	1	25+25	-	50	-
3	PCC	MET3001	Material Science and Testing	2	0	0	2	50	50	100	2
4	PCC	MEP3001	Material Science and Testing Lab	0	0	2	1	25+25	-	50	-
5	PCC	MEP3002	Machine Drawing and CAD Lab	0	0	4	2	25+25	-	50	-
6	PCC	MET3003	Manufacturing Engineering	3	0	0	3	50	50	100	3
7	VSEC	MEP3004	Fab Lab-II	0	0	4	2	25+25	-	50	-
8	OE	MET2980	Open Elective-I **OR** MOOC Course	2	0	0	2	50	50	100	2
9	MGT	HUT3005	Engineering Economics	2	0	0	2	50	50	100	2
10	FP	MEP3005	Field Project- Rural Technology	0	0	4	2	25+25	-	50	-
11	VEC	CHT3001	Environmental Science	2	0	0	2	50	50	100	-
			Total	**13**	**0**	**16**	**21**			**800**	

Open Elective - I	
Course Code	**Course Name**
MET2980-1	Facilities Planning
MET2980-2	Product Design and 3D Printing
MET2980-3	Mechanical Engineering in Daily Life

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester V

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MET5001	Robotics and Mechatronics	2	0	0	2	50	50	100	2
2	MDM	MEP5001	Robotics and Mechatronics Lab	0	0	2	1	25+25	-	50	-
3	PCC	MET5002	Design of Machine Elements	3	0	0	3	50	50	100	3
4	PCC	MEP5002	Design of Machine Elements Lab	0	0	2	1	25+25	-	50	-
5	PCC	MET5003	Manufacturing Technology and Processes	3	0	0	3	50	50	100	3
6	PCC	MEP5003	Manufacturing Technology and Processes Lab	0	0	2	1	25+25	-	50	-
7	PCC	MET5004	Instrumentation and control	3	0	0	3	50	50	100	3
8	PCC	MEP5004	Instrumentation and control Lab	0	0	2	1	25+25	-	50	-
9	PSE	MET5005	Program Specific Elective-I (List Specified)	3	0	0	3	50	50	100	3
10	OE	MET3980	Open Elective-III **OR** MOOC Course	3	0	0	3	50	50	100	3
			Total	**17**	**0**	**8**	**21**			**800**	

Program Specific Elective – I			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET5005-1	Mechanical Electrical & Plumbing	MET5005-5	Data Visualization Tools
MET5005-2	Automotive Powertrains	MET5005-6	Digital Twins & Cyber Physical Systems
MET5005-3	Advanced Materials & Composites	MET5005-7	Machine Learning for Mechanical Engineering
MET5005-4	Manufacturing Execution Systems	MET5005-8	Ancient Indian Machines

Open Elective - III	
Course Code	**Course Name**
MET3980-1	Electric Vehicle Technology
MET3980-2	Robotics and Drone Technology
MET3980-3	Heating Ventilation & Air-Conditioning

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester VII

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MET7001	PLC & Industrial Control System	2	0	0	2	50	50	100	2
2	MDM	MEP7001	PLC & Industrial Control System	0	0	2	1	25+25	-	50	-
3	PCC	MET7002	Applied Thermal Engineering	3	0	0	3	50	50	100	3
4	PCC	MEP7002	Applied Thermal Engineering Lab	0	0	2	1	25+25	-	50	-
5	PSE	MET7003	Program Specific Elective-IV (List specified)	3	0	0	3	50	50	100	3
6	PSE	MET7004	Program Specific Elective-V (List specified)	3	0	0	3	50	50	100	3
7	PSE	MEP7004	Program Specific Elective-V Lab (List specified)	0	0	2	1	25+25	-	50	-
8	PSE	MET7005	Program Specific Elective-VI (List specified)	3	0	0	3	50	50	100	3
9	PSE	MEP7005	Program Specific Elective-VI Lab (List specified)	0	0	2	1	25+25	-	50	-
10	PBL	MEP7006	Project Based Learning (Project stage-1)	0	0	8	4	100	100	200	3
			Total	**15**	**0**	**14**	**22**			**900**	

Program Specific Elective-IV			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7003-1	Artificial Intelligence	MET7003-7	Power Plant Engineering
MET7003-2	Micro Fluidics	MET7003-8	Six Sigma Management
MET7003-3	Micromachining	MET7003-9	Motion Control Systems
MET7003-4	Wealth Creation & Management	MET7003-10	Elements of Marine Engineering
MET7003-5	Armament Technology in Defence	MET7003-11	Space Technology
MET7003-6	Introduction to Corporate Law Practice	MET7003-12	Standards and Certification Processes

Program Specific Elective – V with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7004-1	Augmented Reality & Virtual Reality	MEP7004-1	Augmented Reality & Virtual Reality Lab
MET7004-2	Computational Fluid Dynamics	MEP7004-2	Computational Fluid Dynamics Lab
MET7004-3	Supply Chain Management	MEP7004-3	Supply Chain Management Lab
MET7004-4	Industrial Robotics	MEP7004-4	Industrial Robotics Lab
MET7004-5	Operations Research & Optimization	MEP7004-5	Operations Research & Optimization Lab
MET7004-6	Unmanned Aerial Systems (UAS)	MEP7004-6	Unmanned Aerial Systems (UAS) Lab
MET7004-7	Enterprise Resource Planning	MEP7004-7	Enterprise Resource Planning Lab
MET7004-8	National Accreditation Board for Testing and Calibration Laboratories	MEP7004-8	National Accreditation Board for Testing and Calibration Laboratories Course Lab
MET7004-9	Non-Destructive Testing	MEP7004-9	Non-Destructive Testing Lab

Program Specific Elective - VI with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7005-1	Product Lifecycle Engineering	MEP7005-1	Product Life Cycle Engineering Lab
MET7005-2	Refrigeration & Air Conditioning	MEP7005-2	Refrigeration & Air Conditioning Lab
MET7005-3	Stress Analysis	MEP7005-3	Stress Analysis Lab
MET7005-4	Field and Service Robots	MEP7005-4	Field and Service Robots Lab
MET7005-5	Noise Vibration & Harshness	MEP7005-5	Noise Vibration & Harshness Lab
MET7005-6	Work System Design	MEP7005-6	Work System Design Lab

Scheme of Teaching & Examination for Bachelor of Technology
List of Multi-Disciplinary Minors (MDM) - Automation
(Mechanical Engineering)

Semester	Code	Name of the course	L	T	P	Cr
III	MAT3001	Statistics for Mechanical Engineering	2	0	0	2
III	MAP3001	Statistics for Mechanical Engineering Lab	0	0	2	1
IV	MET4001	Numerical Methods	1	0	0	1
IV	MET4001	Numerical Methods Lab	0	0	2	1
V	MAT5001	Robotics and Mechatronics	2	0	0	2
V	MAP5001	Robotics and Mechatronics Lab	0	0	2	1
VI	MET6001	Robotic Process Automation	3	0	0	3
VII	MET7001	PLC & Industrial Control System	2	0	0	2
VII	MEP7001	PLC & Industrial Control System	0	0	2	1
		Total	**10**	**0**	**8**	**14**

Semester III

Department of Mechanical Engineering

Course Code: MAT3001 **Course: Statistics for Engineers**

L: 2Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 2**

Course Pre-requisite: Basics of Probability and statistics**.**

Course Objective:
The objective of this course is to expose student to understand the basic importance fundamental principles of probability, including probability distributions, random variables, basic statistical methods used for data analysis, inferential statistics, hypothesis testing, confidence intervals, and regression analysis in Mechanical Engineering.

Course Outcomes
On successful completion of the course, student shall be able to:

CO1. Grasp the meaning of discrete and continuous random variables, probability distribution. Interpret the meaning of probabilities derived from distributions. This involves understanding what the calculated probabilities represent in practical terms and drawing conclusions from the results.
CO2. Understand sampling distribution and can use appropriate sampling distribution for estimating the parameters of population.
CO3. Understand the fundamental concept of hypothesis testing, including the null hypothesis (H0) and alternative hypothesis (H1), significance levels, p-values, and the basic logic behind hypothesis testing.

Syllabus

Module 1: Probability Distribution (9 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 2: **Sampling, sampling Distributions and Estimation:** (9 hours)
Introduction to sampling, sampling with and without replacement, introduction to sampling distributions, sampling distribution of means, sampling distribution of proportion, standard errors. Central limit theorem, Introduction, point estimates, interval estimates, confidence intervals, p-value, calculating interval estimates of the mean from large samples, calculating interval estimates of the proportions from large samples, interval estimates using the t distribution.

Module 3: Testing of Hypothesis (**9 hours)**
Testing of Hypothesis for single mean and proportion, Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit, F-distribution.

Text Books:

1. M R. Spiegal , Theory and Problems of probability and statistics ,2nded : Schaum series
2. S. Ross, A First Course in Probability and Statistics, 6th Ed., Pearson Education India, 2002.

Reference Books:

1. Maurtis Kaptein, Statistics for data science, An introduction to probability, statistics and Data Analysis, Springer 2022.
2. Jay L Devore,Probability and Statistics for Engineering and sciences, 8th edition, Cenage learning.

Semester III

Department of Mechanical Engineering

Course Code: MAP3001 **Course: Statistics for Engineers Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Pre-requisite: Basics of Probability and statistics**.**

Course Objectives:

The Statistics for Engineer Lab course will consist of experiments demonstrating the principles of Statistics relevant to the study of Science and Engineering. Students will show that they have learnt Laboratory skills that will enable them to various aspects of Mechanical Engineering, ranging from data analysis and quality control to experimental design and risk assessment, enabling engineers to make informed decisions, improve processes, and design reliable systems. On successful completion of the course students shall be able to:

Course Outcomes:

By using open source software-R Students will be able to

CO1. Analyze the data and identify patterns, trends, and outliers.
CO2. Make inferences about population parameters based on sample data.
CO3. To compare observed results with expected results**.**
CO4. Analyse experimental data, identify significant factors, and make informed decisions to improve processes, products, and systems by using Annova test.
CO5. Predictions about future outcomes based on historical data which is useful in forecasting demand, estimating product performance, or predicting system behaviour.
CO6. Apply the statistical concepts to analyze the data and give appropriate decision.

Mapping of Course Outcomes (COs) with Experiments

Exp. No.	Name of Experiments	Mapped COs
1	To use R software for visualization of data.	CO1
2	Testing of Hypothesis for large sample Test	CO2
3	Testing of Hypothesis for small sample Test	CO2
4	Chi-square test	CO3
5	Analysis of Variances	CO4
6	Estimation of Simple correlation and regression model, significance and confidence interval	CO5
7	Estimation of Multiple correlation and regression model, significance and confidence interval	CO5
8	Case study Project	CO6

Text Books:

1. Peter Daalguard , Introductory Statistics with R , Springer 2022.
2. M R. Spiegal, Theory and Problems of probability and statistics :,2nded :,Schaum series
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books:

1. Maurtis Kaptein, Statistics for data science: An introduction to probability, statistics and Data Analysis, Springer 2022.
2. Jay L Devore,Probability and Statistics for Engineering and sciences, 8th edition, Cenage learning.

Semester III

Department of Mechanical Engineering

Course Code: MET3001 **Course: Material Science and Testing**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Outcomes:
The expected learning outcome is that the students will be able to:

CO1. Understand the fundamentals of various engineering materials and their crystal structure.
CO2. Interpret and explain the phase diagram and make use of this knowledge to illustrate the Iron carbide equilibrium diagram.
CO3. Understand the composition of alloy steel, copper, aluminum, Nickel, Titanium alloys.
CO4. Estimate Mechanical properties of engineering materials using various tests.

Unit I: Structure of materials: crystal structure, space lattice structure. Imperfection in crystal, strengthening mechanisms and slip systems, critically resolved shear stress, Mechanism of plastic deformation. Introduction to Pure metal and alloys, composite materials, Ceramics and Polymers.

Unit II: Cooling curve of pure metal and alloy, Iron Carbon equilibrium diagram, types of steel, heat treatment of steel, solidification of steel, microstructure development. Types of cast Iron, Cast Iron-production processes, Micro structural details.

Unit III: Introduction to alloying of steel, stainless steel and tool steels, Copper and copper alloys, Aluminum and Its alloys, Nickel based super alloys and Titanium alloys, Magnesium and its alloys.

Unit IV: Mechanical Property measurement: Tensile, compression and torsion tests; concept of true and engineering stress-strain curves, Hardness test: Rockwell, Brinell and Vickers tests. Impact test, Fatigue test, creep test. Introduction to nondestructive testing (NDT).

Some of The topics shall be delivered by expert from industry.

Text Books:

1. V. D. Kodgire & S. V. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House.
2. L. Krishna Reddy, Principles of Engineering metallurgy , New Age International Publishers

Reference Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering', Prentice Hall of India Private Limited, 1999. 4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.
4. Sindney H Avner, Introduction to Physical Metallurgy, Mc-Graw Hill Education (India) Pvt. Ltd.

Semester III

Department of Mechanical Engineering

Course Code: MEP3001 **Course: Material Science and Testing Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Outcomes

CO1. Ability to identify phases and composition of various alloys by metallographic examination using metallurgical microscope.
CO2. Ability to get hands on experience on various heat treatment processes.
CO3. Ability to measure hardness and toughness of engineering materials.
CO4. Ability to understand working, principle and utilization of UTM to derive various material properties.

The laboratory will have following Practical:

Name of Experiment:

1. To study the Metallurgical Microscopes and Preparation of specimen for metallographic examination.
2. Micro-structural examination of different types of Steels.
3. Micro-structural study of White Cast Iron and Grey Cast Iron and Micro-structural study of Malleable Cast Iron and Nodular Cast Iron.
4. To study the effect of normalizing on properties of steel.
5. To study the effect of annealing on properties of steel.
6. Effect of hardening process on properties of steels.
7. Measurement of hardness with the help of Rockwell Hardness Tester.
8. Measurement of hardness with the help of Brinell Hardness Tester.
9. Determination of tensile properties of ductile material.
10. Determination of impact properties by Izod /Charpy test.

Semester III

Department of Mechanical Engineering

Course Code: MEP3002 **Course: Machine Drawing and CAD Lab**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

Course Objectives

1. To develop an ability to construct assembly and disability of machine and its components considering limits, fits and dimensioned tolerances as idell of geometric toleranced to components and assemblies on Engineering Drawings.
2. To develop an ability to create solid models of machine component and assembly.

Course Outcomes

1. Ability to select standard machine elements as per the standards.
2. Ability to draw and read production drawings.
3. Ability to use the Drafting and Design package e.g. Catia V6.
4. Ability to model machine components using geometric modeling software and able to construct detailed draft views of part or assembly

Syllabus

UNIT 1:
Conventional representations of standard machine elements like: Bolts, Nuts, Washers, Rivets, and Keys & Couplings. Selection of standard machine elements. Thread terminology, Types of Threads & their representations. Machining Symbols.

UNIT 2:
Limits: Terminology Fits: Types & Applications of fits. Dimensional Tolerance, Geometrical Tolerance. Tolerance Grades & Tolerance Charts, calculations of dimensional tolerance.

UNIT 3:
Assembly and Dismantling Principles: Study of some Standard Assemblies. Subassembly Drawing, Full Assembly Drawing, Exploded Views. Preparation of Bill of material. Production drawing preparation.

UNIT 4: Part modeling and assembly
Module-1 Introduction to modeling and basic concepts , Using solid modeling software interface Selecting and Editing, Sketcher geometry. Creating datum Features: Planes and Axes.

UNIT 5:
Creating datum Features: Planes and Axes , Creating extrudes, Revolves and Ribs ,Creating sweeps and blends (geometric features),Creating holes, shells and drafts, Creating rounds, chamfers ,Copy and mirror tools (Editing features)),Creating patterns. Module -2 Assembling with constraints, exploding assemblies

UNIT 6:

Detailing of Drawings, Introduction to drawings, Creating new drawings and views, Adding details to drawings, Adding notes to drawings, Adding tolerance and symbols

Text Books

1. Machine Drawing by N. D. Bhat, Charotar Publications
2. Machine Drawing by K.L.Narayan, R. Kannaiah, K.V.Reddy, New Age Int. Publishers

Reference Books

1. Machine Drawing by R. K. Dhawan, S. Chand Publications
2. Machine Drawing by P. S. Gill, S. K. Kataria & Sons
3. Engineering Drawing Practice for Schools & Colleges (SP-46:1988): Bureau of Indian Standards.
4. SP46 : 2003, Indian Standards.

Semester III

Department of Mechanical Engineering

Course Code: MET3003 **Course: Manufacturing Engineering**

L: 3 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 3**

Course Objectives:

The objective of the course is:

1. To familiarize and get acquainted with major manufacturing process and required Machine tools.
2. To identify, discuss and select the appropriate process, associated machine and equipment for manufacturing required product.

Course Outcomes:

The expected learning outcome is that the students will be able to:

CO1. Analyze the various casting techniques and patterns suitability for different types of casted components.
CO2. Identify the machining parameters, cutting tool materials and cutting fluids for various machining operations.
CO3. Distinguish with constructional details, mechanisms involved and working principle of various production machines.
CO4. Analyze the suitability of hot and cold working methods for the manufacturing of metal components.
CO5. Apply the knowledge of suitable joining processes to carry out fabrication work.
CO6. Identify and select the suitable unconventional machining process with its working principle for a given application.

Syllabus:

Unit - I

Mould making and Casting - Types of sand moulding, moulding machines & moulding procedure, moulding sand – types, properties, composition and applications, casting defects.

Pattern making - Types, material, allowances, core – types, materials and its properties. Special Casting Processes - Investment casting, centrifugal casting, shell moulding.

Unit - II

Metal Cutting : Single and multi-point cutting, chip formation, Tool wear and tool life, Surface finish and integrity, Cutting fluids, Cutting tool materials and machinability.

Lathe: Introduction, type, specification, construction, work holding devices & tools, mechanism and attachments for various operations, taper turning, thread cutting operations on Lathe.

Unit - III

Shaper: Introduction, type, specification, Quick return Mechanisms, Table feed mechanism, work holding devices, shaper operations.

Milling Machine: Introduction, specification, types, mechanisms and attachments for milling, milling operations, Indexing-simple, compound and differential.

Unit - IV

Forming Processes : Fundamentals of hot and cold working processes, Smithy and forging operations plastic deformation and yield criteria, bulk forming (rolling, extrusion, drawing) and sheet forming (shearing, deep drawing bending)

Unit - V

Welding: Principles of Welding, classification and types, arc welding, TIG and MIG processes and their parameter selection, welding of cast iron, welding electrode – types, composition, specification. Resistance Welding, Principle, equipment and processes, Gas welding, brazing & soldering.

Unit - VI

Unconventional Machine Processes: Characteristics, operation, applications, limitations and selection of processes parameters of Abrasive Jet Machining, Ultrasonic Machining, Plasma Arc Machining, die sink and wire EDM and Laser Beam Machining.

Text Books

1. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.

2. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Reference Books

1. Kalpakjian and Schimd, Manufacturing processes for engineering materials, 5th Edition - Pearson India, 2014.

2. Mikell P. Groover, Fundamentals of Modern Manufacturing : Materials, Processes, and System.

Semester III

Department of Mechanical Engineering

Course Code: MEP3004 **Course: Fab lab-II**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

Course Objectives:
The Objective of the course is:

1. To familiarize with major manufacturing process and required Machine Tools.
2. To get acquainted with and hands on experience on machine tools and equipments.

Course Outcomes: The expected learning outcome is that the students will be able to:

CO1. Perform different machining operations on lathe drilling, shaper and milling machine.
CO2. Understand the basic components of CNC machines and part programming features.
CO3. Understand principle and working of unconventional machining process.
CO4. Prepare a sand mould and identify various casting process operational characteristics.

List of Experiments:

1. Practical on lathe machine to perform operations for turning, facing, step turning, taper turning and threading.
2. Practical on milling machine for spur gear cutting.
3. Practical on Shaper machine to perform operations for horizontal and inclined surface, slotting
4. CNC machines set up and part programming features.
5. CNC Turning machine introduction, demonstration and part programming features.
6. CNC milling machine introduction, demonstration and part programming features.
7. Unconventional machining demonstration and operations on Electric Discharge Machining.
8. Unconventional machining demonstration and operations on Laser cutting.
9. Mould preparation and casting of metals after preparation of suitable moulds.
10. Study of various casting defects & observations of the actual casting.
11. 3D Printing: Demonstration.

As per availability virtual lab session to be conducted.

Text Books

1. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
2. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Reference Books

1. Kalpakjian and Schimd, Manufacturing processes for engineering materials, 5th Edition - Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and System.

Semester III

Department of Mechanical Engineering

Course Code: HUT3005 **Course: Engineering Economics**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course objective

The course aims to equip engineering students to understand the core concepts of Economics in order to bring efficiency in engineering projects/endeavours.

Course Outcomes

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

CO1. Understand the basic concepts of engineering economics.
CO2. Evaluate the strategic role of engineers in business and engineering economic decision making
CO3. Understand revenue and cost concepts in different market structure for better decision-making.
CO4. Evaluate various forces impacting price and output in difference market.
CO5. Review the elements of financial statements.
CO6. Discuss and interpret the role and functioning of financial institutions and markets.

Syllabus

Unit 1: Foundation of Engineering Economics:

Definition of Economics, basic concepts of Economics (value, goods, wealth, income, savings, utility); definition and scope of engineering economics; **demand and supply:** Laws and elasticity.

Unit 2: Engineering Economic decision:

Rational decision-making process, Engineer's role in business, types of strategic engineering economic decisions, fundamental principles in engineering economics, methods to evaluate business and engineering projects (the teacher can take up one method from the book).

Unit 3: Cost and Revenues:

Revenue concepts: Marginal Revenue, Average revenue, operating and non-operating revenue;
Cost concepts: Marginal cost, Average cost, Sunk cost, Opportunity cost, Recurring cost, Non-recurring cost, Incremental cost, Cash cost, Book costs, life cycle cost, direct and indirect costs. Application of the concepts in business/industry.

Unit 4: Money Management:

Time value of money; interest – types and formulas;
Inflation: types, causes, inflation adjusted decisions; Break-even analysis, measures of inflation - Index numbers.

Unit 5: Basic Accounting: Balance sheet, Income Statement, Ratio analysis, Depreciation.
Financial markets: Call Money, Treasury Bills, Bond, Stock, Derivatives.

Books:

1. Panneerselvam. R., (2020) *Engineering Economics*, PHI learning, private limited, Delhi, 2nd ed.
2. Park.C., (2018) *Fundamentals of Engineering Economics*, Pearson India Education Services, Pvt. Ltd, 3rd ed.
3. Dewett.K.K. (2006), *Modern Economic Theory*, S. Chand, New Delhi, 2006.
4. Bhole, L.M. and Jitendra Mahakund (2017), *Financial Institutions and Markets*, Tata McGraw Hill (2007) 6th ed.
5. Chandra, Prasanna (2008) *Financial Management: Theory and Practise*, Tata MacGraw Hill Publishing Company Limited, New Delhi

Reference Books:

1. Ahuja H.L., (2017) *Managerial Economics, Analysis of managerial Decision making*, S. Chand and company Limited, New Delhi, 9th ed.
2. Dwivedi, D.N., *Managerial Economics*, Vikas Publishing House Pvt. Ltd, Nodia (2015) 8th ed.
3. Peterson, H. Craig and Lewis, W.Chis. & Jain. Sudhir K., *Managerial Economics*. Prentice Hall of India (2008) 4th ed.

Semester III

Department of Mechanical Engineering

Course Code: MEP 3005 **Course: Field Project (FP) - Rural Technology**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

Course Description:
This course offers students a unique, hands-on experience with the design, development, and deployment of technology solutions aimed at addressing challenges faced by rural communities. Through a combination of fieldwork, research, and collaborative projects, students will learn to apply their technical knowledge and innovative thinking to real-world problems, promoting sustainable development and improving living conditions in rural areas.

Course Objectives:

1. To introduce students to the socio-economic and environmental challenges faced by rural communities.
2. To develop an understanding of how technology can be applied to solve real-world problems in rural settings.
3. To enhance students' skills in project design, management, and implementation in the context of rural technology.
4. To foster interdisciplinary collaboration, community engagement, and ethical consideration in the development and deployment of technologies.
5. To encourage reflective practice and critical thinking about the impact of technology on rural development.

Syllabus:

Week 1-2: Introduction to Rural Technology- Overview of rural development challenges, Role of technology in empowering rural communities, Case studies of successful rural technology projects,

Week 3-4: Identifying Needs and Challenges- Field visits to rural areas (subject to logistics and safety considerations), Participatory approaches for engaging with rural communities, Methods for identifying and assessing needs and challenges

Week 5-6: Designing Solutions & Project Planning and Management - Principles of sustainable technology design Introduction to appropriate technology and its application. Design thinking workshops for rural technology solutions, - Basics of project planning and management tailored to rural settings, Stakeholder analysis and community involvement, Resource allocation, budgeting, and timelines

Week 7-8: Implementation Strategies and Impact Assessment-Strategies for technology implementation in rural areas, Training and capacity building for local stakeholders, Monitoring and evaluation techniques Methods for assessing the social, economic, and environmental impact of technology projects, Data collection and analysis, Case studies on measuring impact in rural technology projects

Week 9-10: - **Project Work and Presentations-** Students work in teams on assigned projects, mentorship and feedback from instructors and local partners, Final Presentations of field projects to a panel including faculty, community representatives, and potential stakeholders. Reflections, Reflective discussions on lessons learned, challenges faced, and potential for future work

Textbooks and Resources:

Designing Technology for Social Impact: A Guide for Practitioners by Sarah R. Davies (Editor)
Additional readings, case studies, and resources will be provided online or in-class.

Delivery Methods:

1. Lectures and Seminars: For theoretical understanding and introduction to case studies.
2. Field Visits: Direct engagement with rural communities for needs assessment (subject to safety and logistical considerations).
3. Workshops: Hands-on sessions on design thinking, project planning, and implementation strategies.
4. Group Projects: Collaborative work focused on developing and proposing solutions to identified challenges.
5. Presentations: Formal presentation of project work and findings.

Mode of Evaluation (both internal & external components):

1. Participation and Engagement (10 Marks): Active participation in discussions, workshops, and field visits.
2. Assignments and MCQs (10 Marks): Based on lectures, readings, and field observations.
3. Writing Project Proposal (10 Marks): Evaluation of a comprehensive project proposal developed by student teams.
4. Final Presentation (10 Marks): Assessment of the final project presentation, including the proposed solution's feasibility, sustainability, and impact.
5. Reflective Essays (10 Marks): Individual essays reflecting on the learning experience, challenges faced, and personal growth during the course.

Semester III

Department of Mechanical Engineering

Course Code: CHT3001 **Course: Environmental Science**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Outcomes:
After completion of this unit, students would be able to:

CO1. Develop an understanding of pollution and its types.
CO2. Learn about different kinds of sources of pollution.
CO3. Explain sustainable development, its goals, targets, challenges and global strategies for sustainable development
CO4. Understand different methods of assessing environmental quality and associated risks.

Syllabus

Unit 1: Environmental Pollution I

Air pollution: Sources of air pollution; Primary and secondary pollutants; carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; other important air pollutants. Indoor air pollution; adverse health impacts of air pollutants; National Ambient Air Quality
Water pollution: Sources of water pollution; marine pollution and groundwater pollution; Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life, treatment scheme for waste water from different industry.

Unit 2: Environmental Pollution II

Soil pollution and solid waste: Soil pollutants, hazardous wastes and their sources; Impact on human health. Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.
Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health, recent advances in noise pollution control and benefits.
Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit 3: Environmental Sustainability

Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs
Green Technology: goals and significance, sustainability
Green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation.

Unit 4: Environmental laws and regulation

Introduction to environmental laws and regulation: Constitutional provisions- Article
48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.

Environmental management system: ISO 14001
Environmental audit and impact assessment; Environmental risk assessment Pollution control and management.

Reference Books:

1. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P Aarne Vesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth-Heinemann
4. P.T. Anastas & J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press.
5. Environmental Pollution and its control Techniques by Dr. S.S. Dara.

Semester III

Department of Mechanical Engineering

Course Code: MET2980-1 **Course: Facilities Planning**
L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objective: To maximize the efficient use of physical space within facilities. Effective space utilization involves planning, configuring, and managing space to accommodate current and future needs while minimizing waste.

Course Outcome:
At the end of this course students will demonstrate the ability to:

1. Understand fundamentals of facilities planning, including its importance, principles, and key components.
2. Analyze different types of facility layouts, such as process, product, cellular, and fixed-position layouts, and to understand their applications and implications.
3. Equip with the knowledge and tools necessary to optimize resource utilization within facilities, including space, equipment, and personnel.
4. Introduce to lean principles and methodologies and demonstrate how they can be applied to facilities planning to improve efficiency, minimize waste, and enhance productivity.
5. Familiarize students with the use of technology and software tools in facilities planning, including CAD (Computer-Aided Design) software, simulation tools, and other relevant technologies.
6. Encourage students to critically evaluate the sustainability and environmental impact of facilities planning decisions, and to explore strategies for integrating sustainability principles into facility design and management.

Unit 1: Introduction to Facilities Planning: Understand the importance of facilities planning in various industries. Identify the key elements and principles of facilities planning. Analyze the role of facilities planning in optimizing resource utilization. Evaluate case studies to illustrate the significance of effective facilities planning. Explore the relationship between facilities planning and overall organizational efficiency. Discuss emerging trends and challenges in facilities planning.

Unit 2: **Facility Location Analysis:** Analyze different methods and techniques for facility location analysis. Apply quantitative and qualitative factors in determining optimal facility locations. Evaluate the impact of location decisions on operational efficiency and cost. Interpret location models and algorithms to support decision-making processes. Explore case studies and real-world examples of successful facility location strategies. Discuss the implications of globalization on facility location decisions.

Unit 3: Layout Planning and Design: Understand the principles and objectives of layout planning and design. Analyze different types of layouts, such as process, product, cellular, and fixed-position layouts. Apply quantitative techniques, such as flow analysis and space utilization, in layout design. Evaluate the role of technology and automation in modern layout planning. Explore case studies to illustrate effective layout planning strategies across industries. Discuss the importance of ergonomic considerations in layout design.

Unit 4: Material Handling Systems: Identify the components and functions of material handling systems. Analyze different types of material handling equipment and their applications. Evaluate material flow patterns and efficiency in warehouse and distribution environments. Apply principles of logistics and supply chain management in material handling systems. Explore case studies to illustrate best practices in material handling system design. Discuss emerging technologies and trends in material handling systems.

Unit 5: **Facility Design and Maintenance:** Understand the principles of facility design and its impact on operational performance. Analyze factors influencing facility design decisions, such as capacity, flexibility, and sustainability. Evaluate strategies for optimizing facility layout and design to enhance productivity. Discuss the importance of preventive and predictive maintenance in facility management. Explore case studies to illustrate effective facility design and maintenance practices. Discuss the role of energy management and environmental sustainability in facility operations.

Unit 6: Facility Planning and Management Software: Familiarize with various software tools and technologies used in facilities planning and management. Develop proficiency in using CAD (Computer-Aided Design) software for layout planning and design. Explore simulation software for modeling and optimizing facility processes. Evaluate the capabilities and limitations of different facility planning software applications. Apply software tools to analyze and improve facility performance. Discuss ethical considerations and data security issues related to facility planning software.

References:

Text Books:

1. Facilities Planning by James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, Publisher: Wiley
2. Facility Layout and Location: An Analytical Approach, by Sanjay Kumar, Publisher: CRC Press.
3. Operations Management, by Nigel Slack, Alistair Brandon-Jones, and Robert Johnston Publisher: Pearson Education Limited.
4. Introduction to Material Handling Systems, by David O. Chikwendu, Publisher: CRC Press
5. Plant Layout and Material Handling by G. K. Agrawal

Reference Books:

1. Facilities Design, by Sunderesh S. Heragu, Publisher: CRC Press.
2. Facilities Planning and Design by Alberto García-Díaz and Juan Llorens-Montes Publisher: Springer
3. Facilities Planning by James A. Tompkins, John A. White, Yavuz A. Bozer and J. M. A. Tanchoco, Publisher, Wiley

Semester III

Department of Mechanical Engineering

Course Code: MET2980-2 **Course: Product Design and 3D Printing**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objectives:

- To understand the fundamental principles and methodologies of 3D printing technology and its applications.
- To develop proficiency in using computer-aided design (CAD) software for product design.
- To apply design thinking principles in product ideation and Fused Deposition Modeling (FDM) 3-D printing

Course Outcomes:
By the end of the course, students will be able to:

CO1. Demonstrate Proficiency in CAD for Product Design: Utilize CAD software proficiently to create detailed and innovative 3D models for product design projects.
CO2. Apply Design Thinking in Product Development: Apply design thinking methodologies to identify problems, generate ideas, and prototype solutions effectively.
CO3. Operate FDM 3D Printers: Understand the principles of FDM technology, operate Ultimaker 3D printers efficiently.
CO4. Execute Complete 3D Printing Projects: Manage the entire 3D printing process from design optimization to post-processing, ensuring the successful realization of product prototypes.
CO5. Critically evaluate 3D Printing Applications: Analyze the potential applications of 3D printing across various industries and evaluate their impact on innovation and sustainability.

Syllabus

Introduction to Product Design- Principles of design, Design thinking process, Design research and ideation techniques, Fundamentals of 3D Printing

Overview of 3D printing technologies-Materials used in 3D printing, Applications and case studies, Computer-Aided Design (CAD) for Product Design

Introduction to CAD software-2D sketching and 3D modeling techniques, Fused Deposition Modeling (FDM), Understanding FDM technology 3D printers, features and operation, Material selection and print settings, Slicing.

Design Thinking in Product Development- Problem identification and definition-Ideation techniques (brainstorming, mind mapping, etc.), Prototyping and iteration

Hands-on 3D Printing -Preparing 3D models for printing, Ultimaker setup and operation, Post-processing techniques

Advanced Topics in 3D Printing- Additive manufacturing trends, Future prospects and challenges, Sustainability in 3D printing

Textbooks:

1. Product Design and Development by Karl T. Ulrich and Steven D. Eppinger
2. Ultimaker Essentials by Richard Underwood

Reference Books:

1. The Design of Everyday Things by Don Norman
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by Ian Gibson, David W. Rosen, and Brent Stucker

Delivery Methods:

1. Lectures: Traditional classroom lectures to deliver theoretical concepts and frameworks.
2. Workshops: Practical sessions focusing on CAD software usage, design thinking exercises, and hands-on 3D printing activities, including Ultimaker operation.
3. Group Projects: Collaborative projects to apply learned concepts and develop real-world design solutions.
4. Guest Lectures: Industry experts and professionals invited to share insights and case studies on 3D printing applications.
5. Online Resources: Access to online tutorials, video lectures, and interactive learning materials for self-paced learning.

Mode of Evaluation:

1. Assignments and Tests: Regular assignments to assess understanding of theoretical concepts, CAD proficiency, and design thinking application.
2. MCQs: Periodic quizzes to evaluate comprehension of lecture materials and readings.
3. Group Projects: Evaluation of group projects based on creativity, feasibility, and effectiveness of design solutions, including 3D printing prototypes.
4. Practical Exams and viva: Hands-on practical exams to assess skills in Ultimaker operation, FDM printing setup, and troubleshooting.
5. End Semester Exam: Comprehensive exam covering all aspects of the course, including theory, practical skills, and critical analysis of 3D printing applications.

Semester III

Department of Mechanical Engineering

Course Code: MET2980-3 **Course: Mechanical Engineering in Daily Life**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objectives:

CO1. Understand the fundamental concept of mechanical engineering
CO2. Know the principle of operation and working of various manufacturing processes
CO3. Apply the thermodynamic concept to household appliances and systems
CO4. Usage of fluid devices for domestic applications
CO5. Recognize the impact of mechanical engineering on societal advancements

Course Outline:

Unit I: Introduction to Mechanical Engineering: Overview of Mechanical Engineering, Historical development and significance, Basic concepts and principles and Role of mechanical engineers in society.

Unit II: Materials and Manufacturing: Properties of engineering materials, Material selection criteria, Manufacturing processes (e.g., casting, machining, forming), Applications of materials and manufacturing in daily life (e.g., automobiles, appliances)

Unit III: Thermodynamics, refrigeration and air conditioning: Basic concepts of thermodynamics, Laws of thermodynamics. Application of thermodynamics in daily life. Basic of **refrigeration and air conditioning. Domestic refrigeration system and its applications. S**mart home devices.

Unit IV: Fluid Mechanics: Properties of fluids, Fluid statics and dynamics, Bernoulli's equation and its applications such as venturimetrer and orifice meter. Applications of fluid devices in daily life.

Unit V: Environmental Impact and Sustainability: Sustainable practices in mechanical engineering, Case studies of sustainable technologies and practices. Introduction to renewable energy technologies.

Text books

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw-Hill Publication.
2. Refrigeration and Air conditioning, C.P. Arora, Tata McGraw Hill Publication.
3. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, S Chand Publication.

Reference books

1. Modern Engineering Thermo dynamics, Robert Balmer, Publisher-AcademicPress.

Semester V

Department of Mechanical Engineering

Course Code: MET5002 **Course: Design of Machine Elements**

L: 3 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 3**

Course Description:
This course provides an in-depth understanding of the principles and practices involved in the design of various machine elements essential for engineering applications. Emphasis is placed on the analysis, selection, and design of rigid and flexible couplings, shafts, sliding and rolling contact bearings, and drives including gears, chains, and belts.

Course Objectives:

1. To develop a comprehensive understanding of the fundamental concepts underlying the design of machine elements
2. To familiarize students with the principles of selecting appropriate materials and manufacturing processes for machine components.
3. To equip students with practical experience with design calculations, simulation tools, and relevant case studies.

Course Outcomes: Students will be able to

CO1. Understand the fundamental concepts of machine design.
CO2. Apply design principles for mechanical components subjected to dynamic loading.
CO3. Design the shaft based on different criteria.
CO4. Apply the design considerations for both rigid and flexible couplings.
CO5. Apply appropriate selection criteria to select suitable bearings to meet performance, reliability, and durability standards.
CO6. Apply the design principles and analyze the mechanical drives.

Course Outline:

Introduction to Machine Element Design
Definition of Machine Design, types of Machine Design, Basic procedure of design process Overview of machine elements and their significance in engineering design. Selection of material, preferred number. Aesthetic and ergonomic considerations in design. Basic terminology, design considerations, and factors influencing machine element design.

Design against static and dynamic load: Theories of static failure, Stress concentration etc. Overview of fatigue phenomena and its significance in engineering design, stress concentration factors, and notch sensitivity, S-N curves, Fluctuating stresses, Fatigue failure, Soderberg and Goodman criterion, Design of mechanical components subjected to dynamic loading for finite and infinite life.

Shaft Design
Design of shaft on the Basis of Strength, rigidity and critical speed. ASME Code for shaft Design, Design of splines and keys.

Rigid and Flexible Couplings
Types of couplings and their applications. Design considerations for rigid and flexible couplings.
Analysis of torque transmission, misalignment compensation, and vibration damping.

Rolling Contact Bearings: Principles of operation and classification of rolling contact bearings. Bearing life calculations, load ratings, and selection criteria.

Sliding Contact Bearings: Principles of lubrication and friction in sliding contact bearings. Types of sliding contact bearings and their design considerations. Bearing materials, surface finish, and lubrication regimes.

Drives: Gears
Gear types, terminology, and classifications. Gear tooth geometry, strength analysis, and design calculations. Gear materials, lubrication, and efficiency considerations. Design of Gears (Beam strength and wear criterion, AGMA method)

Drives: Chain and Belt
Chain drives: types, selection criteria, and design considerations. Belt drives: types, pulley design, and tensioning systems. Power transmission efficiency, wear analysis, and maintenance practices.

Recommended Resources:

Text and Reference books:

1. Bhandari V.B., Design of Machine Elements, Tata Mc-Graw Hill publications.
2. Machine Design" by Robert L. Norton
3. Data, Design. "Data Book of Engineers by PSG College." Kalaikathir Achchagam, Coimbatore.(PSG Design Data Book.)

Online resources: Engineering handbooks, academic journals, and industry publications.
Software tools: CATIA, ANSYS, OCTAVE/MATLAB, etc., for design simulation and analysis.

Teaching Methodology:
Lectures, demonstrations, and multimedia presentations to introduce theoretical concepts. Practical sessions involving design calculations, problem-solving exercises, and case studies.

Hands-on workshops utilizing software tools for design simulation and analysis. Guest lectures from industry experts to provide real-world insights and applications.

Assessment:
Assignments and quizzes to assess understanding of theoretical concepts.
Design projects focusing on the analysis and design of machine elements.
Midterm and final examinations covering the entire course content.