Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE – 41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

NBA Accredited, NAAC Accredited with A+ Grade, ISO 21001:2018

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum Structure and Syllabus of

S.Y. B. Tech. – Mechanical Engineering

(With effect from - Academic Year 2025 - 26)
(2024 Pattern)

VISION OF THE INSTITUTE

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION OF THE INSTITUTE

- To achieve academic excellence through innovative teaching and learning process.
- To imbibe the research culture for addressing industry and societal needs.
- To inculcate social attitude through community engagement initiatives.
- To provide conducive environment for building the entrepreneurial skills.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION:

To be recognized as center for quality education in the field of mechanical engineering, integrating top-tier teaching, innovative research, and fostering socially conscious and entrepreneurial engineers.

MISSION:

M1: To impart value-added education by creating an ambiance of academic excellence in teaching-learning processes.
M2: To inculcate research approach through innovation and skill development centers.
M3: To inculcate a strong sense of social responsibility and empathy among the students.
M4: To imbibe the entrepreneur skill amongst the students by strengthening Industry- Institute interaction.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Mechanical Engineering graduates excel in solving industrial challenges, innovating for society, and leveraging core engineering principles for industry advancement.
PEO2: Graduates will apply technical expertise, leadership, and entrepreneurship, to establish ethical organizations to address societal needs and pursue higher studies.
PEO3: Graduates will work effectively as individuals and as team members with high ethical values and motivation for life-long learning for the benefit of society.

PROGRAM OUTCOMES (POs):

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, formulate and analyze real-life mechanical engineering problems by applying the principles of thermal, design, manufacturing, interdisciplinary and allied engineering.

PSO2: Select and apply appropriate materials, metallurgical processes, measurement techniques, feedback control systems, hydraulic and pneumatic control systems to develop appropriate solutions to mechanical engineering problems.

PSO3: Select and apply appropriate manufacturing technologies and tools, and develop competencies for working in manufacturing and allied industries.

PSO4: Apply acquired knowledge, skills, and hands-on experiences to work professionally in mechanical and related systems.

DEPARTMENT OF MECHANICAL ENGINEERING

LIST OF ABBREVIATIONS

Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Program Core Course
PEC	Program Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective - Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
CIE	Continuous Internal Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project

DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
MEPC302	PCC	Mechanics of Solids	3	2	-	5	3	1	4	40	60		50	-	150
MEPC303	PCC	Engineering Thermodynamics	3	-	-	3	3	-	3	40	60	-	-	-	100
MEPC304	PCC	Engineering Materials and Metallurgy	3	2	-	5	3	1	4	40	60	-	-	25	125
MEMD301	MDM	Engineering Mathematics – III	3	-	-	3	3	-	3	40	60	-	-	-	100
ALOE301	OE	Open Elective - I#	2	-	-	2	2	-	2	40	60	-	-	-	100
MEMC301	HSSM-MC	Project Management System – I	-	2	-	2	-	1	1	-	-	25	-	-	25
MEVS304	VSEC	Problem Solving Technique – I	-	2	-	2	-	1	1	-	-	25	-	-	25
MEVS305	VSEC	Python & Generative AI Lab		2		2		1	1	-	-	25	-	-	25
MECE301	CEP	Project Based Learning	-	2	-	2	-	1	1	-	-	25	-	-	25
MEIN302	ELC - INT	Internship – II	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**14**	**12**	**-**	**26**	**14**	**8**	**22**	**200**	**300**	**125**	**50**	**25**	**700**

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - I**
ALOE301A	OEC	Digital Literacy and Applications
ALOE301B		Environmental Studies
ALOE301C		Green Energy and Sustainability
ALOE301D		Basics of Consumer Electronics
ALOE301E		Renewable Energy Systems

BoS Chairman

ZES's Zeal College of Engineering & Research Narhe, Pune-41 PU/PN/Engg./285/2007

Director
ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
MEPC405	PCC	Theory of Machines	3	2	-	5	3	1	4	40	60	-	-	25	125
MEPC406	PCC	Fluid Mechanics	3	-	-	3	3	-	3	40	60	-	-	-	100
MEPC407	PCC	Manufacturing Technology – II	3	2	-	5	3	1	4	40	60	-	-	25	125
MEMD402	MDM	Machine Learning & Data Science	2	2	-	4	2	1	3	40	60	-	25	-	125
ALOE402	OE	Open Elective – II#	2	-	-	2	2	-	2	40	60	-	-	-	100
MEMC402	HSSM-MC	Quality Management System – II	-	2	-	2	-	1	1	-	-	25	-	-	25
MEAE402	AEC	Problem Solving Technique – II	-	2	-	2	-	1	1	-	-	25	-	-	25
MEVS406	VSEC	Solid Modelling and Drafting	-	2	-	2	-	1	1	-	-	25	-	-	25
MEPC408	PCC	Fluid Mechanics and Machinery Laboratory	-	2	-	2	-	1	1	-	-	-	25	-	25
MEIN403	ELC - INT	Internship – III	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**13**	**14**	**-**	**27**	**13**	**9**	**22**	**200**	**300**	**100**	**50**	**50**	**700**

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - II**
ALOE402A	OEC	Cyber Security and Laws
ALOE402B		Sustainability and Climate Change
ALOE402C		Energy Audit and Electrical Safety
ALOE402D		Digital Marketing
ALOE402E		Entrepreneurship and Innovations

BoS Chairman

ZES's Zeal College of Engineering & Research PU/PN/Engg./285/2007 Narhe, Pune-41

Director
ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

DEPARTMENT OF MECHANICAL ENGINEERING

INDEX

SYLLABUS

SEMESTER - III

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Mechanics of Solids								**Code:** MEPC302	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	-	50	150

Prerequisites:

Basic concept of Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To understand the basic concepts of stress and strain caused by different types of loads.
2. To learn how to draw Shear Force and Bending Moment Diagrams for beams under transverse loads.
3. To calculate bending stress, shear stress, slope, and deflection in beams.
4. To solve problems related to torsional stress in shafts and buckling in columns.
5. To apply the concepts of principal stresses and failure theories to engineering problems.
6. To use the knowledge of solid mechanics in real-life situations involving combined loading.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply the concepts of stress and strain to calculate axial and thermal stresses in homogeneous and composite members
CO2	Analyze shear force and bending moment diagrams for beams under various loading and support conditions.
CO3	Calculate bending and shear stresses, slope, and deflection in beams using analytical methods and experimental observations.
CO4	Analyze torsional stresses in circular shafts and evaluate critical buckling loads in columns using Euler's theory.
CO5	Evaluate principal stresses and planes, Mohr's Circle, and failure theories to assess material safety under complex loading.
CO6	Solve combined loading problems using concepts of shear force, bending moment, stresses, torsion, buckling, principal stresses and failure theories.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Simple Stresses and Strains**: Types of loads and various types of stresses with applications, Unit conversion & dimensions, Hooke's law, Poisson's ratio, Elastic Constants. Interrelation between elastic constants, Stress-strain diagram for ductile, brittle and composite material, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads. **Thermal stresses:** in plain and composite members.	07
2.	**Shear Force Diagram and Bending Moment Diagram** : Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to	06

	concentrated load, uniformly distributed load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure.	
3.	**Bending Stress in a Beam**: Introduction to bending stress in a beam with application, Theory of Simple bending, assumptions in pure bending, Flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section. **Shear Stress in a Beam**: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section.	08
4.	**Torsion of circular shafts**: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience, torsion in thin wall cylinder. **Buckling of columns**: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory, Introduction to other theories.	07
5.	**Principal Stresses**: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses. **Theories of Elastic failure**: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory.	07
6.	**Combined loading and stresses** Combined stresses at any cross-section or at any particular point for Industrial and Real life example for the following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined problem of Normal and Shear type of Stresses.	07
	TOTAL	**42**

List of Experiments:

1. Tension test for ductile material using extensometer on Universal Testing Machine.
2. Compression test for Brittle material on Universal Testing Machine.
3. To understand the working principle of Strain gauge - Virtual Lab experiment
4. Shear test of ductile material on Universal Testing Machine.
5. Slope & deflection calculation for a simply supported beam with point load at center.
6. Torsion testing for circular bar.
7. Verification of results of any one from experiments no 1-6 using any software tools.

8. Self-learning study practical: Testing (Tensile/Compressive/Shear/Torsion/Bending) of composite material are distributed among the group of 3-5 Students and *groups need to present and also submit the slides/poster on TW file*.
Text Books:
1. R. K. Bansal, "Strength of Materials", Laxmi Publication 2. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd. 3. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi 4. Singer and Pytel, "Strength of materials", Harper and row Publication 5. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication
Reference Books:
1. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication 2. G. H. Ryder, "Strength of Materials", Macmillan Publication 3. Beer and Johnston, "Strength of materials", CBS Publication 4. James M. Gere, "Mechanics of Materials", CL Engineering 5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore
E-Resources:
1. Prof. S.K. Bhattacharyya, IIT Kharagpur , "NPTEL Web course material" https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Thermodynamics								**Code:** MEPC303	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Physics, Fundamentals of Mechanical Engineering.

Course Objectives:

1. To provide students fundamental understanding of basic thermodynamic laws and system behaviour.
2. To enable students to analyze energy interactions in gases, vapors, and various thermodynamic processes.
3. To enable students to evaluate the performance of steam and gas power cycles.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand thermodynamic systems and the First Law of Thermodynamics.
CO2	Interpret the Second Law, entropy, and irreversibility in thermodynamic processes.
CO3	Calculate work, heat, and property changes during ideal gas processes.
CO4	Evaluate properties of pure substances using steam tables and diagrams.
CO5	Explain the Rankine cycle and effect of various parameters on its efficiency.
CO6	Compare various gas power cycles and their efficiency.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Basic Concepts and First Law of Thermodynamics:** Units, Units conversion, Microscopic & Macroscopic point of view, Thermodynamic systems, boundaries, and properties, state, path, process, and cycle, Thermodynamic equilibrium, Quasi-static process, Concepts of work & heat and its sign conventions, Zeroth Law of Thermodynamics, Temperature scales, Measurement of temperature and pressure and its units. Statement of First Law of Thermodynamics, First law applied to closed systems, specific heat, internal energy, enthalpy, First law applied to open systems (steady flow energy equation), Application to nozzles, turbines, compressors, heat exchangers etc.	08
2.	**Second Law of Thermodynamics and Entropy:** Limitations of First Law, Heat engines, refrigerators, heat pumps, Efficiency and COP, Second Law of Thermodynamics - Kelvin-Planck and Clausius statements, It's equivalence, Reversible and irreversible processes, Carnot cycle and Carnot efficiency.	08

	Entropy and its physical significance, T-s and h-s diagrams, Entropy as a property, Clausius inequality, Entropy changes for an Open and Closed System, Entropy - a measure of Disorder.	
3.	**Ideal Gas Processes:** Ideal Gas definition, Gas Laws: Boyle's Law, Charles's Law, Avogadro's Law, Equation of State, Ideal Gas Constant and Universal Gas Constant, Specific Heats and their relationship, Ratio of Specific Heats, Ideal Gas Processes – P-v and T-s Diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, and Throttling Processes (Open and Closed Systems), Calculations of Heat Transfer, Work Done, Internal Energy and Enthalpy Changes during various processes.	06
4.	**Properties of Pure Substances:** Steam formation, Steam properties, Phase change processes, P-v, T-s, and h-s diagrams, Use of steam tables and Mollier charts, Dryness fraction and its determination, Various processes with steam as working substance, Steam calorimeters, Real-life application: Steam power plants and water heating systems.	06
5.	**Steam Power Cycles:** Introduction to Steam Power Plant and its main components, Basic Rankine Cycle – processes and representation on P-v , T-s and h-s diagrams, Comparison between Carnot Cycle and Rankine Cycle, Thermal Efficiency of Rankine Cycle, Concept of Relative Efficiency, Effects of operating parameters on cycle performance – influence of Superheating, Boiler Pressure, and Condenser Pressure, Actual Rankine cycle.	08
6.	**Gas Power Cycles:** Basic considerations in the analysis of Power Cycles, Air-Standard assumptions, An overview of reciprocating engines, Otto cycle, Diesel Cycle, and Dual cycle (Simple Numerical), Sterling Cycle, Ericsson Cycle, Lenoir cycle and Atkinson cycle, Brayton Cycle.	06
	TOTAL	**42**

Text Books:

1. Nag P. K., "Engineering Thermodynamics", Tata McGraw-Hill Publisher Co. Ltd.
2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications.
3. Domkundwar, Kothandaraman and Domkundwar, "Thermal Engineering", Dhanpat Rai Publishers.
4. M M Rathore, "Thermal Engineering", Tata McGraw-Hill.

Reference Books:

1. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill
2. Holman J.P, "Thermodynamics", McGraw Hill
3. Steam Tables/Data book.

DEPARTMENT OF MECHANICAL ENGINEERING

E-Resources:
1. Prof. V. Bapu, IIT Madras, Engineering Thermodynamics – https://nptel.ac.in/courses/112106310 2. Prof. Aditya Bandopadhyay, IIT Kharagpur, Concepts of Thermodynamics - https://nptel.ac.in/courses/112105266

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Materials and Metallurgy								**Code:** MEPC304	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	25	-	125

Prerequisites: Engineering Physics, Engineering Chemistry, Fundamental in Mechanical Engineering

Course Objectives:

1. To overview of engineering materials, internal structure, and defects influencing properties.
2. To learn mechanical behaviour, testing methods, and failure mechanisms.
3. Insight into phase diagrams, heat treatment, corrosion, modern materials, and selection criteria.

Course Outcomes: After completion of this course, students will be able to -

CO1	Classify engineering materials based on type and structure.
CO2	Explain mechanical properties and standard testing methods.
CO3	Describe fracture types and true stress-strain behavior.
CO4	Interpret binary phase diagrams and the iron–carbon diagram.
CO5	Explain heat treatment processes and associated diagrams.
CO6	Select suitable materials using properties and Ashby charts.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamentals of Engineering Materials:** Classification of materials: Metals, polymers, ceramics, composites, and smart materials, Structure of solids: Crystal structures (BCC, FCC, HCP), unit cells, Crystallographic directions and planes, Imperfections in crystals: Point, line, and surface defects, Grain structure and grain boundary.	07
2.	**Mechanical Properties and Testing:** Stress-strain behavior; elastic, plastic deformation, Hardness, toughness, ductility, creep, and fatigue. Testing methods: Tensile test, impact test (Izod/Charpy), hardness tests (Brinell, Rockwell, Vickers), Fracture mechanisms: Ductile and brittle fracture	07
3.	**Phase Diagrams and Alloy Systems:** Concept of phases, phase transformation, solidification, Gibb's phase rule, Iron–carbon diagram: Allotropic forms of iron, critical temperatures, Fe–Fe_3C diagram.	08
4.	**Heat Treatment of Steels:** Purpose and types of heat treatment, Annealing, normalizing, hardening, tempering, case hardening, surface hardening, TTT (Time Temperature Transformation) and CCT (Continuous Cooling Transformation) diagrams, Hardenability and Jominy end-quench test. Corrosion: Types, and prevention techniques on surface	07

5.	**Ferrous and Non-Ferrous Alloys:** Properties and applications of plain carbon steels and alloy steels, Cast irons: Types, microstructure, and applications, Non-ferrous materials: Aluminium, copper, magnesium, and their alloys,	07
6.	**Modern Engineering Materials and Applications:** Introduction to composites: Types, manufacturing methods, and applications, Polymers and ceramics: Structure, properties, and applications, Smart materials: Shape memory alloys, piezoelectric materials, biomaterials, Materials selection criteria in design: Ashby's charts and decision-making.	06
	TOTAL	**42**

List of Experiments/Exercises/Assignment:

(Any 08)

1. Study of crystal structures using models; calculation of Ligancy Number and atomic packing factor.
2. Hardness testing using: Rockwell and Poldi hardness Test.
3. Specimen Preparation for microscopic examination.
4. Demonstration and study of an Optical Metallurgical microscope.
5. Phase diagram plotting; discussion on Fe–Fe_3C curve and microstructure samples.
6. NDT study using the Dye Penetrant test.
7. Microstructure study of steel, cast iron, and non-ferrous alloys using metallurgical microscope.
8. Impact testing using Charpy and Izod methods.
9. Jominy end-quench test for hardenability.
10. Preparation of composite samples using hand lay-up method.
11. Calculation of percentage constituents in phase diagram using Lever rule.
12. Industrial Visit to cover any one of the practice - Foundry or Casting Industry, Heat Treatment Facility, Material Testing Laboratory or NABL Accredited Lab, Composite Manufacturing or Advanced Materials Industry.

Text Books:

1. Dr. V. D. Kodgire & S. V. Kodgire, "A Text Book of Material Science & Metallurgy for Engineers", Everest Publication.
2. William D. Callister Jr., "A Text Book of Materials Science and Engineering an Introduction", John Wiley & Sons, Inc.

Reference Books:

1. Raghvan V., "Material Science & Engineering", Prentice Hall of India, New Delhi. 2003 publication.
2. Avner S.H., "Introduction to Physical Metallurgy", Tata McGraw-Hill, 1997 Publishers.
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd. Publishers.

E-Resources:

1. Lecture Series on Materials Science by Prof.SK. Gupta, Department of Applied Mechanics, IIT Delhi. For more details on NPTEL visit http://nptel.iitm.ac.in
2. Lecture Series on Introduction to Materials Science and Engineering, by Prof.Rajesh Prasad, Department of Materials Science and Engineering, IIT Delhi, http://nptel.iitm.ac.in

3. Lecture Series on phase diagrams in materials science and engineering by Prof.Krishanu Biwas, Department of Materials Science and Engineering, IIT Kanpur, http://nptel.iitm.ac.in
4. Lecture Series on Heat Treatment and Surface Hardening - I by Prof. Sandeep Sangal Department of Materials and Metallurgical Engineering IIT Kanpur http://nptel.iitm.ac.in

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Mathematics – III								**Code:** MEMD301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Differential and Integral calculus, Differential equations of first order and first degree, Fourier series, Elementary concepts of statistics and probability. Vector algebra, Vector Differentiation.

Course Objectives:

1. To familiarize with concepts and techniques in Ordinary & Partial differential equations, Numerical methods, Statistical methods, Probability theory and Vector calculus.
2. To equip with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power useful in respective disciplines.

Course Outcomes: After completion of this course, students will be able to -

CO1	Solve higher order linear differential equations and also model & analyze mass spring systems.
CO2	Solve algebraic and transcendental equations using numerical methods
CO3	Apply interpolation techniques, perform numerical differentiation and integration and solve ordinary differential equations using appropriate numerical methods.
CO4	Summarize and analyze the data generated by mechanical systems using the fundamental concepts of statistics and probability.
CO5	Perform Vector integration, analyze the vector fields and apply to fluid flow problems
CO6	Solve Partial differential equations such as wave equation, one- and two-dimensional heat flow equations.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Linear Differential Equations and It's Applications:** Linear Differential Equations (LDE) of nth order with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's D.E., Simultaneous DE and Symmetric DE, Applications of differential equations in mass spring systems.	08
2.	**Numerical Methods:** Numerical Solution of Algebraic and Transcendental equations: Bisection, Regula-Falsi, Newton– Raphson Method, Numerical Solutions of System of linear equations: Gauss elimination Method, Gauss-Seidel Method, LU Decomposition method.	06
3.	**Numerical Interpolation and solution of ODE:** Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation.	07

	Numerical Integration: Trapezoidal and Simpson's rules, Solution of Ordinary differential equations (ODE): Euler's, Modified Euler's, Runge-Kutta 4th order methods.	
4.	**Statistics and Probability:** Statistics: Central tendencies, measures of dispersion, correlation and regression Probability, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis, Chi-Square test.	07
5.	**Vector Integral Calculus:** Line integral, work done, Green's Lemma, Gauss's Divergence theorem and Stokes's theorem.	07
6.	**Partial Differential Equations (PDE) and It's Applications:** Partial Differential Equations (PDE)**,** Solution of PDE by Variation of Parameter, Modeling and solution of Vibrating String, One and Two-dimensional Heat flow problems.	07
	TOTAL	**42**

Text Books:

1. B.S. Grewal, "Higher engineering Mathematics", Khanna publishers, Delhi (40th edition), 2008
2. P. N. Wartikar & J. N. Wartikar, "Applied Mathematics, Volumes I and II", Pune Vidyarthi Griha Prakashan, Pune
3. H. K. Das, "Higher Engineering Mathematics" S. Chand Publication.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2015.
2. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press.
3. B.V. Ramana, "Engineering Mathematics", Tata McGraw-Hill.
4. Wylie C.R., Barrett L.C., "Advanced Engineering Mathematics", McGraw-Hill, Inc.
5. Thomas L. Harman, James Dabney and Norman Richert, "Advanced Engineering Mathematics with MATLAB", 2e, Brooks/Cole, Thomson Learning.

E-Resources:

1. NPTEL Course "Transform Calculus and its appalicatins in differentail Equations" https://onlinecourses.nptel.ac.in/noc22_ma32/preview
2. NPTEL Course "Probability Theory and Application" https://nptel.ac.in/courses/111104079

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)						**Semester:** III			
Course: Project Management System – I						**Code:** MEMC301			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving techniques.
2. Understanding the structured way of solving problems with the right tools.

Course Outcomes: After completion of this course, students will be able to -

CO1	Know the project and its importance.
CO2	Understand the structured way of project execution process.
CO3	Understand on how to project, goals and timeline.
CO4	Know the key principles of project management.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Project & Management System:** What is a project, What is Project Management, Types, Importance and its benefits.	06
2.	**Project Management Process:** Planning, Execution, Monitoring & Control, Deliverables, Stakeholders.	06
3.	**Principles:** 12 Principles of Project Management.	16
	TOTAL	**28**

Text Books:

1. K. Nagarajan, "Project Management", New Age International Publishers.
2. Joseph Heagney**,** "Fundamentals of Project Management", AMACOM.
3. Harold Kerzner**,** "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley.

Reference Books:

1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute.
2. BB Goel, "Project Management: Principles and Techniques", Deep & Deep Publications Pvt. Ltd.

E-Resources:

1. Dr. Nimisha Singh, "Introduction to Project Management: Principles & Practices", NPTEL Course - https://onlinecourses.swayam2.ac.in/imb25_mg167/preview
2. Prof. Raghu Nandan Sengupta, "Project Management", NPTEL Course - https://onlinecourses.nptel.ac.in/noc25_mg78/preview

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Problem Solving Techniques – I								**Code:** MEVS304	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving techniques.
2. To understand the structured way of solving problems with the right tools.

Course Outcomes: After completion of this course, students will be able to -

CO1	Know the problem and types of problem.
CO2	Understand the structured way of solving a problem.
CO3	Understand the basic tools and its application.
CO4	Apply the learning to solve simple problem cases as a team.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Problem Understanding:** Define problem, Types of Problem, What is problem solving? Structured way of Problem solving – Step by Step.	06
2.	**Problem Solving Approach:** Structured step by step working model, Principles to think and apply.	06
3.	**Basic Tools for Problem Solving:** Knowing the tools and applying the right tools at the right step of problem solving, Problem solving case study.	16
	TOTAL	**28**

Text Books:

1. M.T. Somashekara, "Problem Solving and Programming Concepts", PHI Learning.
2. Dheeraj Sharma, "Problem Solving and Decision Making", McGraw-Hill Education.

Reference Books:

1. Willian Henderson, "Master Critical Thinking, Creative, Logic & Problem solving skills", Peak Publish LLC.
2. Sharma Narender, "Handbook 7 QC tools", Shakehand with Life.

E-Resources:

1. Coursera: "Creative Problem Solving" - https://www.coursera.org/learn/creative-problem-solving.
2. MindTools – "Problem Solving Techniques", https://www.mindtools.com/cx4ems0/problem-solving.

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Python & Generative AI Lab								**Code:** MEVS305	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic Mathematics, Basic Computer Literacy.

Course Objectives:

1. To introduce Python programming and data handling for mechanical applications.
2. To develop skills in engineering computation and data visualization.
3. To expose students to generative AI tools for design and simulation tasks.

Course Outcomes: After completion of this course, students will be able to -

CO1	Construct basic Python programs for mechanical engineering tasks.
CO2	Organize and visualize data using Python libraries and OOP.
CO3	Develop modular code using functions and string operations.
CO4	Apply numerical methods to solve engineering problems.
CO5	Explain fundamental generative AI models and tools.
CO6	Demonstrate AI tools for design, simulation, and documentation.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Python Programming Basics for Engineers:** Python syntax, variables, data types, Control structures (if, loops), functions, Lists, tuples, dictionaries, string operations, function, Simple engineering calculations (e.g., thermal conversion, pressure-volume relations)	06
2.	**Data Handling and Visualization:** **File Handling in Python-** reading/writing CSV, TXT, Plotting graphs using matplotlib, seaborn, working with real data from mechanical labs/simulations, Introduction to NumPy and pandas. **Object-Oriented Programming (OOP) -**Classes, objects, constructors /destructors, Inheritance and encapsulation basics	04
3.	**Code Structuring and Data Handling in Python:** **Functions and Lambda Expressions-**User-defined functions, return values, scope, Lambda functions with map() and filter(). **String Operations-**Slicing, formatting, and manipulation, Built-in string methods: .upper(), .replace(), .count()	04

4.	**Numerical Methods and Engineering Computation:** Solving linear systems using matrices, Root-finding: Bisection, Newton-Raphson methods, Numerical integration and differentiation, Applications in heat transfer, fluid mechanics, and vibration systems	04
5.	**Fundamentals of Generative AI:** What is Generative AI? Introduction to AI/ML/DL, Types of generative models: GANs, VAEs, Transformers, Basics of LLMs (e.g., GPT) and prompt engineering, Overview of tools: ChatGPT, DALL·E, Copilot, Whisper	04
6.	**Generative AI Applications in Mechanical Engineering:** AI-generated design ideas and concept sketches (DALL·E, Stable Diffusion), Simulation support using AI for documentation (e.g., interpreting FEA/CFD results), AI-assisted report writing, documentation, and productivity tools.	06
	TOTAL	**28**

List of Experiments:

1. Thermal Unit Conversion & Ideal Gas Law.
2. File Handling & Plotting Stress-Strain Graph.
3. OOP for Mechanical Components.
4. Functions and Lambda Expressions.
5. String Operations.
6. Numerical Methods – Root Finding (Bisection & Newton-Raphson)
7. Numerical Methods – Numerical integration
8. Simulated Prompt-Response Engine.
9. AI-Inspired Random Design Idea Generator.

Text Books:

1. Sandeep Nagar, "Python for Engineers and Scientists", Apress, 2017
2. John M. Zelle, "Python Programming: An Introduction to Computer Science", Franklin, Beedle & Associates Inc., 2010
3. Jaan Kiusalaas, "Numerical Methods in Engineering with Python", Cambridge University Press, 2010
4. François Chollet, "Deep Learning with Python", Manning Publications, 2017.

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Green Tea Press, 2015
2. Wes McKinney, "Python for Data Analysis", O'Reilly Media, 2017
3. Andreas C. Müller & Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2016
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 2019
5. Steven C. Chapra & Raymond P. Canale, "Numerical Methods for Engineers", McGraw-Hill Education, 2020

E-Resources:
1. Python for Everybody – Dr. Charles Severance (Coursera)- https://www.coursera.org/specializations/python 2. Lambda Functions and String Methods – Geeks for Geeks- https://www.geeksforgeeks.org/python-lambda-anonymous-functions-filter-map-reduce/ 3. Numerical Methods with Python – MIT Open Course Ware- https://ocw.mit.edu/courses/mathematics/18-085-computational-science-and-engineering-i-fall-2008/ 4. Generative AI Explained – Google Cloud Skills Boost- https://www.cloudskillsboost.google/paths/118 5. AI in Engineering Design – NPTEL Course- https://nptel.ac.in/courses/112/106/112106289/

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Project Based Learning								**Code:** MECE301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Engineering Mechanics, Fundamentals of Mechanical Engineering

Course Objectives:

1. To enable students to apply fundamental mechanical engineering concepts through the design, modeling, fabrication, and testing of simple systems, encouraging practical learning beyond theory.
2. To foster teamwork, innovation, and communication skills by engaging students in solving real-world problems through hands-on mini-projects with structured planning and documentation**.**

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply mechanical engineering principles to design and develop simple mechanical systems addressing practical problems.
CO2	Use modeling, simulation, and fabrication tools to create and test functional prototypes or virtual systems.
CO3	Collaborate effectively in teams to plan, execute, and manage mini-projects with critical thinking and creativity.
CO4	Document and communicate project outcomes through technical reports, presentations, and self/peer evaluations.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Brainstorming & project theme selection, Formulation of the problem statement, Setting objectives, team roles and timeline, Initial sketches or CAD models	06
2.	Detailed 2D/3D modelling (CAD + calculations if any), Application of engineering fundamentals	08
3.	Prototype fabrication, Testing, Design iteration (if needed)	08
4.	Final project demonstration, Poster or PowerPoint presentation, Report preparation and reflection	06
	TOTAL	**28**

Text Books:

1. Dr. K. Viswanath Allamraju, "Mechanical Engineering through Project Based Learning", Mahi Publication.
2. "Project Based Learning and Implementation", Bhabad International Publication, 2024.

Reference Books:

1. Dr. Sandhya Khedekar & Dr. Deepak Waikar, "Project Based Learning – Engaging in Real-World Challenges".

DEPARTMENT OF MECHANICAL ENGINEERING

E-Resources:
1. Proceeding of the International Conference on Transformations in Engineering Education, Editor – R. Natrajan, 2014

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Internship – II								**Code:** MEIN302	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

SEMESTER - IV

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Theory of Machine								**Code:** MEPC405	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	25	-	125

Prerequisites:

Engineering Mechanics, Engineering Drawing and Kinematics, Fundamental concepts of Physics and Mathematics

Course Objectives:

1. To understand the fundamental concepts of mechanisms, degrees of freedom, inversions, and steering gear mechanisms.
2. To analyze motion in mechanisms using analytical and graphical methods.
3. To perform dynamic force analysis of reciprocating engine mechanisms and evaluate crankshaft torque.
4. To apply gear theory and analyze speed and torque in various gear train systems.
5. To study gyroscopic effects on vehicle stability and rotating systems.
6. To design cam profiles and analyze follower motion for mechanical automation applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand mechanisms, inversions, and steering gear mechanism
CO2	Analyze motion in mechanisms using analytical and graphical methods.
CO3	Apply dynamic force analysis to reciprocating engine mechanisms and calculate crankshaft torque.
CO4	Understand gear theory and analyze speed and torque in various gear train systems.
CO5	Analyze the gyroscopic effect for the stabilization of ships, airplanes, and four-wheeler vehicles
CO6	Design cam profiles based on specified follower motions.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamental of Mechanisms:** Review of Basics of mechanism, machine, degree of freedom, Kutzbach criterion, Grubler's criterion, Grashoff's law, Inversion of four bar chain, Slider crank and double slider crank Mechanisms, Equivalent Mechanisms. Steering Gear Mechanism, Condition for correct steering, Davis and Ackermann Steering Gear Mechanism. Hooke's Joint and Double Hooke's Joints.	07
2.	**Kinematic Analysis of Mechanisms:** Analytical Methods, Displacement, velocity and acceleration analysis mechanisms by Relative Velocity and Acceleration Method, Instantaneous Centre of Velocity method, Coriolis component of Acceleration	07

3.	**Dynamics of Reciprocating Mechanisms:** Dynamic Force Analysis of Reciprocating Engines, Inertia Forces in Slider-Crank Mechanism, Two-Mass Statically and Dynamically Equivalent System, Correction Couple, Turning Moment (T–θ) Diagram, Crankshaft Torque, Fluctuation of Energy and Flywheel Applications	07
4.	**Gears:** Gear: Classification, Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears **Gear Trains:** Gear Train: Types and its application, Speed and Torque Analysis of Gear Trains	07
5.	**Gyroscope:** Introduction, Precessional angular motion, Gyroscopic couple, Effect of gyroscopic couple on an airplane, Effect of gyroscopic couple on a naval ship during steering, pitching and rolling, Stability of a Four Wheel drive moving in a curved path, Stability of a two-wheel vehicle taking a turn, Effect of gyroscopic couple on a disc fixed rigidly at a certain angle to a rotating shaft.	07
6.	**Cams and Followers:** Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam, Displacement and Cam Profile diagram for the Different Follower and Motion of follower, Cam jump Phenomenon, Application in Automated Systems.	07
	TOTAL	**42**

List of Experiments:

For Laboratory Conduction The student shall complete the following activity as a Term Work:

Practical (Experiments 1 to 5 are compulsory. Perform any one from Experiments 6 and 7)

1. Creation and Presentation of a Model of a Real-Life Mechanism with Kinematic Analysis, and Design of a Simple Planar Mechanism Using 3D Modelling Software
2. Speed and torque analysis of Epicyclic gear train to determine holding torque.
3. To study and verify cam jump phenomenon
4. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect
5. Study of the Working Principles and Applications of Governors
6. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.
7. To study the Gear Boxes and its Types, Gearboxes Used in EV, CVT, AMT, DCT

Assignments using Drawing Aids

Do following graphical assignments on Half Imperial drawing sheet:

1. Velocity and acceleration analysis using relative velocity and acceleration method.
2. Velocity analysis using the ICR method.
3. To draw cam profile for combination of various follower motion with radial and off-set cam.

Assignment Using Software (Perform any One)

1. Kinematic Analysis of Simple Mechanisms using Analytical Methods and Comparison with Computer Programming Results.
2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke's joint Mechanism using Analytical Method.

Assignments using Virtual Laboratory:

Perform any One Virtual lab Experiments and Submit the Report.

1. Mechanics-of-Machines Lab (All Experiments), http://mm-nitk.vlabs.ac.in/index.html
2. Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
3. Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
4. Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

Text Books:

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
3. G. Ambekar, "Mechanism and Machine Theory", PHI
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford
5. Khurmi, R. S. and Gupta, J. K., "Theory of Machines", S. Chand Publishing, 2005.

Reference Books:

1. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
2. Sadhu Singh, "Theory of Machines", Pearson
3. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
4. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
5. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI

E-Resources:

1. Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur https://nptel.ac.in/courses/112104121/
2. Theory Of Mechanisms, IIT Madras, Prof. Sujatha Srinivasan https://nptel.ac.in/courses/112106270
3. Mechanism and Robot Kinematics, Prof. Anirvan Das Gupta, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc20_me53/preview

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Fluid Mechanics								**Code:** MEPC406	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Mathematics , Engineering Mechanics, Fundamental of Mechanical Engineering, Engineering Thermodynamics

Course Objectives:

1. To introduce fundamental fluid properties and principles of fluid statics, including pressure and buoyancy.
2. To explain fluid kinematics and dynamics, covering flow classification and key governing equations.
3. To describe viscous and turbulent flow behavior and the effects on internal flows.
4. To teach flow characteristics and energy losses in pipes and open channels using practical methods.
5. To present control volume concepts and dimensional analysis for fluid flow modelling and experimentation.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain fluid properties and apply fluid statics principles to calculate pressure forces on submerged bodies.
CO2	Describe fluid motion using flow visualization and apply the continuity equation for steady incompressible flow.
CO3	Apply Bernoulli's equation and understand its limitations; interpret fundamental fluid dynamics principles including Navier-Stokes and CFD basics.
CO4	Analyze laminar and turbulent flow behavior in pipes and channels; understand boundary layer development and velocity distribution.
CO5	Evaluate major and minor losses in pipe systems and analyze open channel flow.
CO6	Apply control volume approach and Reynolds Transport Theorem to conservation laws; perform dimensional analysis and assess model-prototype similarity.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fluid Properties and Fluid Statics:** Definition and classification of fluids, fluid properties, Pascal's Law, hydrostatic pressure distribution, buoyancy and Archimedes' Principle, applications of fluid statics forces on submerged bodies, center of pressure and total pressure.	07

2.	**Fluid Kinematics:** Flow visualization techniques, Description of fluid motion, Continuity equation- derivation and applications in steady incompressible flow, Fluid Acceleration	07
3.	**Fluid Dynamics:** Continuity equation in differential form, assumptions, Bernoulli's equation from differential momentum analysis, applications of Bernoulli's equation, limitations of Bernoulli's equation due to viscous effects and compressibility, Introduction to : notches and weirs, Navier–Stokes equation, CFD	07
4.	**Viscous and Turbulent Flows:** Laminar flow through circular pipe, between plates, Shear stress and velocity distribution. Boundary layer theory: thicknesses, separation, and control. Turbulent flow: characteristics, Reynolds experiment, velocity profiles.	07
5.	**Flow in Pipes and Open Channels:** Major and minor losses, Pipe network analysis, Friction factor and Moody chart, Open channel flow: types and regimes. Chezy's and Manning's equations, specific energy, critical depth, hydraulic jump (intro).	07
6.	**Control Volume and Dimensional Analysis:** Control volume concept; Reynolds Transport Theorem. Conservation of mass, momentum, and energy. Applications: pipe bends, nozzles, vanes. Dimensional analysis, Dimensionless numbers, Similitude and model testing	07
	TOTAL	**42**

Text Books:

1. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House.
2. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
3. Russell C. Hibbeler, "Fluid Mechanics", Pearson Publication.

Reference Books:

1. White, "Fluid Mechanics", McGraw Hill Publication
2. Murlidhar, "Advanced Fluid Engineering", Narosa Publication.
3. G.S.Sawhney, "Fundamentals of fluid mechanics", I.K. International Publishing House Pvt. Limited, New-Delhi, 2008 New York.
4. Robert W. Fox, Alan T. McDonald, John W. Mitchell, Fox and McDonald's, "Introduction to Fluid Mechanics", 10th Edition, JOHN WILEY & SONS, INC.

E-Resources:

1. Fluid Mechanics, Prof. Subashisa Dutta, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc25_ce107/preview
2. Fundamental of Fluid Mechanics, Dr. Ishtiyaq Ahmad and Dr. Vikrant Dongre, https://onlinecourses.swayam2.ac.in/nou25_me12/preview

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Manufacturing Technology – II								**Code:** MEPC407	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	25	-	125

Prerequisites:

Fundamentals of Mechanical Engineering, Material Science & Metallurgy, Manufacturing Technology - I

Course Objectives: After completion of this course, students will be able to -

1. Concepts related to metal cutting, tool shapes, chip formation, machining forces, tool wear, surface finish, and machinability.
2. Details of machines used in shaping, turning, milling, drilling, grinding, and gear cutting, along with their parts and functions.
3. Basics of jigs and fixtures, their purpose in manufacturing, design principles, and types used for different machining processes.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain chip formation, tool nomenclature, tool wear, and machinability.
CO2	Describe construction, working, and operations of lathe machines.
CO3	Identify operations, tools, and gear manufacturing processes.
CO4	Classify grinding processes and describe broaching machines.
CO5	Explain jig and fixture concepts with degrees of freedom and 3-2-1 principle.
CO6	Identify jig and fixture types and explain their functional elements.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Theory of Metal Cutting:** Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.	08
2.	**Turning Machines:** Centre lathe, constructional features, specification, operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout - automatic lathes: semi-automatic - single spindle : Swiss type, automatic screw type - multi spindle	06
3.	**Shaper, Milling and Gear Cutting Machines:** Shaper - Types of operations. Drilling, reaming, boring, Tapping, Milling operations – types of milling cutter.	06

	Gear cutting - forming and generation principle and construction of gear milling, Hobbing and gear shaping processes –finishing of gears.	
4.	**Abrasive Process and Broaching:** Abrasive processes: grinding wheel — specifications and selection, types of grinding process– cylindrical grinding, surface grinding, Centre less grinding and internal grinding- Typical applications — concepts of surface integrity, broaching machines: broach construction — push, pull, surface and continuous broaching machines	06
5.	**Overview of Jigs and Fixtures:** Overview of their significance and roles in manufacturing for improving productivity, precision, and repeatability. Explanation of degrees of freedom and the 3-2-1 location principle. Design guidelines for developing efficient jigs and fixtures, including functional and structural considerations. Key advantages in machining and assembly operations. **Fixtures:** Definition and functional elements. Principles of location, clamping, and setting elements. Overview of fixture types for different applications: turning, welding, milling, assembly, and inspection.	08
6.	**Jigs:** Definition and function. Core elements and types of jigs. Guidelines for effective location, clamping, and guiding methods. Study of various jig designs: channel, template, plate, angle plate, turnover, box, and latch-type jigs.	08
	TOTAL	**42**

List of Experiments/Exercises/Assignment: (Any Six)

1. Design of Single point cutting Tool
2. Preparation of cutting edges of single point cutting tool (Use of tool grinder)
3. Compound job involving taper turning and threading operation
4. Manufacturing of spur gear using milling machine
5. Design of welding fixture for given component configuration
6. Design of Jig as per given component drawing
7. Production of tapped hole on compound job (as per Sr. no. 3)
8. Case study on machinability aspects (Use of Taylor Life Equation)

Text Books:

1. P.N. Rao, "Manufacturing Technology – II", Tata McGraw Hill
2. R.K. Jain, "Production Technology", Khanna Publishers
3. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", East-West Press
4. S.K. Hajara Choudhary et al., "Elements of Workshop Technology, Volume II: Machine Tools", Media Promoters and Publishers Pvt. Ltd.

Reference Books:

1. G.C. Sen and A. Bhattacharya, "Metal Cutting and Machine Tools", Wiley Eastern
2. Phillip F. Ostwald and Jairo Munoz, "Manufacturing Processes and Systems", Wiley
3. O.P. Khanna, "Manufacturing Technology", Dhanpat Rai & Sons
4. V.K. Jain, "Advanced Machining Processes", Allied Publishers

DEPARTMENT OF MECHANICAL ENGINEERING

E-Resources:
1. **Unit 1: NPTEL Course:** *Manufacturing Technology – I* by Prof. Amitabha Ghosh Manufacturing Process Technology I & II - Course 2. **Unit 2 to 6 : NPTEL Course:** *Manufacturing Technology – II* by Prof. Amitabha Ghosh Manufacturing Process Technology I & II - Course

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Machine Learning & Data Science								**Code:** MEMD402	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	02	-	03	40	60	-	-	25	125

Prerequisites:

Engineering Mathematics, Basic Programming

Course Objectives:

1. An understanding of Machine Learning and Data Science concepts within the context of Mechanical Engineering applications.
2. Knowledge of methods for preprocessing, analyzing, and modeling datasets relevant to mechanical systems.
3. Awareness of the use of Machine Learning techniques in predictive maintenance, fault detection, and optimization tasks in mechanical engineering.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain data science and machine learning fundamentals from a mechanical engineering perspective.
CO2	Extract and Select meaningful features from mechanical data.
CO3	Apply supervised and unsupervised learning techniques to mechanical problems.
CO4	Understand , Build, tune, and validate ML models for engineering applications.
CO5	Explain key ideas of reinforcement learning and its algorithms.
CO6	Apply deep learning and computer vision for mechanical inspection and prediction tasks.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Basic Concepts of Data and Machine Learning:** **Introduction to Data Science (DS)**-History, Definition and Scope of DS, DS Workflow, Applications in Mechanical Engineering, **Data Types and Pre-processing** -Data Types, Data Quality and Pre-processing. **Machine Learning-** History**,** ML definition, Types of ML, Mechanical Engineering Applications	04
2.	**Feature Extraction and Selection:** **Feature Extraction** Time-domain statistical features (mean, standard deviation, RMS, kurtosis, skewness), Principal Component Analysis (PCA), nonlinear dynamic features (entropy, fractal dimension), **Feature Selection -** Filter methods , wrapper methods (exhaustive search, greedy forward and backward, best-fit), embedded methods (decision tree using entropy/information gain -Numerical)	05

3.	**Supervised Learning:** **Classification:** Decision Trees (ID3-IG), Random Forest, Naive Bayes, Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Logistic Regression (Numerical example on decision trees). **Regression:** Linear regression, Support Vector Regression (SVR), Decision Tree Regression **Unsupervised Learning-Clustering:** k-means, selecting number of clusters, mechanical applications like fault pattern analysis and grouping material properties. (Simple Numerical), hierarchical clustering, DBSCAN	06
4.	**ML Modelling and Evaluation:** **Problem identification:** Classification, clustering, regression, ranking, Steps in ML modelling from data pre-processing to deployment; bootstrap sampling, grid search CV, randomized search CV, k-fold cross-validation. **Model evaluation:** accuracy, precision, recall, true/false positives; understanding confusion matrix. **Basic deployment concepts** (e.g., using Flask or Streamlit for model APIs)	05
5.	**Reinforcement Learning:** Definition and key features of reinforcement learning (RL), Exploration vs Exploitation Trade-off **Types:** Value-based, policy-based, model-based; positive vs negative reinforcement. **Models:** Bellman optimality principle, Markov decision process, Q-learning, SARSA.	04
6.	**Deep Learning and ML Ethics:** **Deep Learning**: Neuron cell model, feedforward and backpropagation Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), activation functions, model training and overfitting **ML Ethics -** Bias and Fairness, Privacy and Data Protection, ML for Sustainability and Environmental Impact	04
	TOTAL	**28**

List of Experiments :

Guidelines for Practical's Conduction

The student shall complete the following activity as a Practical's. Students need to apply the computational algorithms using suitable software / programming language.

1. To acquire the data set and to extract features from given data set and establish training data.
2. To perform Exploratory Data Analysis on dataset.
3. To classify features/ To develop classification model and evaluate its performance (any one classifier.
4. To develop regression model and evaluate its performance (any one algorithm).
5. To apply a machine learning algorithm for predictive maintenance.
6. To build a model that estimates manufacturing cost based on process parameters.

7. To predict tool wear in CNC machining using sensor data and machine.
8. To optimize energy, use in HVAC systems using regression and clustering.

Text Books:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow", O'Reilly Media, 2019
2. Mohri, Rostamizdeh, Talwalkar, "Foundations of Machine Learning", MIT Press, 2018
3. Alberto Boschetti & Luca Massaron, "Python Data Science Essentials", Packt Publishing, 2016.
4. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2017.
2. Solanki, Kumar, Nayyar, "Emerging Trends and Applications of Machine Learning", IGI Global, 2018
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Rajeev Ranjan, "Machine Learning for Mechanical Engineers", McGraw-Hill, 2021.
5. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning, 2017.

E-Resources:

1. Scikit-learn documentation - https://scikit-learn.org
2. TensorFlow tutorials - https://www.tensorflow.org/tutorials
3. Kaggle datasets and notebooks - https://www.kaggle.com
4. Analyticsvidhya - https://www.analyticsvidhya.com

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Quality Management System – II								**Code:** MEMC402	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical and quality thinking.

Course Objectives:

Understanding the QMS clauses and its PDCA way of working in an organization.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the organization and its functional alignment for QMS.
CO2	Understand the quality management system and processes.
CO3	Know the leadership drive and involvement in building quality culture.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Scope, Normative References, Terms & Definition	04
2.	**Context of the Organization:** Understanding the organization and its context, Needs and expectations of interested parties, Determine the scope of the quality management system, Quality management system and its processes.	10
3.	**Leadership:** Accountability, Responsibilities and Commitment for QMS culture, Quality policy.	14
	TOTAL	**28**

Text Books:

1. Kanishka Bedi, "Quality Management", Oxford University Press.
2. Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education.
3. Dale H. Besterfield, "Total Quality Management", Pearson Education.

Reference Books:

1. QMS ISO 9001:2015 Standards

E-Resources:

1. Dr. N.Venkateshwarlu, "Quality Engineering & Management", NPTEL Course, https://onlinecourses.swayam2.ac.in/nou25_me09/preview

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Problem Solving Techniques – II								**Code:** MEAE402	
Teaching Scheme (Hr/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving planning.
2. To understand the effectiveness check and sustenance.

Course Outcomes: After completion of this course, students will be able to -

CO1	Know how to plan and execute the problem solving.
CO2	Understand the measure and monitoring of problem-solving plan and execution.
CO3	Understand the effectiveness measures of problem solving.
CO4	Understand the sustenance working plan and execution.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Planning & Execution:** What is planning? PDCA way of thinking and planning, Inputs requirement mapping.	08
2.	**Measure of Planning & Execution:** Key measures, How to measure and monitor? Reviews & Reporting with documentation.	08
3.	**Effectiveness measures & Sustenance:** Define effectiveness measures, How to measure and monitor? Importance of Sustenance, How to plan and execute sustenance activities.	12
	TOTAL	**28**

Text Books:

1. B. Mahadevan, "Operations Management: Theory and Practice", Pearson Education India.
2. L.M. Prasad, "Principles and Practices of Management", Sultan Chand & Sons.

Reference Books:

1. The PDCA Cycle for Industrial Improvement: Applied Case Studies (Synthesis Lectures on Engineering, Science, and Technology), Springer.

E-Resources:

1. Coursera, "Initiating and Planning Projects" - https://www.coursera.org/learn/project-planning

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Solid Modelling and Drafting								**Code:** MEVS406	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	25	25

Prerequisites:

Engineering Graphics, Solid Mechanics, Engineering Materials and Metallurgy

Course Objectives:

1. Introduce the fundamentals of solid modelling and CAD with a focus on industry applications.
2. Develop skills in 2D sketching, part modelling, and assembly creation using CAD tools.
3. Impart knowledge of modelling concepts, including geometry, topology, surface and sheet metal design.
4. Familiarize students with standard drawing practices, GD&T, and IS/BIS dimensioning standards.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply basic CAD commands to create 2D/3D entities
CO2	Apply the tools from CAD software's to complete 2D sketches of the mechanical components
CO3	Build a complete 3D model of components by applying different commands and constraints
CO4	Conclude on appropriate constraints between different parts of the assemblies for generating the complete model
CO5	Develop a 3D model based on surface parameters
CO6	Generate detailed working drawings with GD&T symbols.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to CAD Software:** Introduction to CAD Software, Types of different CAD Software, Wire frame modeling ,Surface modeling, Solid modeling	02
2.	**Sketching:** Introduction to user interface of CAD software, Drawing tools (line, circle, arc, polygon, etc.) Modifying tools (move, copy, trim, offset, mirror, etc.) and Constraints. Curves-Introduction, Analytic Curves - Line, Circle, Ellipse, Parabola, Hyperbola. Synthetic Curves - Hermite Cubic Spline, Bezier Curve, B-Spline Curve.	06
3.	**Part modelling:** Geometry and Topology, Solid Representation, Boundary Representation, Constructive Solid Geometry, Boolean operation	06
4.	**Assemblies**: Types of assemblies, significance and limitations, Inserting components into an assembly, mates and constraints, Assembly motion and interference checking.	04

5.	**Sheet Metal Modelling & Surface Modelling:** Introduction to surface modeling (patch, loft, and sweep), free form surfacing, creation of closed volume, Introduction to Sheet metal modeling	04
6.	**Geometric Dimensioning & Tolerances, Drafting:** Study of drawing sheet layout, principles of drawing and various IS standards & conventions in machine drawing, dimensioning practices - terminology & basic rules, styles, conventions.	04
	TOTAL	**26**

List of Experiments :

The student shall complete the following Practical in laboratory using suitable CAD modeling

Total 08 of the following practical must be performed.

During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations

1. Introduces the basics of Computer-Aided Design (CAD) software used for 2D drafting and 3D modeling.
2. Simple sketching of any 5 objects by using the above mentioned commands.
3. Creating any 2 simple machine parts by using 3D modeling software and calculation of mass properties by applying suitable material.
4. Creating assembly of model consisting of minimum 5 parts
5. Generation of 3D model by using surface parameters (Such as product casing design, automotive body panel design etc.)
6. Generation of Simple 3D model by using Sheet metal
7. Study and reading of Industrial Drawings to understand standard industrial practices viz. Dimensioning, GD&T, and Surface finish, welding symbols, etc.
8. Generating views from 3D parts and assemblies, Exploded views, Bill of Materials (BOM), GD&T symbols, dimensioning.

Text Books:

1. Zeid I. and Sivasubramania R., (2009), "CAD/CAM: Theory and Practice", 2nd edition, McGraw Hill Education.
2. Rao P. N., (2017), "CAD/CAM: Principles and Applications", McGraw Hill Education.

Reference Books:

1. Lee Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley.
2. Bordegoni Monica and Rizzi Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer.
3. Vukašinovic Nikola and Duhovnik Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer.

E-Resources:

1. A NPTEL Course on "Design Practice – II", Prof. Shantanu Bhattacharya
   https://onlinecourses.nptel.ac.in/noc25_me157/preview
2. A Udemy Course on "Geometric Dimensioning & Tolerancing"
   https://www.udemy.com/topic/geometric-dimensioning-and-tolerancing-gdt/

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)									**Semester:** IV
Course: Fluid Mechanics and Machinery Lab									**Code:** MEPC408
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	25	25

Prerequisites:

Engineering Mathematics , Engineering Mechanics, Fundamental of Mechanical Engineering, Engineering Thermodynamics

Course Objectives:

1. To demonstrate and analyze fluid flow behavior and pressure measurement in practical systems.
2. To evaluate performance characteristics of hydraulic turbines and pumps through experiments.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain the working principles of flow measuring devices and hydraulic machinery.
CO2	Conduct experiments to measure pressure, flow rate, and losses in pipes.
CO3	Analyze flow regimes, head losses, and verify Bernoulli's principle using appropriate apparatus.
CO4	Evaluate the performance of turbines and pumps under different operating conditions.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 08 of the following practical must be performed.

During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations and Detailed Industrial Visit Report.

1. Study of Various Pressure Measuring Devices
2. Calibration of Orifice meter/ Venturimeter.
3. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
4. Verification of Modified Bernoulli's Theorem.
5. Determination of minor losses through metal/non-metal pipes.
6. Determination of major losses through metal/non-metal pipes.
7. Trail on Pelton turbine
8. Trial on Francis Turbine
9. Trial on Centrifugal pump
10. Industrial Visit to pumping station/Hydro power plant.

Text Books:

1. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House.
2. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
3. Russell C. Hibbeler, "Fluid Mechanics", Pearson Publication.

Reference Books:
1. White, "Fluid Mechanics", McGraw Hill Publication 2. Murlidhar, "Advanced Fluid Engineering", Narosa Publication. 3. G.S.Sawhney, "Fundamentals of Fluid Mechanics", I.K. International Publishing House Pvt. Limited, New-Delhi, 2008 New York. 4. Robert W. Fox, Alan T. McDonald, John W. Mitchell, Fox and McDonald's, "Introduction to Fluid Mechanics", 10th Edition, JOHN WILEY & SONS, INC.
E-Resources:
1. Applied Mechanics - Fluid Mechanics Laboratory, IIT Madras, https://nptel.ac.in/courses/112106311

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)						**Semester:** IV			
Course: Internship – III						**Code:** MEIN403			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.