राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचलप्रदेश
NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH
(शिक्षामंत्रालय, भारत सरकारकेतहतराष्ट्रीयमहत्वकासंस्थान)
(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**I**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-1101	Fundamentals of Mechanical Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Understand basic definitions and terminology. **2.** Students get a basic idea of Thermodynamics, Fluid Mechanics, Strength of Material and Manufacturing processes.	**Course Outcomes**	**CO1**	Understand the basic concepts of thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Understanding/ Comprehension*
			CO2	Describe the physics of thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Identify/ Knowledge/ Remember*
			CO3	Solve the fundamental problems related to thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Thermodynamics: Introduction, concepts of systems and control volumes, properties of a system, state and equilibrium, processes and cycles, quasi-static process, reversible & irreversible processes and cycles, temperature and Zeroth law of thermodynamics, concepts of heat and work transfer, introduction to1st and 2nd laws of thermodynamics and their applications.	**10**	**CO1, CO2, CO3**
II	Fluid Mechanics: Properties of fluid-mass and weight density, specific gravity, specific volume, viscosity and Newton's law of viscosity, types of fluid, surface tension and capillarity, Pascal's law, absolute, gauge and vacuum pressures, pressure variation in a fluid at rest, pressure measurement, Bernoulli's equation-velocity and flow measurement, introduction to fluid machineries, classification of pumps and turbines.	**10**	**CO1, CO2, CO3**
III	Strength of Materials: Concept of stress and strain-Hook's law, Poisson's ratio, elastic and plastic deformation, normal stress, shear stress, bearing stress, normal strain, shearing strain, principal stresses, Mohr's circle, relation of Young's modulus, modulus of rigidity and bulk modulus, theories of failure and applications.	**10**	**CO1, CO2, CO3**
IV	Manufacturing Technology: Classification and types of materials, types of casting, patterns, pattern materials and allowances, classification and application of welding, brazing and soldering process, various metal forming techniques.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Nag P K., Engineering Thermodynamics, Tata McGraw Hill Publisher, 2017, 6th Edition.
2. Som S K., Biswas G. and Chakraborty S., Introduction to Fluid Mechanics & Fluid Machines, McGraw Hill Education India, 2017, 3rd Edition.
3. Shames I H., Introduction to Solid Mechanics, Prentice Hall, 2015, 3rd Edition.
4. Rao P N., Manufacturing Technology: Foundry, Forming and Welding, Volume I, Tata McGraw Hill, 2018, 5th Edition.
5. Timoshenko S. P. and Young D. H., Elements of Strength of Materials, East West, 2003, 5th Edition.
6. Srinath L. S., Strength of Materials, Macmillan publishers India, 2000, 1st Edition.

Reference Books:

1. Ghosh A. and Mallik A K., Manufacturing Science, Wiley Eastern, 2010, 2nd Edition.
2. Cengel Y A. and Boles M A., Thermodynamics, An Engineering Approach, McGraw Hill Education, 2017, 8th Edition.
3. Beer F P., Johnston E R., Dewolf J T., Mazurek D F., Sanghi S., Mechanics of Materials, McGraw Hill, 2020, 8th Edition..

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**I**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-1102	Engineering Drawing	**0**	**0**	**2**	**1**	**20**	**30**	**50**	**100**	

Course Objectives

1. Increase ability to understand Engineering Drawing.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

Course Outcomes

CO1	Use the drawing instruments effectively.	*Understanding/ Comprehension*
CO2	Understand the concept of orthographic and isometric projections.	*Understanding/ Comprehension*
CO3	Utilise computer aided software towards developments of 2D and 3D drawings.	*Understanding/ Applying*
CO4		

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Importance of Engineering Drawing, Sheet layout, type of lines and their representations, scales.	**6**	**CO1**
II	Principles of orthographic projection (multi view drawing): 1st and 3rd angle projection. **Orthographic Projections:** Points, lines, surfaces and solids.	**12**	**CO1, CO2, CO3**
III	Projection of sections and intersections of solids: Isometric projection.	**6**	**CO1, CO2, CO3**
IV	Introduction to computer aided drafting software	**6**	**CO1, CO2, CO3**
	Total Hours	**30**	

Text Books:

Reference Books:

1. Bhatt, N.D. and Panchal, V.M., "Engineering Drawing", Charotar Publishing House Pvt. Ltd, 2014, 43rd Ed.
2. Dhananjay, A. J., "Engineering Drawing", TMH, 2017, 1st Ed.
3. Venugopal, K. and Prabhu,V. R., "Engineering Graphics", New Age International Pvt. Ltd, 2018, 15th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**I**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-1103	Basic Mechanical Engineering Laboratory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To understand the fundamental principles and working of various mechanical systems, including turbines, engines, and machine tools. 2. To demonstrate and apply the concepts of fluid mechanics, thermodynamics, and materials science to practical problems. 3. To develop skills in operating, maintaining, and troubleshooting mechanical systems and equipment.	**Course Outcomes**	**CO1**	Explain and demonstrate the working of turbines and engines Describe the types and applications of machine tools and cutting tools	*Understanding/ Comprehension*
			CO2	Apply Bernoulli's principle and fluid mechanics concepts to solve problems related to fluid flow and pressure.	*Understanding/ Applying*
			CO3	Identify and describe the mechanical properties of various materials, including strength, hardness, and toughness.	*Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	To study and demonstrate the working of turbines. To demonstrate and study the working of SI and CI engines and its applications.	**8**	***CO1***
II	To study the different types of machine tools and cutting tools.	**8**	***CO1***
III	To demonstrate the Bernoulli's principle.	**8**	***CO2***
IV	To study the mechanical properties of materials.	**8**	***CO3***
Total Hours		**32**	

Reference Books:

1. Nag P.K., Engineering Thermodynamics, Tata McGraw Hill Publisher, 2017, 6thEdition.
2. Som S K., Biswas G. and Chakraborty S., Introduction to Fluid Mechanics & Fluid Machines, McGraw Hill Education India, 2017, 3rd Edition.
3. Shames I H., Introduction to Solid Mechanics, Prentice Hall, 2015, 3rd Edition.
4. Rao P N., Manufacturing Technology: Foundry, Forming and Welding, Volume I, Tata McGraw Hill, 2018, 5th Edition.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-1201	Engineering Mechanics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Able to utilize scalar and vector analytical techniques for analyzing forces in statically determinate structures. **2.** Able to apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems. **3.** Students get a basic idea of Centre of gravity, moment of inertia, mass moment of inertia, friction.	**Course Outcomes**	**CO1**	Understanding different type of forces, moments and resolving them. — *Understanding/ Comprehension*
			CO2	Analysing centre of gravity, moment of inertia and mass moment of inertia for various figures & bodies. — *Understanding/ Analyzing*
			CO3	Applying principles of kinematics, kinetics and effects of friction for solving problems. — *Understanding/ Applying*
			CO4	

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Forces and Moments:** Force, moment and couple, wrench, equivalent force and moment, forces in space equilibrium, FBD, general equations of equilibrium-Lami's theorem, analysis of forces in truss and frames, brief introduction to vector approach. **Friction:** Introduction to dry friction, laws of friction, friction of simple machines, inclined planes, screw jacks, clutch, and collar pivot bearing (uniform wear and uniform pressure assumptions).	**10**	**CO1**
II	**Centre of gravity and moment of inertia:** Centre of gravity, volume and composite bodies, area moment of inertia and mass moment of inertia for plane figures and bodies. **Virtual work and energy method:** Virtual displacement; principle of virtual work; applications of virtual work principle to machines	**10**	**CO1, CO3**
III	**Kinematics of particle:** Introduction, rectilinear motion, plane curvilinear motion, rectangular coordinates (x-y), normal and tangential coordinates (r-θ). **Kinetics of particle:** Review of force, mass, acceleration, work and energy, impulse, momentum, linear impulse and linear momentum, angular impulse and angular momentum, impact, central-force and motion, and relative motion, **Kinetics of system of particles:** Introduction, generalized Newton's second law, work-energy, impulse-momentum, conservation of energy and momentum, steady mass flow, variable mass.	**10**	**CO1, CO2, CO3**
IV	**Plane kinematics of rigid bodies:** Introduction, rotation, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration, motion relative to rotating axes. **Plane kinetics of rigid bodies:** Introduction, general equation of motion, translation, fixed axis rotation, general plane motion, work energy relations, acceleration from work-energy, virtual work, impulse-momentum equation.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Timoshenko S and Young D.H., "Engineering Mechanics", MGH, 2017, 5th Ed.
2. Beer and Johnston, "Vector Mechanics for Engineers: Statics and Dynamics", TMGH, 2012, 10th Ed.

Reference Books:

1. Meriam, J. L. and Kraige, L. G., "Engineering Mechanics, Volume 1: Statics", Wiley, 2017, 8th Ed.
2. Meriam, J. L. and Kraige, L. G., "Engineering Mechanics, Volume 2: Dynamics", Wiley, 2006, 5th Ed.
3. Shames, I. H. and Rao,G. K., "Engineering Mechanics: Statics and Dynamics'", Pearson 2006, 4thEd.
4. Nelson A., "Engineering Mechanics: Statics and Dynamics", TMGH, 2017, 1st Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**II**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 1202	Material Science and Metallurgy	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Know the fundamental science and engineering principles relevant to materials. **2.** Understand the relationship between microstructure, properties and processing. **3.** Have the experimental skills for a professional career or graduate study in materials. **4.** Design and selections of materials for specific application.	**Course Outcomes**	**CO1**	Understanding of mechanisms, physical and chemical properties of materials, including metals, ceramics, polymers and composites — *Understanding/ Comprehension*
			CO2	Analyse and correlate material structure properties, and performance of different materials. — *Identify/ Knowledge/ Remember*
			CO3	To be able to select the suitable materials for mechanical parts design, and manufacturing of different engineering applications. — *Understanding/ Analyzing*
			CO4	Describe the processing condition of alloys based on phase diagram. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
	CO4															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Material science, definition and its importance in relation to mechanical engineering, application of various materials in mechanical engineering.	**4**	**CO1, CO2, CO3**
II	**Material properties:** Mechanical, thermal and optical properties of materials	**4**	**CO1, CO2, CO3**
III	**Crystallography:** Crystal lattice, seven crystal system and fourteen bravis lattices, relationship between atomic diameter and lattice parameter in SC, BCC, FCC, HCP crystals, coordination numbers, atomic packing factor and voids in above mentioned crystals, introduction to defects in crystal: point defect, line defect.	**8**	**CO1, CO2, CO3**
IV	**Alloys and phase diagram:** Types of alloys, solid solutions, substitutional and interstitial solid solutions, factors affecting solid solubility (Hume Rothary rules), Gibbs phase rule, Lever rule, Isomorphous, eutectic, peritectic, eutectoid and peritectoid system, equilibrium in above binary phase diagrams,iron carbon equilibrium phase diagram and micro structure in plain carbon steel, non-equilibrium solidification in plain carbon steel, transformation curves – time-temperature-transformation (TTT) curves, continuous cooling transformation (CCT) curves.	**8**	**CO1, CO2, CO3**
V	**Heat treatment:** Various heat treatment processes– annealing, recovery, recrystallization and grain growth, normalizing, hardening, tempering, martempering, austempering, concept of hardenability, factors affecting it hardenability, surface hardening of steel, carburizing, cyaniding, nitriding, flame hardening and induction hardening etc.	**8**	**CO1, CO2, CO3**
VI	**Introduction to advanced materials:** Smart materials (shape memory alloys, magneto rheological fluid, electro rheological fluids, piezo electric materials, magneto rheological elastomers), composite materials, functionally graded composite materials, nano materials, biomaterials.	**8**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Smith, W., "Foundations of Materials Science and Engineering", McGraw Hill, 2009, 5th Ed.
2. Callister, W. D., "Material science and Engineering and Introduction", Wiley, 2016, 5th Ed

Reference Books:

1. Raghavan, V., "Materials Science and Engineering", PHI, 2015, 6th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2101	Introduction to Thermodynamics	**2**	**1**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Understand basic definitions and terminology. **2.** Identify special definitions from the thermodynamics point of view. **3.** Discover why and how natural processes occur only in unidirectional way. **4.** Understand the concept of property and how it defines the state thermodynamic. **5.** Identify the change of state results in a process. **6.** Determine why processes are required to build cycles. **7.** Recognize the differences between work producing and work consuming cycles.	**Course Outcomes**	**CO1**	1. Understand of the first and second laws of thermodynamics and their application to a wide range of systems working with pure substance and gaseous mixtures.	*Understanding/ Comprehension*
			CO2	2. Apply the work and heat interactions associated with a prescribed process & path to first law of thermodynamics for a flow and non-flow process.	*Understanding/ Applying*
			CO3	3. Analyse the entropy changes in a wide range of processes to determine the reversibility and irreversibility of a process from such calculations.	*Understanding/ Analyzing*
			CO4	4. Analyse the pressure-temperature diagrams, volume-temperature and pressure-volume phase diagrams and the steam tables for evaluation of engineering devices and systems.	*Analyzing/ evaluating*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Fundamental concepts: Review of fundamental concepts: systems, properties, state, thermodynamic processes and cycles, Zeroth law of thermodynamics, heat and work transfer.	**8**	***CO1***
II	First law of thermodynamics: First law applied to closed and open systems, internal energy, enthalpy, specific heats, perpetual motion machine of first kind (PMMI), steady flow energy equation (SFEE), application of SFEE to various engineering systems.	**10**	***CO2***
III	Second law of thermodynamics: Statements of the second law of thermodynamics and their equivalence, reversibility and irreversibility, Carnot cycle, Carnot theorem, absolute thermodynamic temperature scale, Clausius theorem and inequality, entropy principle, entropy changes during various processes, concept of third law of thermodynamics, availability.	**12**	***CO3***
IV	Properties of pure substances: P-V, P-T, T-s and h-s diagrams of a pure substance, sensible heat, latent heat, saturation temperature, dryness fraction, steam table, Mollier diagram Properties of ideal gases and their mixtures: Gases-equation of state of an ideal gas, thermodynamic property relations, specific heats, internal energy, enthalpy change of ideal gases,equation of state of real gases, principle of corresponding state, compressibility factor.	**10**	***CO4***
	Total Hours	**40**	

Text Books:

1. Cengel, Y. A., Boles, M. A., "Thermodynamics, An Engineering Approach", McGraw Hill Education, 2017, 8th Ed.
2. Nag, P. K., "Engineering Thermodynamics", McGraw Hill, 2017, 6th Ed.

Reference Books:

1 Sonntag, R. E., Borgnakke, C., Wylen, G. J. V., "Fundamentals of Thermodynamics", John Wiley, 2012, 6th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2102	Solid Mechanics	**2**	**1**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior. **2.** To understand and apply for evaluation of stress and deformation in simple geometries such as bars, beams, shafts, for various types of load conditions. **3.** To build the necessary theoretical background to be utilized in design courses.	**Course Outcomes**	**CO1** Understanding the concept of loads, stresses and strains — *Understanding/ Comprehension* **CO2** Distinguishing the deformation behaviour of structural members subjected to axial, transverse and torsional loads. — *Identify/ Knowledge/ Remember* **CO3** Analyzing the deformation characteristics of rods, beams and columns. — *Understanding/ Analyzing* **CO4** Evaluate the design criteria of thin and thick cylinders. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
	CO4															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction and concept of stress and strain:** Load, stress, principle of St. Venant, principle of superposition, strain, Hooke's law, modulus of elasticity, stress-strain diagrams, working stress, factor of safety, strain energy in tension and compression, resilience, impact loads.	**5**	**CO1, CO2**
II	**Analysis of axially loaded members:** Composite bars in tension and compression, temperature stresses in composite rods, concept of statically indeterminate problems. shear stress, complimentary shear stress, shear strain, modulus of rigidity, Poisson's ratio, bulk modulus, relationship between elastic constants.	**6**	**CO1, CO2, CO3**
III	**Biaxial state of stress:** Analysis of biaxial stress. plane stress, principal plane, principal stress, Mohr's circle for biaxial stress, stresses in thin cylinders and thin spherical shells under internal pressure, wire winding of thin cylinders.	**5**	**CO1, CO2, CO3**
IV	**Biaxial state of strain:** Two-dimensional state of strain, principal strains, Mohr's circle for strain, calculation of principal stresses from principal strains, strain Rossette.	**5**	**CO1, CO2, CO3**
V	**Shear force and bending moment diagrams:** Shear force and bending moment, types of load and types of support, support reactions, relationship between bending moment and shear force, point of inflection, shear force and bending moment diagrams.	**5**	**CO1, CO2, CO3**
VI	**Analysis of beams for bending:** Theory of simple bending of initially straight beams, pure bending, bending stresses, shear stresses in bending, distribution of normal and shear stress, composite beams.	**5**	**CO1, CO2, CO3**
VII	**Deflection of beams:** Differential equation of the elastic line, slope and deflection of beams by integration method and area - moment method, Castigliano's theorems.	**5**	**CO2, CO3**
VIII	**Torsion:** Torsion in solid and hollow circular shafts, twisting moment, strain energy in shear and torsion, strength of solid and hollow circular shafts, strength of shafts in combined bending and twisting.	**5**	**CO1, CO2, CO3**
IX	**Pressure vessels:** Stresses in thin and thick cylinders, longitudinal stress, compound cylinders.	**2**	**CO1, CO2, CO3**
X	**Introduction to buckling of columns:** Classification of columns, Euler's theory, crippling stress.	**2**	**CO1, CO2, CO3**
	Total Hours	**45**	

Text Books:

1. Shames, I. H., "Introduction to Solid Mechanics", Prentice Hall , 2015, 3rd Ed.
2. Ryder, G. H., "Strength of Materials", Macmillan Press, 1969, 3rd Ed.
3. Beer and Johnston, "Mechanics of Materials", McGraw Hill, 2017, 7th Ed.
4. Srinath L. S., Strength of Materials, McMillan Publishers India, 2000.
5. Timoshenko S., Elements of Strength of Materials, East West Publisher, 2003, 5th Ed.

Reference Books:

1. Beer and Johnson, Mechanics of Materials, McGraw Hill, 2017, 7th Ed.

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(शिक्षामंत्रालय, भारत सरकारकेतहतराष्ट्रीयमहत्वकासंस्थान)
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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2103	Fluid Mechanics – I	**2**	**1**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Understand the fundamentals of fluid mechanics. 2. Interpretation of different governing equations of fluid flows. 3. Describe the fundamentals of incompressible viscous flow and various flow measurement devices. 4. Able to solve fundamental problems of fluid flow.	**Course Outcomes**	**CO1**	Understand the basics of fluid statics, kinematics and dynamics. — *Understanding/ Comprehension*
			CO2	Know about different governing equations of fluid mechanics. — *Identify/ Knowledge/ Remember*
			CO3	Solve fundamental problems of fluid mechanics. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	3	1	–	–	–	–	–	–	–	–	1	–	–
2	CO2	3	2	3	2	–	–	–	–	2	–	–	–	2	2	2
3	CO3	3	3	3	3	–	–	–	–	2	–	–	1	2	3	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Review of fundamentals:** Introductory concepts, properties and classification of fluids, basic hydrostatic equation, measurement of pressure, forces on submerged plane and curved surfaces, buoyancy and stability.	**6**	**CO1, CO2**
II	**Kinematics of fluids:** Streamline, pathline, streakline, scalar and vector fields, flow field and description of fluid motions, deformation of fluid element.	**6**	**CO1, CO3**
III	**Conservation equations:** integral and differential formulations - conservation of mass, conservation of momentum and conservation of energy; Bernoulli equation, stream function, velocity potential and vorticity, Euler equation.	**10**	**CO1, CO2, CO3**
IV	**Principles of physical similarity and dimensional analysis:** Introduction, concept and type of physical similarity, applications of dynamic similarity, dimensional analysis.	**5**	**CO1, CO2, CO3**
V	**Some incompressible viscous flows:** Reynolds experiment, plane Poiseuille flow, Hagen Poiseuille flow, Couette flow, losses in pipes, friction factors, hydraulic diameter, pipes in series and parallel.	**8**	**CO1, CO2, CO3**
VI	**Flow measurement devices:** Pilot tube, venturi meter, orifice meter, orifice and mouthpieces, pitot static tube.	**5**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Som, S. K.,.Biswas, G and Chakraborty, S., "Introduction to Fluid Mechanics and Fluid Machines", TMH, 2017, 3rd Ed.
2. Munson, B. R., Young, D. F., Okiish, T. H., "Fundamental of Fluid Mechanics", Wiley, 2012, 7th Ed.
3. Cengel Y. A. and Cimbala J. M., Fluid Mechanics: Fundamentals and applications, McGraw, 2019, 4th Ed.

Reference Books:

1. White, F. M., "Fluid Mechanics", TMH, 2014, 8th Ed.
2. Fox, R. W., McDonald, A. T., Pritchard, P. J., "Introduction to Fluid Mechanics", 2003, 6th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 2104	Manufacturing Processes-I	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Identify the various manufacturing processes. **2.** To understand the fundamentals of casting, welding, metal forming and powder metallurgy. **3.** Examine the various manufacturing methods encountered in engineering practice. **4.** Analyze the effect of process variables to manufacture defect free products.	**Course Outcomes**	**CO1**	Describe the various manufacturing processes. — *Understanding/ Comprehension*
			CO2	Interpret casting, welding, metal forming and powder metallurgy techniques — *Identify/ Knowledge/ Remember*
			CO3	Interpret casting, welding, metal forming and powder metallurgy techniques — *Understanding/ Analyzing*
			CO4	Evaluate the effect of process variables to manufacture defect free products. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Casting**: Introduction, patterns, pattern materials, allowances, types of pattern, sand casting, green and dry sand casting process, types of sand, moulding sand and its properties, moulding sand composition, use of cores, core material, core prints, special moulding processes, die casting process, investment casting process, injection moulding, continuous casting process, vacuum-sealed casting process, plaster mould casting, casting defects and testing's, causes and remedies of defects.	**10**	**CO1, CO2, CO3**
II	**Welding**: Classification and application of welding, brazing and soldering process, principles and applications of various welding processes: gas welding, types of flames, shielded material, inert gas welding, tungsten arc welding, submerged arc welding, resistance welding, thermit welding, friction stir welding, high frequency welding, newer welding techniques, laser welding, plasma welding, ultrasonic welding, electron beam welding, various welding defects and testing's	**10**	**CO1, CO2, CO3**
III	**Metal Forming**: Elastic and plastic deformation, concept of strain hardening, hot and cold working processes, various metal forming techniques; rolling, forging, extrusion, wire and tube drawing. Machines and equipment for metal forming processes. Sheet metal forming: shearing, blanking, piercing, bending, stretch forming, metal spinning, and shear spinning, deep drawing, forming defects and testing, swaging, high energy rate forming, explosive forming, electromagnetic forming, electro-hydraulic forming, hydro forming.	**15**	**CO1, CO2, CO3**
IV	**Powder Metallurgy**: Introduction to powder metallurgy, production of metal powders, compaction and sintering processes, secondary and finishing operations, economics, advantages and applications of powder metallurgy.	**6**	**CO1, CO2, CO3**
	Total Hours	**41**	

Text Books:

1. Rao P. N, "Manufacturing Technology: Foundry, Forming and Welding, Volume I", Tata McGraw Hill, 2018, 5th Ed.
2. Ghosh A, Mallik A. K, "Manufacturing Science", Wiley Eastern, 2010, 2nd Ed.

Reference Books:

1. Kalpakjian S, Schmid S. R, "Manufacturing Processes for Engineering Materials", Pearson education, 2009, 5th Ed.
2. Dieter G. E, Mechanical Metallurgy, TMH, 2017, 3rd Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2105	Machine Drawing - Laboratory	**3**	**0**	**0**	**3**	**50**	**-**	**50**	**100**	

Course Objectives	**1.** Explain the basics of ISO codes, tolerances, fits and symbols of welding. **2.** Prepare part and assembly drawings of machine parts. **3.** Develop a part model using CAD tool	**Course Outcomes**	**CO1**	Explain the basic standards of machine drawings. — *Understand*
			CO2	Explain tolerance and symbols used for different operations and fit. — *Understand*
			CO3	Sketch the part and assembly drawings of different machine parts. — *Apply*
			CO4	Develop a part model using CAD tool. — *Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**											**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*											*	*		
2	CO2	*	*										*	*		*
3	CO3	*	*	*	*	*				*			*	*	*	*
4	CO4	*	*			*				*			*	*	*	*

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Review of orthographic projections and sectioning. IS/ISO codes, limits, tolerances and fits, surface finish, symbols for weldments, process flow, electrical and instrumentation units	**4**	**CO1, CO2**
II	Assembly and part drawings of simple assemblies and subassemblies of machine parts such as couplings, clutches, bearings, gear assemblies.	**4**	**CO3**
III	I.C. engine components, valves, machine tools, etc. introduction to solid modellers,	**10**	**CO3**
IV	A drawing project on reverse engineering. Use of drawing software.	**2**	**CO4**
	Total Hours	**20**	

Text Books:

1. Bhatt, N. D., "Machine Drawing", Charotar Book Stall, Anand, 2014, 53rd Ed.
2. Sidheswar, N., Kanniah, P., Sastry, V. V. S., "Machine Drawing", Tata McGraw Hill, 2001, 1st Ed.
3. SP 46: 1988 Engineering Drawing Practice for School & Colleges, Bureau of Indian Standards.

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**CourseName**	**CreditStructure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2106	Strength of Materials Laboratory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To perform the hardness, compression, torsion, tension and impact test in various materials and analyse thebehaviour of materials.	**Course Outcomes**	**CO1**	To analyse the behaviour of materials under tension, compression, torsion and sudden load conditions in various materials.

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
	List of the experiments are as follows: a. To obtain the stress-strain curve by performing the tensile test for both ductile and brittle material in Universal Testing Machine (UTM). b. Determination of hardness of a material using Brinell hardness testing machine, Rockwell hardness testing machine, Vickers hardness testing machine. c. Determination of toughness of a material using Impact testing machine. d. Determination of twisting moment of a material using Digital torsion testing machine. e. Beam bending and deflection of beam with various boundary conditions. f. Column buckling.		***CO1***
	Total Hours		

Text Books:

1. Capareda Sergio, Introduction to Biomass Energy Conversions, CRC Press, 2013, 1st Ed.

Reference Books:

2. Capareda Sergio, Introduction to Biomass Energy Conversions, CRC Press, 2013, 1st Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2107	Laboratory III-Workshop Practice - II	**0**	**0**	**2**	**1**	**20**	**30**	**50**	**100**	
Course Objectives	**1.** Demonstrate the various mechanical measuring instruments.	**Course Outcomes**	**CO1**	Demonstrate various mechanical measuring instruments to measure the dimensions, like. Height, angle, and surface properties of given specimens.						*Understanding/ Comprehension*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	a. Sample preparation. b. Metallographic study using metallurgical/optical microscope. c. Surface roughness measurement. d. Calibration of micrometer and vernier calliper using slip gauges. e. Measurement of the diameter and height of a given specimen using the micrometer. f. Use of different angle measuring instruments. g. Measurement of screw thread parameters using grove micrometer. h. Checking the flatness of granite surface plate using spirit level. i. Measurement of different elements of gear.	**15**	**CO1**
Total Hours		**15**	

Text Books:

1. Rao, P. N., "Manufacturing Technology: Foundry, Forming and Welding, Volume I", Tata McGraw Hill, 2018, 5th Ed.

2. Holman, J. P., "Experimental Methods for Engineers", McGraw Hill Education, 2017, 7th Ed.

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	T	P	C	INT	MID	END	Total	
ME-2101S	SDC1- Learning Modelling Software	**0**	**0**	**2**	**1**	**50**		**50**	**100**	

Course Objectives	**1.** Understand basic of overview of AutoCAD. **2.** Students get a basic idea of 2D Drawing Fundamentals andAdvanced 2D Drawing. **3.** Students get a basic idea of 3D Modeling Fundamentals.	**Course Outcomes**	**CO1** Understand basic of overview of AutoCAD. — *Understanding/ Comprehension* **CO2** Students get a basic idea of 2D Drawing Fundamentals andAdvanced 2D Drawing — *Identify/ Knowledge/ Remember* **CO3** Students get a basic idea of 3D Modeling Fundamentals. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to AutoCAD : Overview of AutoCAD: History, evolution, and importance. Installing and setting up AutoCAD: Hardware and software requirements. User interface: Menu bars, toolbars, and palettes. Navigation: Viewing, zooming, and panning. Basic drawing and sketching: Lines, arcs, circles, and curves.	**3**	**CO1, CO2, CO3**
II	2D Drawing Fundamentals : Sketching fundamentals: Geometric shapes, dimensions, and constraints, Sketching tools: Lines, arcs, circles, and curves, Dimensioning and annotation: Text, dimensions, and leaders, Object modification: Editing, deleting, and manipulating objects, Layer management: Layer creation, properties, and management, Object properties: Color, line type, and line weight, Basic editing tools: Erase, trim, and extend	**4**	**CO1, CO2, CO3**
III	Advanced 2D Drawing : Advanced geometry creation: Polylines, splines, and curves,Hatching and gradients: Fills and patterns, Dimension styles: Customizing dimension styles, Blocks and symbols: Creating and inserting blocks,Attributes and tags: Adding attributes and tags, Advanced editing tools: Array, mirror, and offset,2D drawing best practices: Organization, standards, and efficiency	**4**	**CO1, CO2, CO3**
IV	3D Modeling Fundamentals:Introduction to 3D modeling: Basic concepts and terminology,Primitive shapes: Boxes, cylinders, and spheres,Extrusions and sweeps: Creating 3D models from 2D profiles,Lofts and surfaces: Creating complex shapes,Assembly modeling: Creating and managing assemblies,Material properties: Assigning materials and textures,Basic rendering: Rendering 3D models	**4**	**CO1, CO2, CO3**
	Total Hours	**15**	

Text Books:

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2201	Fluid Mechanics – II	**2**	**1**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Understand the concepts of boundary layers, its related equations and also the mechanics of viscous flow about immersed boundaries. 2. Apply the basic law of thermodynamics to a steady flow in a conduit to derive the general one-dimensional flow equation. 3. Recognize the isentropic flow and normal shock to some flow systems such as discharge of air from tanks and nozzle configurations. 4. Formulate a general treatment of the common forms of turbomachines, covering basic fluid dynamics and thermodynamics of flow through passages and over surface with fundamental governing equations. 5. Describe the basic characteristics of radial and axial pumps, turbines and fans with different kinds of working medium.	**Course Outcomes**	**CO1**	Understand the concepts of viscous boundary layers, boundary layer equations, Blasius solution, momentum integral equation to determine integral thicknesses, wall shear stresses, and skin friction coefficients.	*Understanding/ Comprehension*
			CO2	Describe the principles and applications of turbomachinery in modern industry and apply the principles of fluid mechanics to the operation, design, and selection of fluid machinery such as pumps, fans, and turbines.	*Identify/ Knowledge/ Remember*
			CO3	Evaluate the mechanics of viscous flow about immersed boundaries, as it relates to flow separation, wakes, profile drag, drag coefficients and the determination of drag forces exerted on such bodies.	*Understanding/ Analyzing*
			CO4	Apply the compressible flow analysis to a pipe flow and compute the pressure losses due to friction, area change in the system and assess the performance of the system.	

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	2	1	1	-	-	2	2	-	2	3	3	2
2	CO2	3	2	2	2	1	1	-	-	2	2	-	2	3	3	2
3	CO3	3	2	2	2	1	1	-	-	2	2	-	2	3	3	2
3	CO4	3	2	2	2	1	1	-	-	2	2	-	2	3	3	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Boundary layer flows:** Introduction to laminar boundary layer for flow over a flat plate, boundary layer thickness, displacement and momentum thickness, Boundary layer equations, Blasius solution, momentum-integral equation of boundary layer, separation of boundary layer, turbulent flat plate boundary layers.	**10**	**CO1, CO2, CO3, CO4**
II	**Forces on submerged bodies:** Drag and lift on a stationary body by flowing fluid, streamlined and bluff body, terminal velocity of a body, lift on an aerofoil.	**10**	**CO1, CO2, CO3, CO4**
III	**Compressible flow:** Introduction, thermodynamic relations of perfect gases, speed of sound, pressure field due to a moving source, basic equations, flow through nozzles, stagnation and sonic properties, normal shock waves, oblique shock.	**10**	**CO1, CO2, CO3, CO4**
IV	**Turbomachines:** Euler-equation for turbo-machines, impact of free jets, impulse-momentum principle, force exerted by the jet on stationary flat and curved plate, hinged plate, moving plate and moving curve/vanes, impulse turbine - Pelton wheel, reaction turbine- Francis turbine, propeller turbine, centrifugal pump, performance parameters and characteristics of pumps and turbines, cavitation, net positive suction head (NPSH), positive displacement pumps.	**10**	**CO1, CO2, CO3, CO4**
	Total Hours	**40**	

Textbooks:

1. Som, S. K.,. Biswas, G and Chakraborty, S., "Introduction to Fluid Mechanics and Fluid Machines", TMH, 2017, 3rd Ed.
2. Munson, B. R., Young, D. F., Okiish, T. H., "Fundamental of Fluid Mechanics", Wiley, 2012, 7th Ed.
3. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachines, Butterworth Heinemann, 2005, 5th Ed.
4. Oosthuizen, P.H. and Carscallen,W.E., Compressible Fluid Flow, McGraw-Hill, 2003, 1st Ed.

Reference Books:

1. White, F. M., "Fluid Mechanics", TMH, 2014, 8th Ed.
2. Fox, R. W., McDonald, A. T., Pritchard, P. J., "Introduction to Fluid Mechanics", 2003, 6th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2202	Theory of Machines	**2**	**1**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To learn different mechanism of machine.
2. To learn different working principle of various types of gears, brakes, cams.
3. To learn how to draw velocity and acceleration diagram for kinematics pairs.

Course Outcomes

CO1	Understanding basic concepts of kinematics of various mechanisms to obtain specific motion in machine elements.	*Understanding/ Comprehension*
CO2	Understanding the working principle of different types of gears, brakes, cams.	*Identify/ Knowledge/ Remember*
CO3	Evaluation and analysis of kinematic parameters with the help of velocity and acceleration diagram for kinematics pairs	*Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Machine and mechanism:** Introduction to kinematics, mechanism and machine, link, kinematic pair, degrees of freedom, kinematic chain, various types of joints, degrees of freedom for plain mechanism, inversion, different types of kinematic chain and their inversions, Kutzbachcriteria and Grublercriteria.	**5**	**CO1, CO2**
II	**Velocity and acceleration in mechanism:** Analysis of reciprocating engine mechanism and four bar mechanism, relative velocity method, velocity and acceleration in four bar, slider crank mechanism, instantaneous centre method, Kennedy's theorem, mechanical advantage, Coriolis acceleration component.	**6**	**CO1, CO2, CO3**
III	**Mechanism Synthesis:** Synthesis of mechanism, pantograph, Scott-Russel indicator diagram Graphical methods of synthesis, relative pole and inversion methods, Chebychev spacing for precision positions, Freudenstein's equation applicable to four bar linkages.	**6**	**CO1, CO2, CO3**
IV	**Brakes &dynamometers:** Classification of brakes, analysis of simple block, band and internal expanding shoe brake, braking of a vehicle, absorption and transmission dynamometers, prony brake, rope brake dynamometer, belt transmission, torsion dynamometer.	**7**	**CO1, CO2, CO3**
V	**Gear and gear trains:** Gear terminology and definitions, analysis of mechanism trains, simple train, compound train, reverted train, epicyclic train and their applications.	**8**	**CO1, CO2, CO3**
VI	**Cams:** Introduction, types of followers, cam profile nomenclature, various types of motion of the follower-uniform motion, simple harmonic, uniform acceleration and retardation, cycloidal, graphical and analytical approaches for cam profile synthesis.	**8**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Shigley, J. E., Vicker, J. J., "Theory of Machines and Mechanisms", MGH, 2014, 4th Ed.
2. Rao, J. S., "Mechanism and Machine Theory", Newage publishers, 2010, 2nd Ed.

Reference Books:

1. Rattan, S. S., "Theory of Machine", TMGH, 2017, 4th Ed

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2203	Manufacturing Processes-II	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand the concept and basic mechanics of metal cutting. **2.** To understand the effect of different process parameters during machining. **3.** To understand the concept of non-conventional machining. **4.** To understand the basic concepts of additive manufacturing processes. **5.** To relate all basic concepts related to Industry 4.0 concept	**Course Outcomes**	**CO1**	Demonstrate the concept and mechanics of metal cutting. — *Understanding/ Comprehension*
			CO2	Choose effectively the different process parameters during machining. — *Identify/ Knowledge/ Remember*
			CO3	Identify and apply the concept of non-conventional machining. — *Understanding/ Analyzing*
			CO4	Describe and practice the basic concepts of additive manufacturing processes. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Machining and Machinability**: Classification of metal removal processes, concepts of machining and machinability and its improvement, mechanism of chip formation, orthogonal and oblique cutting, geometry of single point cutting tools, conversion of tool angles from one system to another, use of chip breakers in machining.	**6**	**CO, CO2, CO3**
II	**Mechanics of machining**: Machining forces and Merchant's circle diagram (MCD), analytical and experimental determination of cutting forces, dynamometers for measuring cutting forces, cutting temperature-causes and effects, assessment and control, cutting fluid application, failure of cutting tools and tool life, cutting tool materials for common use, advanced cutting tool materials, estimation of machining time.	**7**	**CO1, CO2, CO3**
III	**Non-conventional machining**: Classification of non-conventional machining based on source of energy, abrasive jet machining, water jet and abrasive water jet machining, ultrasonic machining, chemical machining, electro chemical machining, electro discharge machining, electron beam and laser beam machining, ion beam machining.	**7**	**CO1, CO2, CO3**
IV	**Introduction to micro and nano machining techniques:** Electro chemical discharge machining, electro chemical grinding, electro chemical honing.	**6**	**CO1, CO2, CO3**
V	**Additive manufacturing**: Introduction and working principle of AM techniques like vat photo-polymerization AM process, material jetting AM processes, binder jetting AM processes, extrusion based AM processes, sheet lamination AM processes, powder bed fusion AM processes.	**6**	**CO, CO2, CO3**
VI	**Introduction to Industry 4.0:** Introduction, core idea of industry 4.0, origin concept of industry 4.0, industry 4.0 production system, current state of industry 4.0, main concepts and components of industry 4.0.	**6**	**CO, CO2, CO3**
VII	**Introduction to machine learning:** Learning problems: perspectives and issues, concept learning	**6**	**CO, CO2, CO3**
	Total Hours	**44**	

Text Books:

1. Bhattacharyya A, Metal Cutting: Theory and Practice, New Central.
2. Pandey P.C and Shan H.S, Modern Machining Processes, Tata McGraw Hill, 2017.
3. Rao P. N, Manufacturing Technology: Volume II, Tata McGraw Hill, 2008
4. Ghosh A and Mallik A. K, Manufacturing Science, Wiley Eastern, 1986.
5. Kalpakjian S and Schmid S. R, Manufacturing Processes for Engineering Materials, Pearson education, 2009.
6. Chattopadhyay A. B, Machining and Machine Tools, Wiley, 2011.
7. Chattopadhyay A. B, Machining and Machine Tools, Wiley, 2011.
8. Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0.

Reference Books:

1. Lal G. K, Introduction to Machining Science, New Age International Pvt. Ltd., 2007.
2. Shaw M. C, Metal Cutting Principles, MIT Press, 2004.
3. Mishra P. K, Non-conventional Machining, Narosa Publishing House, 1997.
4. Bandyopadhyay A., Bose S., Additive Manufacturing, CRC Press, Taylor & Francis group, 2020, 2nd edition.
5. Paul C. P., Junoop A. N., Additive Manufacturing: Principles, Technologies and Applications, McGraw Hill, 2021.
6. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2204	Applied Thermodynamics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To learn about various vapour power cycles, cogeneration, steam generators, steam turbines etc. **2.** To study about, refrigeration cycles, air conditioning and refrigeration, properties of dry and wet air and the principles of psychrometry. **3.** To understand about air compressors, IC engines etc.	**Course Outcomes**	**CO1**	Understand and recognize various practical power cycles, heat pump cycles, refrigeration cycles etc. — *Understanding/ Comprehension*
			CO2	Apply the energy conversion in various thermal devices such as nozzles, diffusers, steam turbines and reciprocating compressors — *Understanding/ Applying*
			CO3	Analyse the air compressors, IC engines and their working. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Vapour power cycles: Rankine cycle, cycle with superheat, reheat and regeneration and intercooling.	**8**	***CO1***
II	Gas power cycles: Otto, Diesel and Dual cycles , air standard Brayton cycle, cycle with superheat, reheat and regeneration and intercooling, combined gas and vapour power cycles.	**10**	***CO1***
III	Refrigeration: Vapour compresion refrigeration cycles, vapour absorption refrigeration cycles, refrigerants and their properties, air refrigeration. Psychometry: Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	**10**	***CO1, CO2***
IV	Reciprocating air compressors: Staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines: Velocity and pressure compounding of steam turbines. IC Engines: SI and CI engines, two stroke and four stroke engines, performance parameters, modern fuel ignition systems, combustion in SI and CI engines.	**12**	***CO2, CO3***
	Total Hours	**40**	

Text Books:

1. Cengel Yunus A. and Boles, "Engineering Thermodynamics", Tata McGraw-HillPublishing Co. Ltd, 2017, 8th Ed.
2. Eastop T.D and McConkey A., "Applied Thermodynamics and engineering", 2010, 5th Ed.

Reference Books:

1. Jones, J. B. and Duggan, R. E., "Engineering Thermodynamics", Prentice-Hall of India, 1996.
2. Moran, M. J. and Shapiro, H. N., "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 1999.
3. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., , "Fundamentals of Thermodynamics", John Wiley and Sons, 2003, 6th Edition.
4. Nag, P.K, "Engineering Thermodynamics", Tata McGraw-Hill Publishing Co. Ltd, 1995.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-220A	**Design of Machine Elements**	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To teach the students the basic concepts of the design process and demonstrating the fact that design problems are open-ended, require creativity and involve iterative solutions. **2.** To teach the students design methodologies and simple stresses & applicability of factor of safety. **3.** Will be able to design machine elements based on strength and stiffness.	**Course Outcomes**	**CO1**	Will have knowledge on design philosophy, design considerations for machine component design, engineering materials and their properties. — *Understanding/ Comprehension*
			CO2	Will have basic understanding on machine elements subjected to different loading conditions and failure theories. — *Identify/ Knowledge/ Remember*
			CO3	Will be able to apply knowledge in design of permanent and non-permanent joints e.g. cotter joint, knuckle joint, keys, bolted & coupling and permanent joints e.g. riveted and welded joints subjected to static load. — *Understanding/ Analyzing*
			CO4	Will be able to design machine components like shafts, couplings, mechanical springs, friction drives, various springs and power screws. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Basics of Machine design**: Introduction to Mechanical Design, overview of design and manufacturing procedure, engineering materials, load-stress-strain analysis in machine parts, deflection and stiffness in machine elements.	**6**	**CO1, CO2, CO3**
II	**Design for Strength**: Design for static loading, stress concentration, failures theories from static loading, Introduction to fatigue load, fatigue failure analysis and design, failure theories for fluctuating stress.	**6**	**CO1, CO2, CO3**
III	**Design of Permanent and non-permanent Joints:** Riveted joints, welded joints, design of Non-Permanent Joints: screws, fasteners and bolted joints, keys, knuckle and cotter joints.	**5**	**CO1, CO2, CO3**
IV	**Design of shaft and shaft components:** Design of shaft for static loading and fluctuating loads: pure torsion, simple bending, combined bending and torsion, combined bending, torsion and axial loads.	**6**	**CO1, CO2, CO3**
V	**Design of shaft couplings**: Muff couplings, rigid flange couplings, flexible couplings: bush-pin type.	**5**	**CO1, CO2, CO3**
VI	**Design of mechanical springs:** stresses and deflection of helical springs, closed and open coiled tension and compression springs and their ends, design of helical springs for static and fatigue loading. design of leaf springs,	**6**	**CO1, CO2, CO3**
VII	**Friction drives:** Design of clutches: single plate, multiplate, centrifugal and cone.	**5**	**CO1, CO2, CO3**
VIII	**Design of brakes:** Single and double band, block, differential band brakes, internal expander brakes.	**5**	**CO1, CO2, CO3**
	Total Hours	**44**	

Text Books:

1. Norton, L. R., "Machine Design an Integrated Approach", 5th Ed., Pearson Education Asia, 2018.
2. Shigley, J. E., Mischke, C. R., "Mechanical Engineering Design", 9th Ed., Mcgraw Hill, 2018
3. Bhandari, V. B., "Design of Machine Elements", 4th Ed., McGraw-Hill, 2017.
4. S. Md. Jallaludeen, "Design Data Handbook" (Anuradha Publications)

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**CourseName**	**CreditStructure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2206	Fluid Mechanics and Machinery Laboratory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To provide practical knowledge in various fluid mechanics devices. 2. To gain knowledge in performance testing of fluid machineries.	**Course Outcomes**	**CO1**	Apply knowledge of classical fluid mechanics principles. — *Apply*
			CO2	Evaluate the performance of fluid machineries. — *Evaluate*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
	List of experiments a. Metacentric height apparatus. b. Flow rate measurement using Venturimeter and Orifice meter. c. Determination of flow velocity using Pitot tube. d. Determination of discharge coefficient of notches. e. Determination of friction factor as a function of Reynolds number in pipe flow. f. Impact of jet on flat and curved surfaces. g. Performance characteristics of Pelton wheel, Francis and Kaplan turbine. h. Performance characteristics of pumps.	**12**	***CO1,CO2***
	Total Hours	**40**	

Text Books:

1. Som, S. K.,.Biswas, G and Chakraborty, S., "Introduction to Fluid Mechanics and Fluid Machines", 2017, TMH, 3rd Ed.

Reference Books:

1. Munson, B. R., Young, D. F., Okiish, T. H., "Fundamental of Fluid Mechanics", Wiley, 2012, 7th Ed.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2207	Theory of Machines Laboratory	**0**	**0**	**2**	**1**	**50**	**-**	**50**	**100**	
	1. To provide students with practical experience in analyzing the forces and motions within mechanical systems, including mechanisms like governors, gyroscopes, and balancing machines.		**CO1**	Understand the Terminology and types associated with vibration in machine elements.						*Understanding*
			CO2	Identify and select the appropriate power transmission mechanisms.						*Analyzing*
			CO3	Analyze CAM profile for the specific follower motion.						*Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Motion analysis of different CAM and follower pair.	**02**	**CO3**
II	Free vibration of single and two degree of freedom system	**01**	**CO1**
III	Forced vibration of single and two degree of freedom system	**01**	**CO1**
IV	Analysis of gyroscope effect.	**02**	**CO2**
V	Determination of critical speed of whirling of shafts.	**02**	**CO1**
VI	Static and dynamic balancing of revolving masses.	**02**	**CO1**
VII	Analysis of pressure distribution in hydrodynamic lubrication of journal bearing.	**02**	**CO2**
	Total Hours	**12**	

Text Books:

Reference Books:

1. Bevan Thomas., Theory of Machines, CBS Publishers and Distributors, 2005, 3rd Edition.
2. Rattan.S.S, Theory of Machines, Tata McGraw -Hill Publishers, New Delhi, 2009.
3. Uicker J John., Pennock R Gordon, Shigley E Joseph., Theory of Machines and Mechanism, Oxford university Press, 2014.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-2208	Manufacturing Process Laboratory-I	**0**	**0**	**2**	**1**	**50**		**50**	**100**	

Course Objectives

1. Acquire skills of the various manufacturing processes.
2. Acquire practical knowledge of casting, welding, metal forming and powder metallurgy processes.
3. Examine the various manufacturing methods encountered in engineering practice.
4. Analyse the effect of process variables to manufacture defect free products

Course Outcomes

CO1	Understand Metal Casting Processes for both ferrous and non-ferrous metals,	*Understanding/ Comprehension*
CO2	Understand how to join thin metal sheets using resistance welding and its applications in modern manufacturing.	*Identify/ Knowledge/ Remember*
CO3	Evaluate Sand Properties to determine the friability value and moldability index of compacted molding sand. Assess Green Sand Strength to evaluate the suitability of molding sand compositions.	*Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Perform metal casting for both ferrous and non-ferrous metals.	**4**	**CO1, CO2, CO3**
II	To perform joining of two metals using gas welding and arc welding.	**4**	**CO1, CO2, CO3**
III	To join thin metal sheets using resistance welding.	**2**	**CO1, CO2, CO3**
IV	Sieve analysis test of sand/powder and its specification and also to find the distribution of sand grains using a set of sieves and to find the average grain fineness number.	**2**	**CO1, CO2, CO3**
V	To find the friability value and the moldability index of the compacted moulding sand.	**2**	**CO1, CO2, CO3**
VI	To find the green compression strength of the given specimen at different percentage of clay and moisture.	**2**	**CO1, CO2, CO3**
	Total Hours	**16**	

Text Books:

Reference Books:

1. Rao P. N, "Manufacturing Technology: Foundry, Forming and Welding, Volume I", Tata McGraw Hill, 2018, 5th Ed.
2. Ghosh A, Mallik A. K, "Manufacturing Science", Wiley Eastern, 2010, 2nd Ed..

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	T	P	C	INT	MID	END	Total	
ME-2201S	SDC2-Learning Analysis Software	**0**	**0**	**2**	**1**	**50**	**0**	**50**	**100**	

Course Objectives	**1.** Understand basic of Introduction to Solid Works **2.** Students get a basic idea of 2D Sketching. **3.** Students get a basic idea of 3D Modeling Fundamentals	**Course Outcomes**	**CO1**	Understand basic of Introduction to Solid Works — *Understanding/ Comprehension*
			CO2	Students get a basic idea of 2D Sketching. — *Identify/ Knowledge/ Remember*
			CO3	Students get a basic idea of 3D Modeling Fundamentals — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to Solid Works :Overview: History, evolution, and importance, Installing and setting up: Hardware and software requirements, User interface: Menu bars, toolbars, and palette, Navigation: Viewing, zooming, and panning, Basic drawing and sketching: Lines, arcs, circles, and curves	**4**	**CO1, CO2, CO3**
II	2D Sketching : Sketching fundamentals: Geometric shapes, dimensions, and constraints, Sketching tools: Lines, arcs, circles, and curves, Dimensioning and annotation: Text, dimensions, and leaders, Sketch modification: Editing, deleting, and manipulating sketches, Best practices: Organization, standards, and efficiency	**4**	**CO1, CO2, CO3**
III	3D Modeling Fundamentals : Introduction to 3D modeling: Basic concepts and terminology, Primitive shapes: Boxes, cylinders, and spheres, Extrusions and sweeps: Creating 3D models from 2D profiles, Lofts and surfaces: Creating complex shapes, Assembly modeling: Creating and managing assemblies, Material properties: Assigning materials and textures, Basic rendering: Rendering 3D models	**6**	**CO1, CO2, CO3**
Total Hours		**14**	

Text Books:

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 3101	Heat Transfer	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To understand basic phenomena of heat transfer mechanisms, i.e. conductions, convection and radiation.
2. To develop methodologies for solving a wide variety of practical engineering problems requiring the formulations of conduction and convection.
3. To develop basic understanding of two phase flow heat transfer.

Course Outcomes

CO1	Understanding the different modes of heat transfer and basic governing laws.	*Understanding/ Comprehension*
CO2	Analysis of problems involving steady and transient heat conduction in simple geometries.	*Identify/ Knowledge/ Remember*
CO3	Understand the fundamentals of convective heat transfer process in engineering applications.	*Understanding/ Analyzing*
CO4	Analysis of heat exchanger performance and effectiveness as well as boiling heat transfer.	*Understanding/ Analyzing/ Applying*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*	*											*		
2	CO2	*	*	*										*		
3	CO3	*	*	*										*		
4	CO4	*	*	*										*	*	

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Typical heat transfer situations, modes of heat transfer, introduction to laws, some heat transfer parameters.	**4**	**CO1**
II	**Conduction:** Fourier's law and thermal conductivity, equation of heat conduction, boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere, concept of thermal resistance, concept of overall heat transfer coefficient, critical radius, heat generation, fin analysis, uniform cross section, two dimensional steady heat conduction, transient conduction-lumped capacitance model, one dimensional transient conduction – analytical solutions.	**10**	**CO2**
III	**Natural convection:** Introduction, differential equations, vertical plate, horizontal cylinder, horizontal plate. **Forced convection:** Differential equation of convection, laminar flow and heat transfer in circular pipe, thermal entrance region, turbulent flow heat transfer, heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy, flow across a cylinder and sphere, flow across banks of tubes.	**10**	**CO3**
IV	**Radiation:** Stephen-Boltzman law, Plank's law, emissivity and absorptivity, radiant exchange between black bodies.	**8**	**CO3**
V	**Heat exchangers:** Types of heat exchangers, LMTD-NTU approach – parallel and counter-flow arrangements. **Boiling and condensation:** Dimensionless parameters, boiling modes, correlations, forced convection, laminar film condensation on a vertical plate.	**8**	**CO4**
	Total Hours	**40**	

Text Books:

1. Cengel A.Younis, Heat Transfer: A Practical Approach, McGraw Hill, 2002, 2nd Ed.
2. Incropera, F. P., Dewitt, D. P., Bergman, T. L., Introduction to Heat Transfer, John Wiley & Sons, 2006, 5th Ed.

Reference Books:

1. Bejan, A., Convection Heat Transfer, John Wiley, 2006, 3rd Ed.
2. Ozisik, M. N., Heat Conduction, John Wiley & Sons, 2012, 3rd Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-3102	Machine Design	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To understand the design and analysis of clutches, brakes and fly wheels.
2. To determine the forces on different type of gears for power transmission.
3. To determine the different forces acting on bearings and understanding selection of bearings.

Course Outcomes

CO1	Understanding the principles and functions of clutches, brakes and flywheels.	*Understand*
CO2	Applying design methods for various gear systems, including analysis of forces and stresses.	*Apply*
CO3	Exploring lubrication mechanisms in sliding and journal bearing.	*Understand*
CO4	Designing IC engine components with a focus on reliability.	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*												*		
2	CO2	*	*	*								*	*	*	*	
3	CO3	*										*	*	*		
4	CO4	*	*	*								*	*	*	*	

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Design of Clutches, Brakes and Flywheels: Brakes and clutches need and functioning, design of disc and cone type of clutches for uniform pressure and wear. Design of internal expanding and external contracting brakes, band type of brakes, cone and disk brakes. Flywheel: coefficient of fluctuation of speeds, fluctuation of energy, energy stored in flywheel, stresses in flywheel ring and arms.	**10**	**CO1**
II	Design of gear: Gears types and application and gear terminology, law of gearing-conjugate action and interference in gears, analysis of forces on spur, and helical gears, bending and contact stress in gear tooth Lewis equation for design, dynamic loading and wear-buckingham equations for design, force analysis on bevel and worm gears, design approach for bevel gears-equivalent tooth, design of fixed ratio gearbox general design procedure.	**10**	**CO2**
III	Sliding and Journal Bearing: Types of lubrication, hydro static and dynamic lubrication, Petroff's equation and the bearing characteristic number, lubrication regimes-boundary and film lubrication, hydro dynamic bearings-pressure distribution-eccentricity and minimum film thickness Reynolds equation and use of bearing design charts, heat generation and thermal equilibrium. Rolling Contact Bearing: Types of ball bearing, thrust ball bearing, types of roller bearing, selection of radial ball bearing, bearing life, selection of roller bearings, dynamic equivalent load for roller contact bearing under constant and variable loading, reliability of bearing. selection of rolling contact bearing.	**10**	**CO3**
IV	Design of IC Engine Components: General design consideration, design of cylinder, cylinder liner, cylinder head, pistons, connecting rod and crank shaft. Reliability analysis in Design.	**10**	**CO4**
	Total Hours	**40**	

Text Books:

1. Norton, L. R, Machine Design, Pearson Education Asia, 2018, 5th Ed.
2. Spotts, M. F. and Shoup, T. E., Design of Machine Elements, Pearson Hall, 2006, 8th Ed.
3. Shigley, J. E. and Mischke. C. R., Mechanical Engineering Design, McGraw Hill 2014, 10th Ed.
4. Bhandari, V. B., Design of Machine Elements, McGraw-Hill, 2017, 4th Ed.

Reference Books:

1. Juvinal, R. C. and Marshek, K. M., "Fundamentals of Machine Component Design" John Wiley Publication, 2016, 5th Ed.

Data Book:

1. "Design Data: Data Book of Engineers", PSG College of Technology, Coimbatore, 2012.
2. S.Md.Jalaludeen, "Design Data Hand Book –Mechanical & Automobile", Anuradha Agencies Kumbakonam, 2016, 3rd Ed.
3. Maitra, G.M. and Prasad, L.V., "Handbook of Mechanical Design", McGraw-Hill Inc, 1985.
4. Mahadevan, K. and Balaveera, K. Reddy, "Design Data Handbook for Mechanical Engineering", CBS Publishers, 2013, 4th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 3103	Industrial Engineering & Operations Research	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms. **2.** To develop skills necessary to effectively analyze and synthesize the many inter-relationships inherent in complex socio-economic productive systems. **3.** To gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.	**Course Outcomes**	**CO1** Understanding the key concepts, terminology and methodology used industrial engineering and operations research. — *Understanding/ Comprehension* **CO2** Understanding different theories, principles and optimization models of Industrial engineering and operations research. — *Understanding/ Comprehension* **CO3** — *Understanding/ Analyzing* **CO4**

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Concept of industrial engineering, its role & applications, work study: time & motion study, method study, principles of motion economy, workplace layout, stopwatch time study, SIMO chart, man-machine chart, Therbligs, PMTS, MTM, work sampling. **Organisation:** Organisation structures, types, principles of organization structure, features of various ownerships, company formations, its management and finance, public limited & private limited company. **Material Management:** Functions of material management, Inventories- its types, Just in Time (JIT), MRP, concept of EOQ & EBQ, simple EOQ model with and without stock outs, simple EOQ model with varying demand and production, P- type & Q- type of inventory policies, selective inventory control like ABC, VED, SDE techniques etc.	**10**	**CO1, CO2**
II	**Production Planning &Control:** Functions and role, value analysis, exponential smoothing constant and moving average method in demand and production forecasting, break even analysis.	**6**	**CO1, CO2**
III	**Metrology and Quality** Management: Introduction to engineering metrology: Linear, angular and rotational measurement comparators, screw threads and gear measurement, strain gauge and surface finish measurement, quality v/s reliability, quality maintenance and quality assurance, SQC technique, acceptance sampling, concept of TQM, ISO standards. **Plant Layout:** Location factors, principles and design, types of layouts, tools & technique**.** **Plant Maintenance:** Break down, scheduled and preventive maintenance, steps in preventive maintenance, online maintenance, TPM concept.	**10**	**CO1, CO2**
IV	**Operational Research:** concept of OR, methods of OR, concept of optimization, linear programming, simplex method transportation problem, queuing theory. decision theory, integer programming, revised simplex method, network techniques (PERT & CPM), theory of games, simulation.	**14**	**CO1, CO2**
	Total Hours	**40**	

Text Books:

1. Ralph M. Barnes, 'Motion and Time Study: Design and measurement of work', Wiley, 1980, 7th Ed.
2. M. Mahajan, 'Industrial Engineering and Production Management' Dhanpat Rai and Co., 2015.
3. H. A. Taha, 'Operations Research- An Introduction', Prentice Hall of India, 1997.

Reference Books:

1. S. N. Chary, Problems & Solutions in Production and Operations Management, TMH,1995

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-310X	Fundamentals of Mechanical Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Understand basic definitions and terminology. **2.** Students get a basic idea of Thermodynamics, Fluid Mechanics, Strength of Material and Manufacturing processes.	**Course Outcomes**	**CO1**	Understand the basic concepts of thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Understanding/ Comprehension*
			CO2	Describe the physics of thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Identify/ Knowledge/ Remember*
			CO3	Solve the fundamental problems related to thermodynamics, fluid mechanics, strength of materials and manufacturing technology. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Thermodynamics: Introduction, concepts of systems and control volumes, properties of a system, state and equilibrium, processes and cycles, quasi-static process, reversible & irreversible processes and cycles, temperature and Zeroth law of thermodynamics, concepts of heat and work transfer, introduction to1st and 2nd laws of thermodynamics and their applications.	**10**	**CO1, CO2, CO3**
II	Fluid Mechanics: Properties of fluid-mass and weight density, specific gravity, specific volume, viscosity and Newton's law of viscosity, types of fluid, surface tension and capillarity, Pascal's law, absolute, gauge and vacuum pressures, pressure variation in a fluid at rest, pressure measurement, Bernoulli's equation-velocity and flow measurement, introduction to fluid machineries, classification of pumps and turbines.	**10**	**CO1, CO2, CO3**
III	Strength of Materials: Concept of stress and strain-Hook's law, Poisson's ratio, elastic and plastic deformation, normal stress, shear stress, bearing stress, normal strain, shearing strain, principal stresses, Mohr's circle, relation of Young's modulus, modulus of rigidity and bulk modulus, theories of failure and applications.	**10**	**CO1, CO2, CO3**
IV	Manufacturing Technology: Classification and types of materials, types of casting, patterns, pattern materials and allowances, classification and application of welding, brazing and soldering process, various metal forming techniques.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Nag P K., Engineering Thermodynamics, Tata McGraw Hill Publisher, 2017, 6th Edition.
2. Som S K., Biswas G. and Chakraborty S., Introduction to Fluid Mechanics & Fluid Machines, McGraw Hill Education India, 2017, 3rd Edition.
3. Shames I H., Introduction to Solid Mechanics, Prentice Hall, 2015, 3rd Edition.
4. Rao P N., Manufacturing Technology: Foundry, Forming and Welding, Volume I, Tata McGraw Hill, 2018, 5th Edition.
5. Timoshenko S. P. and Young D. H., Elements of Strength of Materials, East West, 2003, 5th Edition.
6. Srinath L. S., Strength of Materials, Macmillan publishers India, 2000, 1st Edition.

Reference Books:

1. Ghosh A. and Mallik A K., Manufacturing Science, Wiley Eastern, 2010, 2nd Edition.
2. Cengel Y A. and Boles M A., Thermodynamics, An Engineering Approach, McGraw Hill Education, 2017, 8th Edition.
3. Beer F P., Johnston E R., Dewolf J T., Mazurek D F., Sanghi S., Mechanics of Materials, McGraw Hill, 2020, 8th Edition..

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	VIVA	REP	PER	Total	**Bloom's taxonomy**
ME-3105	Thermal Laboratory-I	**0**	**0**	**2**	**1**	**30**	**30**	**40**	**100**	

Course Objectives	**1.** To understand the basic internal combustion engine performance, brake power, indicated power, friction power and volumetric efficiency of I.C. engines. **2.** To develop an idea of fuel properties and their variation with temperature, determination of kinematic viscosity and calorific value of fuel. **3.** To understand engine emissions.	**Course Outcomes**	**CO1**	Calculate viscosity, flash points, fire points, cetane number and calorific value of fuel. — *Apply/ Determine*
			CO2	Calculate different performance characteristics of engines. — *Apply/ Determine*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															

SYLLABUS

No.	**List of experiments**	**Hours**	**COs**
I	Determination of Viscosity, Calorific value, Flash points and Fire points of liquid fuels.	**10**	**CO1**
II	Determination of cetane number of liquid fuels	**2**	**CO1**
III	Determine the performance characteristics of engines	**2**	**CO2**
IV	Determine the FAD of air compressor.	**2**	**CO2**
V	Measurement and analysis of engine emissions with variable loads	**2**	**CO2**
VI	Measurement of brake power and brake specific fuel consumption.	**2**	**CO2**
	Total Hours	**20**	

Reference Books:

1. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill, 2017, 4th Ed

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-3106	Manufacturing Process Laboratory- II	**0**	**0**	**2**	**1**	**50**		**50**	**100**	

Course Objectives	**1.** To identify and distinguish the particle size of a given sand sample. **2.** To calculate the average grain fineness number by sieving/ screening. **3.** To analyse the friability value and moldability index of the molding sand. **4.** Demonstrate laboratory techniques including the proper use of relevant instruments for measurement of various physical quantities.	**Course Outcomes**	**CO1** Students will develop an understanding of the mechanism and types of chips formed during machining, gaining insights into material behaviour under different cutting conditions. — *Understanding/ Comprehension*
			CO2 Students will learn to measure cutting forces using dynamometers in lathe, drilling, and milling operations, enhancing their ability to analyze machining processes and optimize cutting parameters. — *Identify/ Knowledge/ Remember*
			CO3 Students will acquire the skills to measure surface roughness of machined surfaces using a surface roughness tester, enabling them to assess the quality of machining processes. — *Understanding/ Analyzing*
			CO4 Students will gain hands-on experience in performing heat treatment on mild steel and analyzing its microstructure, understanding the effects of heat treatment on material properties. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Study the mechanism and formation of different types of chips during machining.	**2**	**CO1, CO2, CO3**
II	Measure the cutting force using dynamometers during operations in lathe, drilling and milling.	**4**	**CO1, CO2, CO3**
III	To measure the surface roughness of various machined surfaces using surface roughness tester.	**2**	**CO1, CO2, CO3**
IV	Heat treatment of mild steel and analysis of its microstructure.	**4**	**CO1, CO2, CO3**
V	Generate flat surface of mild steel workpiece by using shaper machine.	**2**	**CO1, CO2, CO3**
	Total Hours	**14**	

Text Books:

Reference Books:

1. Rao, P. N., Manufacturing Technology: Foundry, Forming and Welding, Volume I", Tata McGraw Hill, 2018, 5th Ed.
2. Holman, J. P., Experimental Methods for Engineers, McGraw Hill Education, 2017, 7th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-3107	Design Practices	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To acquire a skill of design, drafting and analysis of permanent and non-permanent joints by using design software **2.** To acquire a skill of design, drafting and analysis of bearings and gears using design software and comparing with analytical results. **3.** To acquire skill of design, drafting and analysis of IC engine parts using design software and comparing with analytical results.	**Course Outcomes**	**CO1**	Develop skill to apply knowledge of design software for design of permanent and non-permanent joints, shaft and springs. — *Understanding/ Comprehension/ Analyzing*
			CO2	Define and construct the Mechanical Engineering parts and components which include gears, bearings, IC engine parts along with their assembly drawing and analysis — *Identify/ Knowledge/ Remember/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Design and Analysis of Mechanical components using AutoCAD/Solid works/CATIA/ANSYS.	**2**	**CO1, CO2, CO3**
II	Design and analysis of Permanent joints (Riveted Joints, Welded Joints).	**2**	**CO1, CO2, CO3**
III	Design and Analysis of temporary joints (Knuckle joints, Cotter joints, Nut and bolts).	**2**	**CO1, CO2, CO3**
IV	Design and Analysis of shafts, couplings and springs.	**4**	**CO1, CO2, CO3**
V	Design and Analysis of bearings.	**2**	**CO1, CO2, CO3**
VI	Design and Analysis of Gears.	**2**	**CO1, CO2, CO3**
VII	Design of IC engine parts (Cluthes, Fly Wheels, Connecting Rods, Crank Shafts, Pistons, Cylinders and Cylinder heads.	**4**	**CO1, CO2, CO3**
	Total Hours	**18**	

Text Books:

Reference Books:

1. Shigley, J. E. and Mischke. C. R., "Mechanical Engineering Design", Mcgraw Hill, 2014, 10th Ed.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	T	P	C	INT	MID	END	Total	
ME-3101S	SDC3- CNC Machining	**0**	**0**	**2**	**1**	**50**	**0**	**50**	**100**	

Course Objectives	**1.** Understand basic of CNC Machine Fundamentals. **2.** Students get a basic idea of CNC Programming. **3.** Students get a basic idea of CNC Machining Operations	**Course Outcomes**	**CO1**	Understand basic of CNC Machine Fundamentals. — *Understanding/ Comprehension*
			CO2	Students get a basic idea of CNC Programming. — *Identify/ Knowledge/ Remember*
			CO3	Students get a basic idea of CNC Machining Operations — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	CNC Machine Fundamentals :Machine setup and operation: Hands-on practice setting up and operating CNC machines. Tooling and fixtures: Introduction to tooling, fixtures and workholding devices. Material handling: Practice loading/unloading materials and setting zero points. Basic machining operations: Practice basic operations (e.g., turning, milling, drilling).	**4**	**CO1, CO2, CO3**
II	CNC Programming : G-code programming: Learn basic G-code programming concepts and syntax.,CAM software: Practice generating CNC programs using CAM software.,Program editing and debugging: Learn to edit and debug CNC programs.,Program optimization: Practice optimizing CNC programs for efficiency.	**6**	**CO1, CO2, CO3**
III	CNC Machining Operations :Turning operations: Practice turning operations (e.g., facing, turning, threading).,Milling operations: Practice milling operations (e.g., pocketing, profiling). Drilling and tapping: Practice drilling and tapping operations. Advanced machining operations: Practice advanced operations (e.g., 3D machining, multi-axis machining).	**6**	**CO1, CO2, CO3**
Total Hours		**16**	

Text Books:

Reference Books:

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचलप्रदेश
NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH
(शिक्षामंत्रालय, भारत सरकारकेतहतराष्ट्रीयमहत्वकासंस्थान)
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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 311H	Advanced Thermal Systems	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To provide advanced knowledge of thermal systems and their components. 2. To enable students to model, analyze, and optimize thermal systems for energy applications. 3. To explore thermal system integration with digital monitoring, simulation, and control technologies. 4. To prepare students for application of advanced thermal technologies in energy systems and smart manufacturing.	**Course Outcomes**	**CO1**	Apply thermodynamic and heat transfer principles to complex thermal systems. — *Remembering/ Understanding*
			CO2	Model and simulate performance of integrated energy systems. — *Understanding/ Analyzing*
			CO3	Analyze energy efficiency and optimize thermal system performance. — *Applying/ Analyzing*
			CO4	Design thermal systems with renewable and waste heat recovery components. — *Evaluating/ Creating*
			CO5	Integrate control, monitoring, and digital tools with thermal systems for smart operation. — *Applying/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Classification and applications of thermal systems, Review of thermodynamic cycles and heat transfer modes, Role of thermal systems in energy conversion and storage, Digital trends in thermal energy systems	**5**	**CO1**
II	Types and configurations of heat exchangers, Design equations and effectiveness–NTU method, Compact and microchannel heat exchangers, Fouling, pressure drop, and performance enhancement techniques	**7**	**CO1, CO2**
III	Sensible, latent, and thermochemical storage, Phase Change Materials (PCMs) and thermal batteries, Design considerations for energy storage systems, Applications in solar, HVAC, and industrial systems	**6**	**CO1, CO3**
IV	Combined heat and power (CHP) systems, Gas turbine–steam turbine combined cycles, Organic Rankine Cycle and Kalina cycle, Industrial waste heat recovery integration	**7**	**CO2, CO3, CO4**
V	Solar collectors: flat plate, evacuated tube, CPC, parabolic trough, Thermal modeling and efficiency calculations, Solar-assisted absorption cooling systems, Hybrid systems integrating solar, biomass, and fossil sources	**6**	**CO1, CO3**
VI	Lumped and distributed parameter models, Use of MATLAB, TRNSYS, and ANSYS Fluent for system simulation, Dynamic behavior, control strategies, and digital twins, Optimization using genetic algorithms and neural networks	**5**	**CO2, CO3, CO5**
VII	IoT in thermal system control, Sensors and data acquisition in real-time monitoring, Machine learning in thermal performance forecasting, Smart thermal grids and Industry 4.0 applications	**4**	**CO1, CO5**
Total Hours		**40**	

Text Books:

1. Y.A. Cengel & M.A. Boles, Thermodynamics: An Engineering Approach, McGraw-Hill.
2. F.P. Incropera et al., Fundamentals of Heat and Mass Transfer, Wiley.
3. Dincer & Rosen, Thermal Energy Storage: Systems and Applications, Wiley.

Reference Books:

1. G. Tsilingiris, Advanced Thermodynamics Engineering, Taylor & Francis.
2. W.F. Stoecker, Design of Thermal Systems, McGraw-Hill.
3. Tiwari & Ghosal, Renewable Energy Resources: Basic Principles and Applications, Narosa Publishing.
4. ASHRAE Handbook – HVAC Systems and Equipment.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 320A	Additive Manufacturing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. Understand the working principle of various additive manufacturing techniques.
2. Interpret various rapid prototyping techniques and their applications.
3. Understand the basic concepts in reverse engineering.

Course Outcomes

CO1	Describe the importance of additive manufacturing.	*Understand*
CO2	Select the suitable AM technique for manufacturing a component.	*Apply*
CO3	Explain the preprocessing and post processing requirements in AM.	*Apply*
CO4	Explain the process of reverse engineering	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*												*		
2	CO2	*	*	*	*	*	*			*		*	*	*	*	*
3	CO3	*	*	*	*	*	*			*		*	*	*	*	*
4	CO4	*		*	*	*	*			*		*	*	*	*	*

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to Additive Manufacturing (AM): Introduction to AM, AM evolution, distinction between AM & CNC machining, steps in AM, classification of AM processes, advantages of AM and types of materials for AM. Vat photo-polymerization AM processes: Stereolithography (SL), materials, process modeling, SL resin curing process, SL scan patterns, micro-stereolithography, mask projection processes, two-photon vat photo-polymerization, process benefits and drawbacks, applications of vat photo-polymerization, case studies. Material jetting AM processes: Evolution of printing as an additive manufacturing process, materials, process benefits and drawbacks, applications of material jetting processes, binder jetting AM processes: materials, process benefits and drawbacks, research achievements in printing deposition, technical challenges in printing, applications of binder jetting processes. Extrusion based AM processes: Fused deposition modelling (FDM), principles, materials, process modelling, plotting and path control, bio-extrusion, contour crafting, process benefits and drawbacks, applications of extrusion based processes, case studies. Sheet lamination AM processes: Bonding mechanisms, materials, laminated object manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications, case studies. Powder bed fusion AM processes: Selective laser sintering (SLS), materials, powder fusion mechanism and powder handling, process modelling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes, case studies.	**20**	**CO1, CO2**
II	Rapid prototyping with allied technologies: Introduction to rapid manufacturing (RM), RM of polymeric objects, direct and indirect routes for RM of metallic & ceramic objects, advancement in RM (Synergistic integration of hybrid processes and multiple technologies).	**5**	**CO1, CO2**
III	Computational aspects of additive manufacturing (AM): Introduction to STL format, pre & post-processing of STL files, various slicing methods, various area-filling methods, overview of the algorithms for slicing and area-filling, emerging trends, an overview of mathematical modelling of AM processes: thermal cycle, residual stress, single bead and multi bead formation in cladding based AM processes.	**10**	**CO3**
IV	Reverse engineering (RE): Introduction to RE, digitizing methods, 3D reconstruction, design for AM (build orientation, topology optimization, conformal cooling channels).	**5**	**CO4**
	Total Hours	**40**	

Text Books:

1. Gibson I, Rosen D, and Stucker B, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, 2015, 2nd edition.
2. Liou F. W, Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, CRC Press, Taylor and Francis Group, 2007.
3. Pham D, Dimov S. S, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer-Verlag London, 2001.
4. Kai C. C, Fai L. K, 3D Printing and Additive Manufacturing: Principles & Applications, World Scientific, 2015, 4th edition..

Reference Books:

1. Venuvinod P. K and Weiyin M, Rapid Prototyping: Laser-based and Other Technologies, Springer, 2004.
2. Pham D. T, Dimoy S. S, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley& Sons, 2006.
4. Bandyopadhyay A, Bose S, Additive Manufacturing, CRC Press, Taylor &Francis Group, 2020, 2nd edition.
5. Paul C. P, Junoop A. N, Additive Manufacturing: Principles, Technologies and Applications, McGrawHill, 2021.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**CourseName**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-320B	IC Engine & EV	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand the basics of IC engines. **2.** To understand combustion principles, parameters and variables affecting IC engines. **3.** Provide fundamental knowledge of electric vehicle configurations and components and understand the working principles of electric drives, batteries, and charging systems.	**Course Outcomes**	**CO1** Understanding the working principles of thermodynamic cycles. — *Understanding/ Comprehension* **CO2** Analyse the effect of various engine components on engine performance and efficiency. — *Analysis/Apply* **CO3** Apply the principles of engine performance to measure the parameters such as power, efficiency and fuel consumption. — *Apply* **CO4** Explain the architecture and operation of electric and hybrid electric vehicles. — *Understanding/ Comprehension*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Engines, classifications & construction of IC engines, engine performance parameters, review of air-standard cycles, fuel-air cycles, actual cycles and their analysis, SI and CI engine fuels, alternate fuels.	**04**	***CO1***
II	**Carburetion:** Factors affecting carburetion, air-fuel mixtures, the simple carburettor, essential parts of modern carburettors, calculation of air fuel ratio, working of various carburettors.	**04**	***CO1***
III	**Combustion in S.I. Engines:** Stages, flame propagation, factors influencing the flame speed, rate of pressure rise, ignition delay, knocking.	**04**	***CO1, CO2***
IV	**Fuel Injection and Mixing:** Air and solid injection, fuel feed pump, injection pumps, fuel injector,nozzles, injection in SI engine, mechanical and pneumatic governor, spray characteristics, swirl, squish and tumble, electronic fuel injection system, MPFI, injection timing.	**04**	***CO1, CO2***
V	**Ignition system:** Introduction, classification, components of ignition system, modern ignition systems.	**03**	***CO2, CO3***
VI	**Combustion in C.I. Engines:** Stages, injection delay, factors influencing the delay, knocking, effect of variables on knocking.	**03**	***CO1, CO2***
VII	**Cooling and Lubrication System:** Introduction, need and type of cooling system, air and liquid cooling, thermosyphon, pressure cooling, engine friction, function and mechanism of lubrication, lubrication systems, properties of lubricant.	**03**	***CO1, CO2***
VIII	**Supercharging and Turbocharging:** Supercharging, methods of supercharging, turbocharging, charge cooling, effect on engine efficiency and output.	**03**	***CO1, CO2***
IX	**Nonconventional Engines:** CRDI engine, dual fuel and multi fuel engines, free piston engines, wankel and stirling engines, vcr engine, PFI and GDI engines.	**03**	***CO1, CO2***
X	**Measurement and Testing:** Tests for friction power, indicated power, brake power, fuel consumption, air consumption.	**03**	***CO3***
XI	**Emissions and Control:** Introduction, emission norms, engine emissions, emission control methods.	**03**	***CO3***
XI	**Introduction to Electric Vehicles:** Classification of EVs: BEV, HEV, PHEV, FCEV; Basic architecture and components of an electric vehicle; Energy flow in electric vehicles; Comparison with conventional IC engine vehicles; Overview of EV development and market trends.	**03**	***CO4***
	Total Hours	**40**	

Text Books:

1. V. Ganesan, Internal Combustion Engines, Tata McGraw-Hill, 2017, 4th Ed.
2. Pulkrabek W, Engineering Fundamentals of IC engine, Pearson, 2003, 2nd Ed.
3. Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press.

Reference Books:

1. C.R. Fergusan and A.T. Kirkpatrick, Internal Combustion Engines, John Wiley & Sons, 2001, R. Stone, Internal Combustion Engines, The Macmillan Press Limited, 2012, 4th Ed.
2. Heywood John, IC Engine Fundamentals, Mcgraw Hill, 1988.
3. Chau, K.T., *Electric Vehicle Machines and Drives: Design, Analysis and Application*, Wiley.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME321A	Control System Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1.To explain basic concepts and definitions of measurement and control. 2.To explain the measurement of different physical quantities. 3.To explain the control systems and related mathematical formulation.	**Course Outcomes**	**CO1**	Understand basics of measurement regarding different physical quantity and control system. — *Understanding*
			CO2	Explain the accuracy of measuring instruments. — *Understanding*
			CO3	Analyze calibration of measuring instruments. — *Analyzing*
			CO4	Evaluate control system for mechanical components. — *Evaluate*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction to measurement:** Generalized measurement system, standards, and types of signals, static performance characteristics, dynamic performance, general model, zero order, first order: step response and frequency response, second order: step response and frequency response.	**10**	**CO1**
II	**Analysis of uncertainties:** Error classification, systematic and random errors, statistical analysis of data, propagation and expression of uncertainties.	**06**	**CO2**
III	**Measurement of physical quantities:** Linear and angular displacement, velocity, force, torque, strain, viscosity, pressure, flow rate and temperature.	**12**	**CO3**
V	**Mathematical modeling of control systems:** Classification of control system. Open loop and closed loop systems, Concept of transfer function, block diagram algebra, transient and steady state analysis of first and second order system. Time Domain specifications, step response of second order system, steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs.	**12**	**CO4**
	Total Hours	**40**	

Text Books:

1. Doebelin E.O., Manik D.N., Measurement Systems, McGraw-Hill International, 2019, 7th Ed.
2. Holman, J. P., Experimental Methods for Engineers, McGraw-Hill Company, 2017, 7th Ed.
3. Kumar, D. S., Mechanical Measurements and Control, Metropolitan Book Co. (P) Ltd, 2015, 5th Ed.

Reference Books:

1. Nelson A., Engineering Mechanics: Statics and Dynamics, TMGH, 2017, 1st Ed.
2. Backwith, T. G., Marangoni, R. D. and Lienhard, J. H., Mechanical Measurements, Addison Wesley, 1993, 5th Ed.
3. Dally, J. W., Riley, W. F. and McConnell, K. G., Instrumentation for engineering measurements, John Wiley & Sons, 1993, 2nd Ed.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 321B	Viscous Fluid Flow	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand the physics of viscous fluid flow. **2.** To explain different equations involved in viscous fluid flow. **3.** To formulate the numerical methods required in viscous fluid flow.	**Course Outcomes**	**CO1**	Understand the physics of viscous fluid flow. — *Understanding/ Comprehension*
			CO2	Evaluate different equations involved in viscous fluid flow. — *Identify/ Knowledge/ Remember*
			CO3	Apply the numerical methods required in viscous fluid flow. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*	*											*		
2	CO2	*	*	*										*		
3	CO3	*	*	*										*		

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Preliminary concepts; Conservation of mass, momentum and energy; Exact solutions of the viscous flow equations: Couette flows, Poiseuille flow through ducts, unsteady duct flows	**10**	**CO1, CO2**
II	Laminar boundary-layers: integral analysis and similarity solutions; Laminar free shear flows: jet, wake, and plume; Stability of laminar flows;	**10**	**CO2, CO3**
III	Turbulent flow: fundamentals, Reynolds-averaged equations, velocity profile in wall-bounded flows, turbulent flow in pipes and channels, turbulent free-shear flows (jet, wake, and plume);	**10**	**CO2, CO3**
IV	Turbulence modelling: zero, one, and two equation models of turbulence; Numerical methods.	**10**	**CO2, CO3**
Total Hours		**40**	

Text Books:

1. Frank M White, Viscous Fluid Flow, McGraw-Hill, 1991.
2. Schlichting and Gersten, Boundary-Layer Theory, Springer-Verlag, 2000.
3. F S Sherman, Viscous Flow, McGraw-Hill, 1990.

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2024-25**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	T	P	C	INT	MID	END	Total	
ME 322A	Refrigeration and Air-conditioning	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		
1. Learning the fundamental principles and different methods of refrigeration and air conditioning. 2. Study of various refrigeration cycles and evaluate performance using p-h charts and/ or refrigerant property tables. 3. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning. 4. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.		**CO1**	Define the fundamental principles and applications of refrigeration and air conditioning system.	*Understanding/ Comprehension*
		CO2	Explain the properties, applications and environmental issues of different refrigerants.	*Apply/ Determine*
		CO3	Calculate cooling capacity and coefficient of performance of air refrigeration system, VCRS and VA.	*Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, types and application of refrigeration and air condensing systems. **Refrigerants:** Classification, nomenclature, desirable properties, secondary refrigerants, future industrial refrigerants. **Air refrigeration:** Reversed Carnot cycle and its limitation, Bell-Coleman cycle, aircraft refrigeration, working and analysis of simple; bootstrap; reduced ambient and regenerative air refrigeration systems.	**10**	**CO1, CO2, CO3**
II	**Vapour compression Refrigerating (VCR) system**: Reverse Carnot cycle and its limitations, simple VCR system and its performance analysis, factors affecting the performance of cycle, actual cycle, compound compression system, multiple evaporators system, cascade refrigeration system. **Vapour absorption system:** Desirable characteristics of refrigerant, selection of pair, practical H2O -NH3 cycle, LiBr – H2O system and its working, electrolux refrigeration system. Refrigeration system components: Compressors- reciprocating and axial, condensers and evaporators, expansion devices.	**15**	**CO1, CO2, CO3**
III	**Psychometry:** Air properties and psychometric chart, sensible heating, sensible cooling, humidification, dehumidification and their combinations, bypass factor, sensible heat ratio, comfort, psychometric calculations for cooling, evaporative cooling.	**8**	**CO1, CO2, CO3**
IV	**Summer and winter air conditioning:** Simple summer air conditioning process, room sensible heat factor, coil sensible heat factor, ADP, winter air conditioning, comfort zone, clothing. Load analysis: Internal heat gain, system heat gain, break-up of ventilation load and effective sensible heat factor, cooling load and heating load estimation.	**7**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill, 2017, 3rd Ed.
2. Stoecker W. F. and Jones J.W., Refrigeration and Air Conditioning, Tata McGraw-Hill, 2014, 2nd Ed.

Reference Books:

1. Dossat, R. J., Principles of Refrigeration, Pearson Education, 2002, 4th Ed.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 322B	Optimization Techniques	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Learn the fundamentals of engineering optimization (minimization and maximization of objective function). **2.** Formulate problem using linear, dynamic programming, game theory and queuing models. **3.** Design of mathematical models for quantitative analysis of problems in industry.	**Course Outcomes**	**CO1**	Understanding various issues related to linear programming modelling to formulate real-world problems as a L P model.	*Understanding/ Comprehension*
			CO2	Understanding theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function.	*Understanding/ Comprehension*
			CO3	Identify appropriate optimization method to solve complex problems involved in various industries.	*Understanding/ Analyzing*
			CO4	Applying queuing models, constrained and unconstrained optimization techniques to real world scenarios.	*Applying/Developing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Concept of optimization, classification of optimization, problems. **Linear programming:** Examples of linear programming problems, formulation simplex methods variable with upper bounds, principal duality, dual simplex method, sensitivity analysis, revised simplex procedure, solution of the transportation problem, network minimization, shortest route problem, maximal two problem, representation of networks.	**14**	**CO1, CO2**
II	**Queuing theory:** Queuing model, poison and exponential distributions, queues with combined arrivals and departures, random and series queues.	**6**	**CO1, CO4**
III	**Unconstrained optimization:** Maximization and minimization of convex functions, necessary and sufficient conditions for local minima, speed and order of convergence, unibariate search, steepest and desent methods, metcher reeves' method, conjugate gradient method.	**10**	**CO1, CO2, CO3, CO4**
IV	**Constrained optimization:** Necessary and sufficient condition, equality constraints, inequality constraints, kuhn – tucker conditions, gradient projection method, penalty function methods, cutting plane methods of sibel directions.	**10**	**CO1, CO2, CO3, CO4**
	Total Hours	**40**	

Text Books:

1. Rao S.S., Optimization Theory &Applications, Wiley Eastern, 2000.
2. Deb. K, Optimization for Engineering Design, Prentice Hall of India, 2002.
3. Reklaitis G.V., Ravindram A., Ragsdell K.M., Engineering Optimization Methods and Application, Wiley, 2001.

Reference Books:

1. Verma, A. P,. Operation Research, S. K. Kataria and Sons, 2007.
2. Vora, N. D, Quantitative techniques, Tata Mc-Graw Hill, 2006.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**CourseName**	**CreditStructure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 322C	Sustainable Energy Conversion	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand energy scenario, energy sources and their utilization. **2.** To study the basic processes and systems for sustainable conversion.	**Course Outcomes**	**CO1**	Understand the basic concept of various types of sustainable power generation. — *Understanding/ Comprehension*
			CO2	Describe basic processes and systems for sustainable conversion. — *Describe/ Knowledge/ Remember*
			CO3	Select suitable sustainable energy technologies. — *Understanding/ Analysing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Sustainability Concepts**: Sustainable development goals for clean energy (SDGS), emerging issues in energy access, technologies, economics. sustainability concepts of energy generation technologies, energy and resource utilization.	**06**	***CO1***
II	**Biomass Energy, Biofuel:** Characterization, biomass relevance to energy production, properties relevant to energy production, thermal conversion, bioconversion, economics.	**06**	***CO2, CO3***
III	**Solar Energy:** Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator). Fundamentals of Solar photovoltaic energy conversion.	**08**	***CO2, CO3***
IV	**Wind Energy:** Introduction to wind turbine, classification and analysis of different components, theory, design and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.	**06**	***CO2, CO3***
V	**Hydro Power:** Introduction to hydro power plant, overview of micro, mini and small hydro power plants, hydraulic turbines, Brief theory, design and analysis of hydro power plants.	**06**	***CO2, CO3***
VI	**Ocean Wave, Tide, Current, and Thermal Energy Conversion:** Energy from the tides and currents, energy from waves, economic prospects, environmental and sustainability considerations.	**08**	***CO2, CO3***
	Total Hours	**40**	

Text Books:

1. Sustainable Energy: Choosing Among Options, Tester, J. W., Drake, E. M., Driscoll, M. J., Golay, M. W., Peters, W. A., MIT Press, 2012, 2nd Edition.
2. Encyclopedia of Sustainable Technologies, Martin A. Abraham, Volume 3: Sustainable Energy Technologies & Sustainable Chemical Processes by Vladimir Strezov, Joseph Zoeller, Elsevier Science, 2017.
3. Sustainable Energy Technologies, Eduardo Rincon-Mejia, Alejandro de las Heras, CRC Press, Taylor & Francis Group, 2018.

Reference Books:

1. Sustainable Engineering: Principles and Implementation, Mulligan, C. N., CRC Press, Taylor and Francis Group, 2019.
2. Sustainable Engineering: Principles and Practice, Bakshi, B. R., Cambridge University Press, 2019.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 323A	Mechatronics and Automation	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Generate conceptual design for mechatronics systems based on potential customer requirements. **2.** Selection of appropriate sensors and transducers and devise an instrumentation system for collecting information about processes, control systems. **3.** Design a control system for effective functioning of mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers. **4.** Selection of appropriate actuators for physical systems. **5.** Study design of robot as case study	**Course Outcomes**	**CO1**	Will be able to identify the need of mechatronics and integrated product design procedure and role of mechatronics in various engineering fields.	*Understand*
			CO2	Will have basic understanding of various types of sensors and transducers including modelling	*Understand*
			CO3	Will study and select appropriate actuators and drivers along with design of control system and modelling.	*Understand*
			CO4	Will have case studies and design of robotic systems and application of mechatronic in system design.	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*											*	*		
2	CO2	*	*			*							*	*	*	
3	CO3	*	*	*		*		*					*	*	*	*
4	CO4	*	*	*	*	*		*					*	*	*	*

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to mechatronics, need and applications, philosophy and approach; role of mechatronics in automation, manufacturing and product development. Sensors and transducers: Characteristics, classification, working principles, development in transducer technology, opto-electronics shaft encoders, strain, velocity, acceleration, LVDT, temperature sensors, vision system, etc. Drives and Actuators: Electrical actuators such as servo motor and stepper motor, drive circuits, open and closed loop control; embedded systems: hardware structure, software design and communication, programmable logic devices, automatic control and real time control systems	**15**	**CO1, CO2, CO3**
II	Smart Materials: Shape memory alloy, piezoelectric and magneto strictive actuators, microsensors, micro actuators.	**05**	**CO2, CO3**
III	Hydraulic and Pneumatic Systems: Introduction to hydraulic systems, hydraulic pumps, control valves, pressure relief valves, graphical representation of hydraulic and pneumatic elements, design of hydraulic circuit, introduction to Pneumatic systems, compressors, air treatment and pressure regulation, actuators, pneumatic controllers, application of pneumatic systems	**10**	**CO3**
IV	Application: Case studies based on the application of mechatronics in manufacturing, machine diagnostics, road vehicles and medical technology, bionics and avionics. industrial robotics, types of industrial robots, classification based on work envelope, generations configurations and control loops, co-ordinate systems, need for robot, basic parts and functions, specifications.	**10**	**CO4**
	Total Hours	**40**	

Text Books:

1. Bolton, W., Mechatronics, Electronic control systems in mechanical and electrical engineering, Pearson Education, 2011, 5th edition.
2. Alcaiatore, G.D., Michel B. H., Introduction to Mechatronics and Measuring Systems, Mc. Graw Hill International, 2006, 3rd edition.
3. Robert H. B., The Mechatronics Handbook, CRC Press, 2007, 2nd edition.

Reference Books:

1. Stenersons, J., Fundamentals of Programmable Logic Controllers Sensors and Communications, Pearson Education, 2004, 3rd edition.
2. Kuttan K. A., Introduction to Mechatronics, Oxford University Press, 2007.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 323B	Materials Characterization Methods	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To provide an introduction to materials characterization and its importance.
2. To discuss different types of characterization techniques and their uses.
3. To understand crystal structure using diffraction methods.
4. To describe the properties and behaviour of x-rays and their use in materials characterization.
5. To describe the operation and use of a SEM, FESEM and TEM.

Course Outcomes

CO1	Understand the working principle of optical microscope, XRD, Raman spectroscopy, TEM, FESEM.	*Understanding/ Comprehension*
CO2	Understanding the crystal structure using diffraction method.	*Understanding/ Comprehension*
CO3	Analyse the microstructure of samples using SEM, TEM.	*Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Need of material characterization and available techniques. **Optical Microscopy:** Optical microscope, basic principles and components, different examination modes (bright field illumination, oblique illumination, dark field illumination, phase contrast, polarised light, hot stage, interference techniques), stereomicroscopy, photo-microscopy, colour metallography, specimen preparation, applications.	**10**	**CO1, CO2**
II	**Electron Microscopy: I**nteraction of electrons with solids, scanning electron microscopy, transmission electron microscopy and specimen preparation techniques, field emission scanning electron microscopy, energy dispersive spectroscopy, wavelength dispersive spectroscopy.	**10**	**CO1, CO2, CO3**
III	**Diffraction Methods: F**undamental crystallography, generation and detection of X-rays, diffraction of X-rays, X-ray diffraction techniques, electron diffraction. **Surface Analysis: A**tomic force microscopy, scanning tunnelling microscopy, X-ray photoelectron spectroscopy.	**10**	**CO1, CO2, CO3**
IV	**Spectroscopy:** Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transforms infrared spectroscopy, Raman spectroscopy, XRD. **Thermal Analysis: T**hermo gravimetric analysis, differential thermal analysis, differential scanning calorimetry, thermo mechanical analysis and dilatometry.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Lin Li, Kumar A, Zhang S, Materials Characterization Techniques, CRC Press, 2008.
2. Cullity B. D, Stock R. S, Elements of X-ray Diffraction, Prentice Hall, 2001.
3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, 2001.
4. Tyagi A. K., Roy M., Kulshreshtha S. K, Banerjee S, Advanced Techniques for Materials Characterization, Materials Science Foundations, Volume 49-51, 2009.
5. Wendlandt W. W, Thermal Analysis, John Wiley & Sons, 1986.

Reference Books:

1. Wachtman J. B, Kalman Z. H, Characterization of Materials, Butterworth-Heinemann, 1993.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 320X	Mechatronics and Automation	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Generate conceptual design for mechatronics systems based on potential customer requirements. **2.** Selection of appropriate sensors and transducers and devise an instrumentation system for collecting information about processes, control systems. **3.** Design a control system for effective functioning of mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers. **4.** Selection of appropriate actuators for physical systems. **5.** Study design of robot as case study	**Course Outcomes**	**CO1**	Will be able to identify the need of mechatronics and integrated product design procedure and role of mechatronics in various engineering fields.	*Understand*
			CO2	Will have basic understanding of various types of sensors and transducers including modelling	*Understand*
			CO3	Will study and select appropriate actuators and drivers along with design of control system and modelling.	*Understand*
			CO4	Will have case studies and design of robotic systems and application of mechatronic in system design.	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*											*	*		
2	CO2	*	*			*							*	*	*	
3	CO3	*	*	*		*		*					*	*	*	*
4	CO4	*	*	*	*	*		*					*	*	*	*

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to mechatronics, need and applications, philosophy and approach; role of mechatronics in automation, manufacturing and product development. Sensors and transducers: Characteristics, classification, working principles, development in transducer technology, opto-electronics shaft encoders, strain, velocity, acceleration, LVDT, temperature sensors, vision system, etc. Drives and Actuators: Electrical actuators such as servo motor and stepper motor, drive circuits, open and closed loop control; embedded systems: hardware structure, software design and communication, programmable logic devices, automatic control and real time control systems	**15**	**CO1, CO2, CO3**
II	Smart Materials: Shape memory alloy, piezoelectric and magneto strictive actuators, microsensors, micro actuators.	**05**	**CO2, CO3**
III	Hydraulic and Pneumatic Systems: Introduction to hydraulic systems, hydraulic pumps, control valves, pressure relief valves, graphical representation of hydraulic and pneumatic elements, design of hydraulic circuit, introduction to Pneumatic systems, compressors, air treatment and pressure regulation, actuators, pneumatic controllers, application of pneumatic systems	**10**	**CO3**
IV	Application: Case studies based on the application of mechatronics in manufacturing, machine diagnostics, road vehicles and medical technology, bionics and avionics. industrial robotics, types of industrial robots, classification based on work envelope, generations configurations and control loops, co-ordinate systems, need for robot, basic parts and functions, specifications.	**10**	**CO4**
Total Hours		**40**	

Text Books:

1. Bolton, W., Mechatronics, Electronic control systems in mechanical and electrical engineering, Pearson Education, 2011, 5th edition.
2. Alcaiatore, G.D., Michel B. H., Introduction to Mechatronics and Measuring Systems, Mc. Graw Hill International, 2006, 3rd edition.
3. Robert H. B., The Mechatronics Handbook, CRC Press, 2007, 2nd edition.

Reference Books:

1. Stenersons, J., Fundamentals of Programmable Logic Controllers Sensors and Communications, Pearson Education, 2004, 3rd edition.
2. Kuttan K. A., Introduction to Mechatronics, Oxford University Press, 2007.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	T	P	C	VIVA	REP	PER	Total	
ME-3202	Thermal Laboratory-II	**0**	**0**	**2**	**1**	**30**	**30**	**40**	**100**	

Course Objectives	**1.** Define the fundamental concepts to students in the area of heat transfer and its applications. **2.** Recognize the practical significance of various parameters involved in different modes of heat transfer. **3.** To demonstrate and develop understanding among the students about the basic working principles of refrigeration and air conditioning with hands-on experience and demonstrates the basics of psychometry.	**Course Outcomes**	**CO1** Conduct experiments on conduction, convection and radiation of heat; collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures — *Understanding/ Comprehension* **CO2** Determine thermal properties and performance of heat exchanger. — *Apply/ Determine* **CO3** Knowledge of compressors, evaporator, condenser, and expansion devices used in vapour compression refrigeration system. — *Analyzing* **CO4** Understand the principles and applications of vapour compression, vapour absorption refrigeration systems. — *Evaluating*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															

SYLLABUS

No.	**List of experiments**	**Hours**	**COs**
I	Thermal conductivities of various fluids.	**4**	**CO1**
II	Free and forced convection.	**4**	**CO1**
III	Parallel flow, counter flow, shell and tube heat exchanger.	**2**	**CO2**
IV	Verification of Stefan-Boltzmann law of radiation.	**2**	**CO1**
V	Vapour compression refrigeration system.	**2**	**CO3, CO4**
VI	Vapour absorption refrigeration system.	**2**	**CO4**
VII	Air conditioning system.	**2**	**CO3, CO4**
	Total Hours	**18**	

Reference Books:

1. Incropera, F. P., Dewitt, D. P., Bergman, T. L., Introduction to Heat Transfer, John Wiley & Sons, 2006, 5th Ed.
2. Arora, C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill, 2017, 3rd Ed.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**CourseName**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-324A	Advanced Manufacturing Laboratory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Provide hands-on experience with non-traditional and advanced manufacturing processes such as EDM, additive manufacturing, and advanced welding. 2. Develop an understanding of the influence of process parameters on machining and joining performance. 3. Familiarize students with optimization techniques for process parameters to achieve better productivity and surface quality. 4. Introduce modern fabrication methods such as 3D printing and hybrid joining techniques. 5. Enable students to analyze, compare, and evaluate various advanced manufacturing processes for real-world engineering applications.	**Course Outcomes**	**CO1** Identify and compare the characteristics of different advanced manufacturing processes such as EDM, 3D printing, and welding. — *Understand* **CO2** Determine and analyze the material removal rate of various materials in EDM and interpret the effect of process parameters. — *Apply* **CO3** Optimize EDM process parameters for improved machining performance using experimental data. — *Analyze* **CO4** Fabricate and evaluate welded joints using TIG, MIG, SAW, and Spot/Plasma welding processes. — *Apply* **CO5** Demonstrate 3D printing techniques using different filaments and assess dimensional accuracy and surface finish. — *Analyze* **CO6** Interpret the influence of welding parameters (current, voltage, speed) on bead geometry and joint quality. — *Analyze* **CO7** Apply the principles of advanced manufacturing for prototype development and product improvement in industrial context. — *Evaluate*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Determine material removal rate (MRR) of graphite, tungsten, Inconel, and copper during EDM machining.	**03**	***CO1***
II	Optimize process parameters (current, pulse-on time, pulse-off time, etc.) of EDM machining.	**03**	***CO2***
III	3D Printing of components using different filament materials	**03**	***CO1***
IV	Join specimens using TIG and MIG welding and study bead characteristics.	**03**	***CO4***
V	To study the effect of welding current, arc voltage, and welding speed on the bead geometry of a submerged arc weld.	**03**	***CO6***
VI	Perform Spot and Plasma Welding to join metal sheets and evaluate joint quality.	**03**	***CO7***
	Total Hours	**18**	

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**CourseName**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-324B	IC Engine & EV Laboratory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To familiarize students with the construction, operation, and performance evaluation of SI and CI engines. 2. To provide hands-on experience in measuring and analyzing key engine parameters. 3. To study combustion characteristics, fuel injection, ignition, cooling, and lubrication systems. 4. To introduce experimental analysis of alternative fuels and electric vehicle components	**Course Outcomes**	**CO1** Identify and understand various components and subsystems of IC engines. — *Understanding/ Comprehension* **CO2** Conduct experiments to determine engine performance parameters (BP, IP, FP, η, SFC). — *Analysis/Apply* **CO3** Analyze combustion phenomena and emission characteristics in SI and CI engines. — *Apply* **CO4** Demonstrate understanding of basic architecture and energy flow in electric vehicles. — *Understanding/ Comprehension*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Study of IC Engine Components and Construction:** Demonstration of SI and CI engine parts — piston, cylinder head, valves, camshaft, fuel pump, injector, etc.	**02**	***CO1***
II	**Performance Test on Single-Cylinder Diesel Engine (4-Stroke):** Determination of Brake Power, Specific Fuel Consumption, Brake Thermal Efficiency, and Mechanical Efficiency.	**04**	***CO2***
III	**Heat Balance Test on IC Engine:** Energy distribution analysis—heat equivalent to BP, coolant, exhaust, and unaccounted losses.	**04**	***CO2***
IV	**Measurement of Engine Emissions using Exhaust Gas Analyzer:** Determination of CO, CO_2, HC, NOx emissions; comparison with emission norms.	**02**	***CO3***
V	**Study of Electric Vehicle Powertrain and Components:** Identification of motor, controller, battery pack, and charging system.	**03**	***CO4***
VI	**Performance Study of BLDC / PMSM Motor Drive used in EVs:** Measurement of torque-speed characteristics and efficiency.	**03**	***CO4***
	Total Hours	**18**	

Reference Books:

1. C.R. Fergusan and A.T. Kirkpatrick, Internal Combustion Engines, John Wiley & Sons, 2001, R. Stone, Internal Combustion Engines, The Macmillan Press Limited, 2012, 4th Ed.
2. Heywood John, IC Engine Fundamentals, Mcgraw Hill, 1988.
3. Chau, K.T., *Electric Vehicle Machines and Drives: Design, Analysis and Application*, Wiley.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 325A	Mechatronics and Automation Laboratory	**3**	**0**	**0**	**3**	**50**		**50**	**100**	

Course Objectives

1. To encourage interdisciplinary research and industry driven innovation in the cutting-edge areas of mechatronics and automation.
2. The laboratory is designed to assist the students in the development of "hands-on" skills with an emphasis on mechatronics systems.

Course Outcomes

CO1	Explain the uses and working of different actuators in the industrial automation.	*Understand*
CO2	Describe role of different mechanical components and their working in the automation system.	*Understand*
CO3	Compare different sensors and actuators and select proper one for a typical industry application	*Apply*
CO4	Describe study basic robot co-ordinate configurations and Automated guided Vehicles.	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*								*			*	*	*	
2	CO2	*		*	*					*			*	*	*	
3	CO3	*	*	*	*					*			*	*	*	*
4	CO4	*								*			*	*	*	

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Study and demonstration of Mechatronics system and its components like sensors and Actuators. Automatic actuation of single acting cylinder using PLC Automatic actuation of double acting cylinder using PLC Controlling the single acting cylinder using push button switch Controlling double acting cylinder using push button switch Actuation of single acting cylinder using on delay timer Demonstration of Cartesian/ cylindrical/ spherical robot Demonstration of Automated guided Vehicles.	**20**	**CO1, CO2, CO3, CO4**
	Total Hours	**20**	

Text Books:

1.

Reference Books:

1. Bolton, "Mechatronics", Prentice Hall, 2008
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Prentice Hall, 2008, 5th Edition.
3. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2012.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-3201S	3D printing	**0**	**0**	**2**	**1**	**50**	**0**	**50**	**100**	

Course Objectives	1. Understand basic 3D Printing Fundamentals. 2. Students get a basic idea of 3D Modeling and Design. 3. Students get a basic idea of 3D Printing Operations.	**Course Outcomes**	**CO1**	Understand basic 3D Printing Fundamentals. — *Understanding/ Comprehension*
			CO2	Students get a basic idea of 3D Modeling and Design. — *Identify/ Knowledge/ Remember*
			CO3	Students get a basic idea of 3D Printing Operations. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	3D Printing Fundamentals :3D printing processes: FDM, SLA, SLS, and other technologie.3D printing materials: Plastics, metals, ceramics, and composites.3D printing software: Slicing, modeling, and control software.3D printing hardware: Printers, extruders, and hot ends. Hands-on exercise: Assembling and calibrating a 3D printer	**4**	**CO1, CO2, CO3**
II	3D Modeling and Design :3D modeling software: Tinkercad, Fusion 360, Blender. Design principles: Geometry, topology, and optimization. Modeling techniques: Extrusions, sweeps, and lofts. Design for 3D printing: Considerations and best practices. Hands-on exercise: Designing and printing a simple object	**5**	**CO1, CO2, CO3**
III	3D Printing Operations :Printer setup and calibration: Preparing the printer for printing. Material handling: Loading and unloading filament. Print settings: Temperature, speed, and layer height. Print monitoring and troubleshooting: Identifying and resolving issues. Hands-on exercise: Printing a complex object	**6**	**CO1, CO2, CO3**
Total Hours		**15**	

Text Books:

Reference Books:

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 321H	Sustainable Manufacturing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To understand the importance of sustainable manufacturing 2. To study various tools/techniques of sustainable manufacturing 3. To perform Life Cycle Assessment and assess environmental impacts of manufacturing processes 4. To develop eco-friendly products/processes	**Course Outcomes**	**CO1**	Understand the concept of sustainable manufacturing — *Understand*
			CO2	Utilise tools and techniques of sustainable manufacturing — *Apply*
			CO3	Evaluate product sustainability and environmental parameters. — *Evaluate*
			CO4	Perform life cycle assessment and assess environmental impacts of manufacturing processes — *Analyze/ Evaluate*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Sustainable Manufacturing - Concept of Triple bottom line, Environmental, Economic and Social Dimensions of Sustainability, Relation between lean and sustainable manufacturing.	**10**	**CO1**
II	Tools and Techniques – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly, Design for recycling, Eco friendly product design methods.	**10**	**CO2**
III	Environmental Impact Assessment Methods –CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 standards, Environmental Impact parameters. Sustainability Assessment – Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility.	**10**	**CO3**
IV	Sustainable characteristics of manufacturing processes - Energy efficiency analysis of manufacturing processes - Software packages for sustainability analysis and LCA - Scope of sustainable manufacturing centres.	**10**	**CO4**
	Total Hours	**40**	

Text Books:

1. G. Atkinson, S. Dietz, E. Neumayer, "Handbook of Sustainable Manufacturing". Edward Elgar Publishing Limited, 2007.
2. D. Rodick, Industrial Development for the 21st Century: Sustainable Development Perspectives, UN New York, 2007.

Reference Books:

1. P. Lawn, Sustainable Development Indicators in Ecological Economics, Edward Elgar Publishing Limited.
2. S. Asefa, The Economics of Sustainable Development, W.E. Upjohn Institute for Employment Research, 2005.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-410A	Convective Heat Transfer	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. To recall the basics of fluid flow and heat transfer. 2. The focus of the course is a central theme of modern applied mathematics. Based on mathematical concepts of gradient, divergence, vorticity and tensor, the basic properties normally ascribed to fluids such as density, compressibility and dynamic viscosity will be introduced. 3. The general equations, including continuous equation, momentum equation and energy equation are derived. 4. The course is used to model a vast range of physical phenomena and plays a vital role in science and engineering.	**Course Outcomes**	**CO1**	Understand the concept of fluid and the models of fluid flow and heat transfer for flow over external surfaces and duct of different cross-sections. — *Understanding/ Comprehension*
			CO2	To be able to derive the equations for laminar flow and turbulent flow over different solid objects. — *Apply/ Determine*
			CO3	To be able to solve practical convection oriented problems. — *Analyzing/Evaluating*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Continuity, momentum and energy differential equations in different coordinate systems, boundary layer approximations/scaling analysis.	**5**	**CO1, CO2**
II	**Laminar external flow and heat transfer**: Blasius solution for flat plate, pressure gradient flow, von Karman-Pohlhausen method for flows with pressure gradient integral solutions for flow over an isothermal flat plate, flat plate with constant heat flux. **Laminar internal flow and heat transfer:** Fully developed forced convection in pipes with different wall boundary conditions- Hagen Poiseuille flow, plane Poiseuille flow, and Couette flow, Graetz solution for forced convection in the thermal entrance region of ducts and channels.	**15**	**CO1, CO2, CO3**
III	**Natural convection heat transfer:** Governing equations for natural convection, Boussinesq approximation, dimensional analysis, similarity solutions for laminar flow past a vertical plate with constant wall temperature and heat flux conditions.	**10**	**CO1, CO2, CO3**
IV	**Turbulent convection:** Governing equations for averaged turbulent flow field (RANS), eddy viscosity and eddy thermal diffusivity, turbulence models, turbulent flow and heat transfer across flat plate and circular tube.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Kays, W., Crawford, M. and Weigand, B., Convective Heat and Mass Transfer, McGraw Hill Education, 2017, 4th Edition.
2. Burmeister, C., L., Convective Heat Transfer, John Wiley and Sons, 1993, 2nd Edition
3. Bejan, A., Convection Heat Transfer, John Wiley, 2006, 3rd Edition.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-410B	Mechanical Vibration	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Introduction to mathematical models of problems in free and forced vibrations using Newton's second law or energy principles. **2.** Determine a complete solution to the modelled mechanical vibration problems. **3.** Correlate results from the mathematical model to physical characteristics of the actual system. **4.** Design of a mechanical system using fundamental principles of vibration.	**Course Outcomes**	**CO1**	Construct the governing differential equation and able to solve for the motion and the natural frequency of damped and undamped system. — *Apply*
			CO2	Formulate any periodic function in terms of a series of simple harmonic motions using Fourier series analysis. — *Apply*
			CO3	Solve for the motion and the natural frequency for forced vibration of a single degree of freedom damped or undamped system. — *Analysis*
			CO4	Obtain the complete solution for the motion of a single degree of freedom vibratory system (damped or undamped) that is subjected to non-periodic forcing functions. — *Analysis*
			CO5	Acquire design parameters and indicate methods of solution for a complicated vibratory problem. — *Analysis*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*	*	*	*			*		*			*	*	*	
2	CO2	*	*	*	*			*		*			*	*	*	
3	CO3	*	*	*	*			*		*			*	*	*	
4	CO4	*	*	*	*			*		*			*	*	*	
5	CO5	*	*	*	*			*		*			*	*	*	

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: Causes and effects of vibration, classification of vibrating system, discrete and continuous systems, degrees of freedom, identification of variables and parameters, linear and nonlinear systems, physical models, schematic models and mathematical models. Free Vibration Analysis: Formulation of equation of motion: De-Alembert's method, Energy method, Newton's method and Rayleigh methods, differential equations of motion for first order and second order linear systems, undamped free vibration response, damped free vibration response, Eigen values and Eigen vectors, normal modes and mode superposition problem formulation and response calculation.	**10**	**CO1**
II	Forced Vibration analysis: Response to harmonic excitations, solution of differential equation of motion, vector approach, complex frequency response, magnification factor resonance, rotating/reciprocating unbalances, force transmissibility, motion transmissibility, vehicular suspension, vibration measuring instruments, problems on forced vibration.	**10**	**CO2, CO3**
III	Two degree of freedom systems: Introduction, formulation of equation of motion, equilibrium method, Lagrangian method, problem formulation of equations of motion. Multi degree of freedom systems: Introduction, formulation of equations of motion, free vibration response, natural modes and mode shapes, orthogonally of model vectors, normalization of model vectors, decoupling of modes, model analysis, mode superposition technique, free vibration response through model analysis, forced vibration analysis through model analysis, model damping, Rayleigh's damping, introduction to experimental model analysis.	**10**	**CO3, CO4**
IV	Vibration Analysis of Continuous systems: Introduction to continuous systems, exact and approximate solutions, free vibrations of bars and shafts, free vibrations of beams, forced vibrations of continuous systems and approximate methods for continuous systems.	**10**	**CO5**
	Total Hours	**40**	

Text Books:

1. Nag Meirovich, L., Elements of Vibration Analysis, 2nd Ed., McGraw-Hill, 2014.

2. Rao, S.S, Mechanical Vibrations, 6th Ed., Pearson Education, 2018.

3. Thomson, W.T., Theory of Vibration, 5th Ed., Pearson Education, 2002

Reference Books:

1. Clarence W. de Silva, "Vibration: Fundamentals and Practice", 2nd Ed., CRC Press, 2006.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-410C	Nanotechnology	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Demonstrate a working knowledge of nanoscience/nanotechnology principles and applications 2. Explain the nanoscale paradigm in terms of properties at the nanoscale dimension.	**Course Outcomes**	**CO1**	Understood the basic concept of nanotechnology.	*Understanding/ Comprehension*
			CO2	Apply key concepts in materials science, chemistry, physics, biology, and engineering to the field of nanotechnology.	*Identify/ Knowledge/ Remember*
			CO3	Identify societal and technology issues that may impede the adoption of nanotechnology.	*Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*												*		
2	CO2	*	*	*										*		
3	CO3	*	*	*				*						*		

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Importance of Nano-technology, Emergence of Nano-Technology, Bottom-up and Top-down approaches, challenges in Nano Technology.	**5**	**CO1**
II	**Zero Dimensional Nano-structures**: Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic Nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.	**8**	**CO1, CO2**
III	**One Dimensional Nano-structures**: Nano wires and nano rods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electrospinning and Lithography.	**10**	**CO1, CO2**
IV	**Two dimensional nano-structures**: Fundamentals of film growth. Physical vapour Depostion(PVD): Ebvaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Chemical Vapour Deposition (CVD): Typical chemical reactions, Reaction kinetics, transportant phenomena, CVD methods, diamond films by CVD. **Thin films**: Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films.	**12**	**CO1, CO2, CO3**
V	**Special Nano Materials:** Carbon fullerence and nano tubes: carbon fullerness, formation, properties and applications. Carbon nano tubes: formation and applications.	**5**	**CO3**
	Total Hours	**40**	

Text Books:

1. Hornyak G.L., Dutta J., Tibbals H.F., Rao A.K., Introduction to Nanoscience, CRC Press, 2008.
2. Cao Guozhong, Nano structures and Nano materials: Synthesis, properties and applications, Imperial College press, 2004.

Reference Books:

1. Lindsay S.M., Introduction to Nanoscience, Oxford, 2009

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-411A	Robotics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To explain the basic principles of Robotic technology, configurations, control and applications of Robots. **2.** To explain the basic concept Coordinate Frames, Mapping and Transforms. **3.** To describe the concept of Robot kinematics and dynamics. **4.** To choose the appropriate Sensor and vision system for a robot for a given application. **5.** To understand the motion planning and control trajectory of the robot.	**Course Outcomes**	**CO1** Understanding the various components of robotic system. — *Understand* **CO2** Analyse kinematic modelling and dynamics of robotic manipulators. — *Apply* **CO3** Conducting dynamic analysis of robotic systems using appropriate formulations. — *Analyzing* **CO4** Designing and implementing motion planning and control strategies for robotic operations. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*		*	*	*						*	*			
2	CO2	*	*	*	*	*						*	*			
3	CO3	*	*	*	*	*						*	*			
4	CO4	*	*	*	*	*						*	*			

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: Basic concepts, definition and origin of robotics, different types of robots, robot classification, applications, robot specifications. Coordinate Frames, Mapping and Transforms: Coordinate Frames, description of objects in space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices, mechanical structure and notations, description of links and joints, kinematic modeling of the manipulator, Denavit-Hartenberg notation, kinematic relationship between adjacent links, manipulator transformation matrix.	**10**	**CO1**
II	Kinematic Modeling of Robots: Position analysis – direct and inverse kinematic models of robotic manipulators, various examples. Velocity analysis–Jacobian matrix.	**10**	**CO2**
III	Dynamics of Robots Modeling of Robots: Dynamic analysis of the manipulator robot, Lagrange-Euler dynamic formulation, static force analysis, transformation of force and moment.	**10**	**CO3**
IV	Robotic Sensors and Vision: Sensors in robotics, architecture of robotic vision systems, image acquisition, image representation, image processing. Motion Planning and Control: Basics of trajectory planning, Cartesian space trajectory, basics of control system, block diagram, Laplace transform, PID control, trajectory planning - position, velocity and force control.	**10**	**CO4**
	Total Hours	**40**	

Text Books:

1. Craig J.J., Introduction to Robotics: Mechanics and Control, Pearson Education International, 2004, 3rd edition.

2. Spong M.W., and Vidyasagar M., Robot Dynamics and Control, Wiley, 2008.

3. Schilling R.J., Fundamentals of Robotics Analysis and Control, Prentice Hall of India, 1990

Reference Books:

1. Fu K.S., Gonzalez, R.C., and Lee, C.S.G., Robotics control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.

2. Saha S.K., Introduction to Robotics, McGraw Hill, 2014, 2nd edition.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-411B	Gas Turbine Technology	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. Understand the fundamental principles of gas turbine operations.
2. Analyse the performance of gas turbine engines.
3. Understand the various types of gas turbines and their components.

Course Outcomes

CO1	Demonstrate a comprehensive understanding of the classification, operation and fundamental principles of gas turbines.	*Understanding/ Comprehension*
CO2	Apply the thermodynamic concepts to evaluate the performance of gas turbine cycle, compressors, turbines	*Understanding/ Applying*
CO3	Assess and compare the performance characteristic of various propulsion systems.	*Understanding/ Analyzing*
CO4	Identify and evaluate various gas turbine cooling methods	*Evaluating*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Fundamentals of Turbo Machines:** Classification, applications, isentropic flow, energy transfer, efficiency, static and stagnation conditions, continuity equation, Euler's flow through variable cross-sectional area, unsteady flow in turbo machine. **Review of Fundamentals: T**hermodynamic concepts, isentropic conditions, Mach number and area – velocity relation, dynamic pressure, normal shock relations for perfect gas, supersonic flow, oblique shock waves.	**10**	***CO1***
II	**Gas Turbine Cycles:** Simple gas turbine cycle– single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, component losses, stage and overall efficiency, polytropic efficiency. **Centrifugal Compressors:** Elements of compressor stage, velocity triangles and efficiencies, blade passage design, diffuser and pressure recovery, slip factor, compressor performance - stall and surge, performance characteristics. **Axial Flow Compressors:** Flow analysis, work and velocity triangles, efficiencies, thermodynamic analysis, stage pressure rise, degree of reaction, stage loading, free and forced vortex blades, effect of axial velocity and incidence on velocity triangles, Performance characteristics. **Axial Flow Gas Turbines:** Work done; velocity triangles and efficiencies; thermodynamic flow analysis, degree of reaction, free-vortex blades, blade angles for variable degree of reaction, matching of compressor and turbine. **Radial Flow Gas Turbines:** Work done; velocity triangles and efficiencies.	**12**	***CO2***
III	**Aircraft Propulsion Cycles:** Propulsive devices viz., turbojet, turboprop and turbofan engines; performance analysis-thrust equation, specific thrust, specific fuel consumption; propulsive, thermal and overall efficiencies, bypass ratio, ideal and actual t-s diagrams of aircraft engines.	**10**	***CO3***
IV	**Gas Turbine Cooling:** Effect of high gas temperature, methods of cooling-internal and external, convective, film, impingement and transpiration cooling.	**8**	***CO4***
	Total Hours	**40**	

Text Books:

1. R. D. Flack, Fundamentals of Jet Propulsion with Applications, Cambridge University Press, 2005.
2. H. I. H Saravanamuttoo, G. F. C. Rogers and H. Cohen, Gas Turbine Theory, Pearson, 2003.

Reference Books:

1. F.El-Sayed, Fundamentals of Aircraft and Rocket Propulsion, Springer-Verlag, London, 2016.
2. V. Ganesan, Gas Turbines, Tata McGraw Hill, 2003.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-412A	Gas Dynamics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand the physics of Gas Dynamics. **2.** To understand shock relations and wave behaviours in supersonic flow. **3.** To study flow measurement in ducts and wind tunnels.	**Course Outcomes**	**CO1**	Understanding the application of basic principles of thermodynamics and fluid mechanics to analyse one dimensional gas dynamics. — *Understanding/ Comprehension*
			CO2	Understanding and applying the problems in supersonic flow, including shock waves and Prandtl-Meyer expansions. — *Understanding/ Applying*
			CO3	Analysing the supersonic wind tunnels and duct flows, focussing on nozzles and shock recovery. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Concepts from thermodynamics; The basic equations of fluid motion; One-dimensional gas dynamics; Isentropic conditions, speed of sound, Mach number, area velocity relations	**8**	***CO1***
II	normal shock relations for a perfect gas, Fanno and Rayleigh flow, one-dimensional wave motion, the shock tube; Waves in supersonic flow: oblique shock waves, supersonic flow over a wedge, Mach lines, piston analogy, supersonic compression by turning, supersonic expansion by turning, the Prandtl-Meyer function,	**12**	***CO1, CO2***
III	reflection and intersection of oblique shocks, Mach reflection, shock expansion theory, thin aerofoil theory; Flow in ducts and wind tunnels: area relation, nozzle flow, normal shock recovery, effects of second throat, wind tunnel pressure ratio, supersonic wind tunnels;	**12**	***CO2, CO3***
IV	Small perturbation theory; The method of characteristics; Methods of measurement; Elements of hypersonic flow	**8**	***CO3***
	Total Hours	**40**	

Text Books:

1. H. W. Liepmann and A. Roshko, Elements of Gas Dynamics, John Wiley, 1960.
2. J. D. Anderson, Modern Compressible Flow, McGraw Hill, 1989.
3. B. K. Hodge and C. Koenig, Compressible Fluid Dynamics (with P.C. applications), PH, 1995.

Reference Books:

1. H. Shapiro, The Dynamics and Thermodynamics of Compressible Flow, Ronald Press, 1954.
2. R. D. Zucker and O. Biblarz, Fundamentals of Gas Dynamics, Wiley, 2002

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 412B	Composite Materials and Structure	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Provide students a basic understanding and uses of composite materials, develop skill to understand different composites manufacturing methods. 2. To enable the students to find physical and mechanical properties of composites using micromechanics and experimental methods. 3. Illuminate the knowledge and skills to design the composite laminate subjected to different in-plane loading conditions by applying the mechanics and failure theories of the composite materials.	**Course Outcomes**	**CO1** Understand the various fabrication techniques and select suitable method for given application. — *Understanding* **CO2** Calculate displacement, strain and stresses in composite laminates. — *Apply* **CO3** Examine the failure of laminate using different failure theories. — *Apply* **CO4** Analyze experimentally the material properties of the composite laminates. — *Analyze* **CO5** Evaluate material properties of composite material using micromechanics. — *Evaluate* **CO6** Propose the construction of laminate for given loading conditions. — *Create*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Definition, Classification of Composites, Applications of Composites Reinforcing Fibers: Synthetic fiber, Natural Fibers; Matrix Materials: Polymers such as Thermosetting and Thermoplastic Polymers, Metals and ceramics. Fabrication of PMC's, MMC's C/C and CMC's Composites	**5**	**CO1**
II	**Macromechanical Analysis of a Lamina:** Introduction, Stress–Strain Relations for Orthotropic Materials, Transversely Isotropic Material, Isotropic Material, Transformation of Engineering Constants, Hooke's Law and Stiffness and Compliance Matrices: General Anisotropic Material, Transformation of Stress and Strain, Orthotropic Material under Plane Stress Compliance Tensor and Compliance Matrix, Relations between Engineering Constants and Elements of Stiffness and Compliance Matrices, Transformation of Stiffness and Compliance Matrices.	**8**	**CO2**
III	**Micromechanical Analysis of a Lamina:** Introduction, Micromechanical Analysis of a Lamina-Volume and Weight Fractions and void content Prediction of Elastic constants using Micromechanics, Ultimate Strengths of a Unidirectional Lamina, Coefficients of thermal and Moisture expansion.	**6**	**CO5**
IV	**Analysis of Laminated Composites:** Classical Lamination Theory (CLT): Introduction, Laminate Displacements and Strains, Laminate Stresses, Resultant Forces and Moments, Laminate Constitutive Relations, Laminate Description System Design, Construction and Properties of Laminates: Symmetric Laminates Unidirectional, Cross-Ply, and Angle-Ply Laminates Quasi-Isotropic Laminates	**8**	**CO6**
V	**Theories of Failures:** Strengths of an Orthotropic Lamina, Failure of Laminates, Maximum-Stress Theory, Maximum-Strain Theory, Maximum-Work Theory, Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Initial Failure Laminate Analysis after Initial Failure, Hygrothermal Stresses in Laminates	**6**	**CO3**
VI	**Experimental Characterization of Composites:** Introduction, Measurement of Physical Properties, Density, Constituent Weight and Volume Fractions, Void Volume Fraction, Thermal Expansion Coefficients, Moisture Absorption and Diffusivity Moisture Expansion Coefficients	**4**	**CO4**
VII	**Mechanical Properties and Damage assessment of composites:** Properties in Tension, Properties in Compression, In-Plane Shear Properties, Flexural Properties, Interlaminar Shear Strength and Fracture Toughness, In-Plane Fracture Toughness Tests, Dynamic properties, Impact Tests, Tests for Aerospace Applications, Damage Identification Using Non-destructive Evaluation Techniques, Ultrasonics Acoustic Emission X-Radiography Thermography Laser Shearography.	**6**	**CO4**
	Total Hours	**43**	

Text Books:

1. Autar K. Kaw, Mechanics of Composite Materials, 2006, 2 nd Edition, Taylor & Francis

Reference Books:

1. Robert Millard Jones Mechanics of Composite Materials 2nd Edition CRC Press.
2. Jack R. Vinson, Robert L. Sierakowski The behavior of structures composed of composite materials, 2006, Springer, Dordrecht
3. M. W. Hyer, Scott R. White Stress Analysis of Fiber-reinforced Composite Materials, 2009 DEStech Publications.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**CourseName**	**CreditStructure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 413A	Energy Storage Systems	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To provide an insight into the various modes of energy storage. **2.** To impart knowledge on construction, working principle and performance analysis of different storage systems	**Course Outcomes**	**CO1**	Understand the principles, concepts, and operation of thermal energy storage systems. — *Understanding/ Comprehension*
			CO2	Select the suitable energy storage materials. — *Apply/ Knowledge*
			CO3	Design thermal energy storage systems. — *Apply/ Knowledge*
			CO4	Evaluate the performance of thermal energy storage systems for different applications. — *Analysing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**MappingwithPSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Classification of Energy Resources, Energy Scenario in the World and India, Need for Energy Efficiency, Energy Conservation and Management. Thermodynamics of Energy Storage, System Types, Environmental Impact.	**05**	***CO1***
II	**Sensible Heat Storage Systems:** Introduction, Types, Principles of Sensible Heat Storage Systems, Limitations, Advantages and Future Trend.	**05**	***CO1, CO2***
III	**Latent Heat Storage Systems (Phase Change Materials):** Introduction, Types, Selection Criteria, Thermophysical Properties, Thermal Stability, Corrosion, Phase Segregation, Sub Cooling, Applications.	**05**	***CO1, CO2***
IV	**Microencapsulation and Nanoencapsulation of Phase Change Materials:** Introduction, Microencapsulation and Nanoencapsulation of Phase Change Materials, Methods, Shape Stabilized Phase Change Materials, Applications.	**05**	***CO2***
V	**Design of Latent Heat Storage System:** Introduction, Requirements and Considerations for the Design, Design Methodologies, Applications of Latent Heat Storage Systems Incorporating Pcms, Future Trends.	**05**	***CO3***
VI	**Phase Change Materials for Energy Conservation in Buildings:** Introduction, Integration of Pcms into Building Envelop, PCM Containment, Measurement of Thermal Properties of PCM Integrated in Buildings, Experimental and Numerical Studies.	**05**	***CO3, CO4***
VII	**Thermochemical Heat Storage:** Introduction, Phenomena and Principles, Thermochemical Energy Storage Systems, Applications, Remarks.	**05**	***CO3, CO4***
VIII	**Thermal Energy Storage Systems Applications:** Introduction, Solar Air Heating, Solar Water Heating, District Heating, Heat to Waste, Cogeneration and Trigeneration Systems, Concentrated Solar Power, Cooling.	**05**	***CO3, CO4***
	Total Hours	**40**	

Text Books:

1. Thermal Energy Storage Technologies for Sustainability Systems Design, Assessment and Applications, Kalaiselvam, S., Parameshwaran, R., Elsevier, 2014.
2. Advances in Thermal Energy Storage Systems - Methods and Applications, Luisa F. Cabeza, Elsevier, 2015.

Reference Books:

1. Thermal Energy Storage: Systems and Applications, Ibrahim Dinçer, Marc A. Rosen, John Wiley & Sons Ltd., 2010.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-413B	Principle of Tribology	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To provide the students with the fundamental concepts and principles of tribology.
2. Emphasis on the design, selection and performance of lubricated components such as pistons, bearings, gears etc.
3. To understand the concepts of friction and wear and to deal with surface properties, contact mechanics in the field of Industrial Tribology.

Course Outcomes

CO1	Understand basic principles of tribology, including friction wear and lubrication.	*Understanding/ Comprehension*
CO2	Apply the theories of friction, wear and lubrication to predict frictional behaviour of commonly encountered sliding interfaces.	*Understanding/ Comprehension*
CO3	Analyse the performance of tribological systems using experimental data on friction, wear and lubrication.	*Understanding/ Analyzing*
CO4	Develop strategies for improving the tribological performance of mechanical systems by advanced cooling materials and lubrication.	

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Introduction to tribology, history of tribology, interdisciplinary approach, economic benefits, application of tribology in engineering.	**6**	**CO1**
II	**Friction:** Causes of friction, adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction instability, measurement and quantification of friction. **Wear:** Wear mechanisms, adhesive wear, abrasive wear, corrosive wear, fretting wear, wear analysis, methods and wear reduction.	**12**	**CO1, CO2, CO3**
III	**Lubrication and lubricants:** Importance of lubrication, boundary lubrication, mixed lubrication, full fluid film lubrication, types and properties of lubricants, lubricants additives.	**10**	**CO1, CO2, CO3, CO4**
IV	**Fluid film lubrication:** Concept of fluid mechanics, equation of continuity and motion, generalized Reynolds equation with compressible and incompressible lubricants. **Application of tribology:** Rolling contact bearings, gears, journal bearings, finite bearings.	**12**	**CO1, CO2, CO3, CO4**
	Total Hours	**40**	

Text Books:

1. Halling J, Principles of Tribology, The Macmillan Press Ltd., London, 1975.
2. Dowson D, History of Tribology, Longman London, 1979.
3. Ludema K. C, Friction, Wear, Lubrication: A textbook in Tribology, CRC Press, 2010.

Reference Books:

1. Stachowiak G. N, Batchelor A. W. and Stachowick G. B, Experimental methods in Tribology, Tribology series 44, Editor D. Dowson, 2004.
2. Michael M. Khonsari, Applied Tribology (Bearing Design and Lubrication), John Wiley & Sons, 2001.
3. Edwards K. S. & McKee R. B, Fundamentals of Mechanical Component Design, McGraw Hill Inc., 1991.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 414A	Automobile Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** Introduction to engineering analysis of the automobile and its sub-systems. **2.** Application of engineering principles to automotive design. **3.** Acquaintance with modelling and analysis methods. **4.** Acquaintance with the automotive industry and its terminology.	**Course Outcomes**	**CO1**	Identify the main parts of automobile chassis body and engine components. — *Recognizing/ Understanding*
			CO2	Understand vehicle propulsion and road performance. — *Understanding/ Comprehension*
			CO3	Understand and apply the design and functions of braking and transmission system, gear box, steering system — *Understanding/ Applying*
			CO4	Analyse the electrical systems and principles of electrical hybrid vehicles. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: Main units of automobile chassis and body, different systems of the automobile, description of the main parts of the engine, motor vehicle act.,	**8**	***CO1***
	Power for Propulsion Resistance to motion, rolling resistance, air resistance, gradient resistance, power required for propulsion, tractive effort and traction, road performance curves.	**8**	***CO2***
II	Braking systems: Hydraulic braking system, braking of vehicles when applied to rear, front and all four wheel, theory of internal shoe brake, design of brake lining and brake drum, different arrangement of brake shoes, servo and power brakes. Transmission Systems: Layout of the transmission system, main function of the different components of the transmission system, transmission system for two wheel and four wheel drives. Hotchkiss and torque tube drives.	**8**	***CO3***
III	Gear box: Sliding mesh, constant mesh and synchromesh gearbox, design of 3 speed and 4 speed gear box, over drive, torque converter, semi and fully automatic transmission. Hookes joint, propeller shaft, differential, rear axles, types of rear axles, semi floating, there quarter floating and full floating types. Front wheel Geometry and steering systems: Camber, castor, kingpin inclination, toe-in and toe-out, centre point steering condition for true rolling, components of steering mechanism, power steering.	**8**	***CO3***
IV	Electrical system of an automobile: Starting system, charging system, ignition system, other electrical system. Electrical vehicles: History, electrical vehicles and the environment pollution, description of electric vehicle, operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.	**8**	***CO4***
Total Hours		**40**	

Text Books:

1. **Gupta S.K., A text book of Automobile Engineering, , S. Chand, 2020, 2nd Edition.**
2. **Heitner J., Automobile Mechanics, , CBS Publishers & Distributers, 2nd Edition.**

Reference Books:

1. Crouse W.H. and Anglin D.L., Automotive Mechanics, , TMH, 2017, 10th Edition.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 414B	Advanced Machine Tools and Operation	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. Classify the various abrasives and the abrasive processes.
2. Differentiate the superfinishing processes and their applications.
3. Understand the different screw threads and gear manufacturing methods.
4. Explain the various non-conventional machining techniques.

Course Outcomes		
CO1	Describe the various abrasives and the abrasive processes	*Understanding/ Comprehension*
CO2	Distinguish the superfinishing processes and their applications.	*Understanding/ Comprehension*
CO3	Compare the different screw threads and gear manufacturing methods.	*Understanding/ Analyzing*
CO4	Define the various non-conventional machining techniques.	

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Abrasive Processes:** Basic principle, purpose and application of grinding, abrasive particles, wheel designation, selection of wheels and their conditioning, classification of grinding machines and their uses.	**10**	**CO1, CO2**
II	**Superfinishing processes:** Honing, lapping and superfinishing processes, tools and abrasives used, process parameters and their control.	**10**	**CO1, CO2, CO3**
III	**Screw threads and gear manufacturing methods:** Production of screw threads by machining, rolling and grinding, manufacturing of gears.	**10**	**CO1, CO2, CO3**
IV	**Non-conventional machining:** Review of abrasive jet machining, ultrasonic machining, water jet and abrasive water jet machining, chemical machining, electro chemical machining, electro discharge machining, electro chemical discharge grinding, electro chemical honing electron beam and laser beam machining.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Rao P. N, Manufacturing Technology, Volume II, Tata McGraw Hill, 2008.
2. Chattopadhyay A. B, Machining and Machine Tools, Wiley, 2011
3. Shaw M. C, Metal Cutting Principles, MIT Press, 2004.
4. Kalpakjian S, Schmid S. R, Manufacturing Processes for Engineering Materials, Pearson Education, 2009, 5th Ed.
5. Pandey P.C and Shan H.S, Modern Machining Processes, Tata McGraw Hill, 2017

Reference Books:

1. Begeman, M. L. and Amstead, B. H., Manufacturing Process, Wiley, 1987, 8th Edition.
2. Chapman, W. A. J. and Arnold E., Workshop Technology, Vol. I, II & III, CRC press, Prentice Hall, 2001, 2005 and 1995, 5th, 4th and 3rd editions.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 414C	Introduction to Aeronautics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**1.** To understand the basic physics of aeronautics. **2.** To study factors affecting aircraft performance. **3.** To study the propulsion of an aircraft.	**Course Outcomes**	**CO1**	Understand the basic physics involved in aeronautics. — *Understanding/ Comprehension*
			CO2	Understand the various parameters and factors involved in operation of an aircraft. — *Understanding/ Comprehension*
			CO3	Understand the processes involved in jet propulsion. — *Understanding/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** History of aircraft flight; classification of aircraft, fixed and rotary wing aircraft; anatomy of the aircraft – fuselage, wings, horizontal and vertical stabilizers, landing gear, monoplane and biplane configurations. **Standard atmosphere:** Definition of standard atmosphere, geometric, absolute, geo-potential altitudes, pressure, temperature and density altitudes.	**10**	**CO1, CO2**
II	**Aerodynamics:** Wind tunnels and their application, measurement of airspeed,airfoils and wings; airfoil nomenclature, lift, drag and moment coefficients, infinite and finite wings, critical mach number, induced drag, swept wings, high-lift devices. **Aircraft performance:** Drag polar, cruising, climbing, and gliding flight; range and endurance; takeoff and landing flights; turning performance and V-n diagram.	**10**	**CO1, CO2**
III	**Stability and control:** Definition of stability and control, moments on the airplane, stick-fixed and stick-free stability, control surfaces, static and dynamic stability, longitudinal and lateral stability. **Propulsion:** Aircraft propulsion – piston-prop, turbojet, turboprop, turbofan, turbo-shaft and ramjet engines; general thrust equation, propulsive efficiency; two and three spool configurations; elements of rocket propulsion.	**10**	**CO1, CO2, CO3**
IV	**Airplane structure:** Structural elements, fuselage construction, monocoque, semi-monocoque and truss type constriction, choice of materials, stress-strain diagram. **Future scope:** Airplanes of the future, hypersonic vehicles, basics of space flight, rocket propulsion.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Anderson, J. D. Introduction to Flight, Tata McGraw-Hill, 2007, Fifth Edition
2. Shevell, R. A., Fundamentals of Flight, Pearson Education, 1989.
3. Clancy, L. J., Aerodynamics, Himalayan Books, 1996.

Reference Books:

1. Hull, D. G. Fundamentals of Airplane Flight Mechanics, Springer, 2010.
2. Newman, D. Interactive Aerospace Engineering and Design, McGraw-Hill, 2002.
3. S. A. Brandt, S. A., Stiles, R. J., Bertin, J. J. and Whitford, R. Introduction to Aeronautics: A Design Perspective, AIAA Education series, 2004.
4. Kermode, A. C., Mechanics of Flight, Longman, 1996.
5. Hill, P. G. and Peterson, C. R. C. Mechanics and Thermodynamics of Propulsion, Addison Wesley, 1965.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 415A	Computer-Aided Design and Manufacturing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1.To introduce the students to the basic tools of Computer Aided Design (CAD). 2. To impart the parametric fundamentals to create and manipulate geometric models using curves. 3.To introduce the students to the standard terminologies, design and operational characteristics of Numerical Control (NC) and Computer Numerical Controlled (CNC) machines. 4.To prepare the students to be an effective user of a CAD/CAM system.	**Course Outcomes**	**CO1** Acquainted with CAD/CAM system. — *Remember* **CO2** Understand geometric transformation techniques in CAD. — *Understanding* **CO3** Apply the NC, CNC, DNC and adaptive control in machine tools in practical fields. — *Apply* **CO4** Develop mathematical models to represent curves. — *Analyzing* **CO5** Develop the classification and coding techniques for part families and Computer aided Process Plans for the parts to be manufactured. — *Analyzing* **CO6** Correlate the NC technologies with FMS, CIM systems. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Fundamentals of CAD, Historical Development, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems. Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), product cycle and automation in CAD/CAM, Need of CAD/CAM.	**06**	**CO1**
II	**Transformation:** Representation of points; Transformation matrix; Transformation of a point; Homogeneous coordinates; General transformation – rotation, reflection, translation, scaling and sharing; Combined transformation; Solid body transformation; Parallel projections – orthographic, axonometric and oblique; Perspective projections – single-point, two-point, three-point and vanishing points.	**08**	**CO2**
III	**Plane Curves:** Curve representation – parametric and nonparametric curves, like circle, ellipse, parabola and hyperbola; Conic sections. **Space Curves:** Fundamental of Curve Design, Parametric Space of a Curve, Reparameterization, Representation of space curves; Cubic splines; parabolic blending; Bezier curves; B-spline curves, Rational Polynomials, NURBS.	**08**	**CO4**
IV	**Process Planning:** Basic concepts of process planning, computer aided process planning (CAPP), Retrieval or variant and generative approach of CAPP, Implementation consideration of CAPP. **Group Technology (CT):** Introduction, needs of GT, part families, classification and coding systems, GT machine cells, benefits of GT	**06**	**CO5**
V	**Numerical control of Machine tools:** Principles of Numerical control (NC), Computer Numerical control (CNC), Direct Numerical control (DNC), comparison between conventional and CNC systems, Classification of CNC system, NC coordinate system, positional control, system devices; drives, ball screws, transducers, feedback devices, counting devices, signal converters, interpolators, adaptive control system.	**06**	**CO3**
VI	**NC Part programming:** Concept, format, codes, preparatory and miscellaneous coded, manual part programming, APT programming, macros, fixed cycles.	**04**	**CO6**
VII	**CIM and FMS:** Introduction, hierarchical computer system, components of CIM, types of manufacturing systems, transfer lines, flexible manufacturing system (FMS), The manufacturing cell, tool management and workpiece handling system, benefits of CIM.	**04**	**CO6**
	Total Hours	**42**	

Text Books:

1.Ibrahim Z., CAD/CAM: Theory and Practice, TMH.

2.Rao P. N., CAD/CAM: Principles and Applications, TMH.

3.Groover M.P and Zimmers E., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall.

4.Alavala C. R., CAD/CAM: Concepts and applications, PHI Learning Pvt. Ltd., 2008.

Reference Books:

1.Valentino V. James and Goldenberg Joseph, Introduction to Computer Numerical Control, Prentice Hall, Englewood Cliff, New Jersey, 2012, 5th Edition.

2.Gibbs David and Crandall Thomas, CNC Machining and Programming: An Introduction, Industrial Press Inc., 2003.

3.David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 415B	Finite Element Analysis	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To learn the theory and characteristics of finite elements that represent engineering problems.
2. To learn and apply finite element solutions to structural, thermal, dynamic problem.
3. To develop the knowledge and skills needed to effectively evaluate finite element analyses.

Course Outcomes

CO1	Apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.	*Understanding/ Comprehension*
CO2	Analyze linear 1D problems like bars and trusses; 2D structural problems using CST element and analyse the axi-symmetric problems with triangular elements.	*Identify/ Knowledge/ Remember*
CO3	Solve linear 2D structural beams and frames problems; 1Dheatconduction and convection heat transfer problems.	*Understanding/ Analyzing*
CO4	Evaluate the Eigen values and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non-linearity.	*Understanding/ Analyzing/ Applying*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*	*											*		
2	CO2	*	*	*										*		
3	CO3	*	*	*										*		
4	CO4	*	*	*										*		

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction:** Continuous and discrete systems (discussion on differential equations, matrix algebra)	**6**	**CO1**
II	**Energy methods:** Variational principles and weighted residual techniques (least square method, collocation, sub-domain collocation, Galerkin method) for one-dimensional equation, Rayleigh-Ritz Formulation, development of bar and beam element, application to truss and frames.	**12**	**CO2**
III	**Finite elements for two-dimensions:** Equivalence between energy formulation and Galerkin approach, discretization concepts, choice of elements, derivation of element shape functions (Lagrangian and Hermite) in physical coordinates, Iso-parameteric mapping, numerical integration, assembly procedure, solution techniques.	**12**	**CO3**
IV	**Applications:** Plane elasticity, heat conduction, potential flow and Transient problems, computer implementation.	**10**	**CO4**
	Total Hours	**40**	

Text Books:

1. Logan D L., A first course in the finite element method, Cengage Learning India Private Limited, 2012, 5th Edition.
2. Reddy J.N, Introduction to Finite Element Method, McGraw Hill, 2020, 4th Edition.
3. Dixit US, Finite Element Methods for Engineers, Cengage Learning, 2009.
4. Seshu P., Textbook of Finite Element Analysis, PHI Learning, 2003.

Reference Books:

1. Fish J. and Belytschko T., A first course in finite elements, Wiley, 2007, 1st Edition.
2. Desail Abel, Introduction to The Finite Element Method a Numerical Method for Engineering Analysis, CBS, 2005.
3. BatheK J., Finite element procedures, Prentice Hall, Indian edition, 2006, 1st Edition.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 411H	Advanced Mechatronics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Generate conceptual design for Mechatronics systems based on potential customer requirements. 2. Selection of appropriate sensors and transducers and devise an instrumentation system for collecting information about processes, control systems. 3. Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers. 4. Selection of appropriate actuators for physical systems. 5. Analyse PD, PI and PID controllers for a given mechatronics system. 6. Develop pneumatic and hydraulic circuits. 7. Determine the performance of different Mechatronics system.	**Course Outcomes**	**CO1**	An ability to identify, select, and integrate mechatronic components to meet product requirements.	*Remembering/ Understanding*
			CO2	An ability to analyse PD, PI and PID controllers for a given mechatronics system.	*Understanding/ Analyzing*
			CO3	An ability to develop pneumatic and hydraulic circuits.	*Applying/ Analyzing*
			CO4	An ability to design, analyze, and optimize mechatronic products.	*Evaluating/ Creating*
			CO5	An ability to determine the performance of different Mechatronics system.	*Applying/ Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: Introduction to Mechatronics, need and applications, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man Machine Interface; role of mechatronics in automation, manufacturing and product development.	**6**	**CO1**
II	Importance of sensors in Mechatronics, characteristics of sensors, classification of sensors basic working principles errors and output impedance of sensors, transducers for measurement of displacement, LVDT, strain, position, velocity, noise, flow, pressure, temperature, humidity, vibration, liquid level, vision sensors.	**10**	**CO1, CO2**
III	Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;	**6**	**CO1, CO5**
IV	Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators, Microsensors, Microactuators.	**8**	**CO2, CO3, CO4**
V	Case studies based on the application of mechatronics in manufacturing, Machine Diagnostics, Road vehicles and Medical Technology, bionics and avionics. Industrial robotics, types of Industrial robots, classification based on work envelope, Generations configurations and control loops, coordinate systems, need for robot, basic parts and functions, specifications.	**10**	**CO1, CO5**
Total Hours		**40**	

Text Books:

1. Bolton, W., "Mechatronics, Electronic control systems in mechanical and electrical engineering", 5th edition, 2011, Pearson Education.
2. Alcaiatore, G.D., Michel B. H., "Introduction to Mechatronics and Measuring Systems", 3rd edition, 2006, Mc. Graw Hill International.
3. Robert H. B., "The Mechatronics Handbook", 2nd edition, 2007, CRC Press.

Reference Books:

1. Stenersons, J., "Fundamentals of Programmable Logic Controllers Sensors and Communications", 3rd Ed., 2004, Pearson Education.
2. Kuttan K. A., "Introduction to Mechatronics", 2007, Oxford University Press.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VIII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME-421A	Materials selection and Design	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1.To apply systematic approach to the selection of metals, ceramics, polymers and composites required for mechanical design. 2.To familiarize the students with material properties and materials fabrication processes and an approach for selecting a process capable of producing a component possessing the size, shape, properties and cost dictated by the design. 3.To learn students how to deal with multiple constraints and conflicting objectives including realistic constraints involving the economics, environment, manufacturability and sustainability.	**Course Outcomes**	**CO1** Define the basic concepts, types and classification of materials used in engineering applications. — *Remember* **CO2** Understand the relationship between material properties and design performance. — *Understanding* **CO3** Apply material selection techniques and tools to choose suitable materials for specific engineering designs. — *Apply* **CO4** Analyze design requirements and constraints to select the most appropriate materials in engineering applications. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															
4	CO4															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Material Selection in Design:** Introduction, relation of materials selection to design, general criteria for selection, performance characteristics of materials, materials selection process, design process and materials selection, types of design, material property chart, material performance indices, materials selection procedure, structural index, economics of materials, recycling and materials selection.	**08**	**CO1**
II	**Manufacturing Considerations in Design:** Surface finish, texture, standardization, interchangeable manufacturing, selective assembly, selection of materials based on mechanical properties — preferred numbers, limits, fits and tolerances, types of fits and tolerances, geometric tolerance, types of form and position tolerances, tolerance and manufacturing methods, selection of fits.	**08**	**CO2**
III	**Materials in Design:** Design for brittle fracture, plane strain fracture toughness, fatigue failure, design criteria, fatigue parameters, infinite, safe life and damage tolerance design , fatigue life prediction, corrosion resistance, forms of corrosion, corrosion prevention, design against wear, types of wear, wear prevention, designing with plastics, design for stiffness, time dependent part performance.	**08**	**CO3**
IV	**Engineering materials and their properties:** Material property charts, strategy for material selection, materials selection involving multiple constraints and/or conflicting objectives, hybrid materials, bio-inspired materials, the material life-cycle and environment-friendly selection.	**08**	**CO4**
V	**Integrated computational materials engineering:** New frontiers in systems design of materials, material processes and process selection, failure analysis and materials selection for durability, aesthetics and industrial design.	**08**	**CO4**
	Total Hours	**40**	

Text Books:

1.Dieter George E, Engineering Design, Tata McGraw-Hill education, 1991.

2.Michael F Ashby, Materials selection in Machine Design, Butterworth and Heinemann, 2010.

Reference Books:

1.Charles J A and Crane F A A, Selection and Use of Engineering Materials, Elsevier, 2013.

2.Bhandari V B, Design of Machine Elements, Tata McGraw-Hill Education, 2010, 3rd edition.

3.Mangonan P L, The Principles of Materials Selection for Engineering Design, Prentice Hall, 1999.

4.ASM Handbook : Materials Selection and Design, Volume 20, Taylor and Francis,1997.

5.Mahmoud M Farag, Materials and Process Selection for Engineering Design, CRC Press, 2013.

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Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VIII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 421B	Product Design and Development	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To study the basic concepts of product design and development process.
2. To expose the students to different design principles like designing for function, production, maintenance, packaging etc.
3. To study the applicability of product design and development in industrial applications including product specifications, concept development, design for prototyping and manufacturing.

Course Outcomes

CO1	Describe an engineering design and development process.	*Understand*
CO2	Employ engineering, scientific and mathematical principles to execute a design from concept to finished product.	*Understand*
CO3	Choose an appropriate standardization method for product and develop methods to minimize the cost.	*Apply*
CO4	Explain product design for manufacturing and manual assembly.	*Apply*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	*											*	*		
2	CO2	*	*			*	*		*	*		*	*	*	*	
3	CO3	*	*			*	*		*	*		*	*	*	*	
4	CO4	*					*		*				*	*		

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: Product design definition and evolution, product design morphology, product life cycle, product policy of an organization, selection of a profitable product, product design process, product analysis. Product design: Flow charting, creativity techniques, translating customer needs, product development process.	**10**	**CO1, CO2, CO3**
II	Value engineering in product design: Advantages, applications in product design, problem identification and selection, functional analysis, functional analysis system techniques (FAST), case studies.	**10**	**CO1, CO2, CO3**
III	Product design tools: Quality function development (QFD), computer aided design, robust design, design for excellence, design for manufacturing, design for assembly, ergonomics in product design. Product costing: Elements of product cost, life cycle costing, material selection, metals and alloys, plastics, ceramics, rubber.	**10**	**CO1, CO2, CO3**
IV	Design for manufacturing and assembly: Guidelines, product design for manual assembly, design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., rapid prototyping, needs, advantages, working principle of stereo lithography, laminated object manufacturing, selective laser sintering.	**10**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books:

1. Eppinger S and Ulrich K, Product design and development, McGraw Hill Higher Education, 2015.
2. Magrab E. B, Gupta S. K, McCluskey F. P and Sandborn P, Integrated product and process design and development: The product realization process, CRC Press, 2009.
3. Ulrich K. T, Steven D. E, Product Design & Development, Tata McGraw Hill, New Delhi, 2003

Reference Books:

1. Boothroyd G, Product design for manufacturing and assembly: Computer Aided Design, 26 (7), pp 505-520, 1994.
2. Hollins B and Pugh S, Successful Product Design, Butter Worths, London.
3. Bralla J G, Handbook of Product Design for Manufacture, McGraw Hill, New York.

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CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VIII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 421C	Industry 4.0 and Machine Learning	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1.To know about the necessity of industry 4.0 for manufacturing industries. 2.Understand the advances in robotics to implement in manufacturing and assembly. 3.Understand the need for machine learning for various problem solving. 4.To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning.	**Course Outcomes**	**CO1**	Remember the core concepts of Industry 4.0 and algorithms of machine learning.	*Remember*
			CO2	Understand the need for machine learning for various problem solving and advances in robotics.	*Understanding*
			CO3	Apply different machine learning algorithms to solve real world problems based on Industry 4.0.	*Apply*
			CO4	Develop predictive models using machine learning.	*Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction to industry 4.0:** Introduction, core idea of industry 4.0, origin concept of industry 4.0, industry 4.0 production system, current state of industry 4.0, main concepts and components of industry 4.0, state of the art, supportive technologies, proposed framework for industry 4.0.	**06**	**CO1**
II	**Advances in robotics in the era of industry 4.0:** Introduction, recent technological components of robots, advanced sensor technologies, internet of robotic things, cloud robotics and cognitive architecture for cyber-physical robotics, industrial robotic applications in manufacturing, maintenance and assembly.	**10**	**CO1**
III	**Introduction to machine learning:** Learning problems: perspectives and issues, concept learning, version spaces and candidate eliminations, inductive bias, decision tree learning, representation, algorithm, heuristic space search.	**08**	**CO1, CO2**
IV	**Supervised learning:** Basic methods: distance-based methods, nearest-neighbors, decision trees, naive bayes, linear models: linear regression, logistic regression, generalized linear models, support vector machines, nonlinearity and kernel methods, beyond binary classification, multi-class/structured outputs, ranking.	**08**	**CO3, CO4**
V	**Unsupervised learning:** Clustering: K-means/Kernel K-means, dimensionality reduction: PCA and kernel PCA, matrix factorization and matrix completion, generative models (mixture models and latent factor models).	**08**	**CO3, CO4**
	Total Hours	**40**	

Text Books:

1.Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference Books:

1.Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things.

2.Klaus Schwab, The Fourth Industrial Revolution.

3.Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0.

4.Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.

5.Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचलप्रदेश
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(शिक्षामंत्रालय, भारत सरकारकेतहतराष्ट्रीयमहत्वकासंस्थान)
(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	Bachelor of Technology in Mechanical Engineering	**Academic Year of Regulation**	**2025-26**
Department	Mechanical Engineering	**Semester**	**VIII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	T	P	C	INT	MID	END	Total	**Bloom's taxonomy**
ME 421H	AI and Machine Learning in Mechanical Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	1. Understand the basic ideas of Artificial Intelligence (AI) and Machine Learning (ML) and their use in solving practical problems in mechanical engineering. 2. Learn how to use simple AI/ML tools for data analysis, prediction, design optimization, and automation	**Course Outcomes**	**CO1**	Understand basic concepts and types of AI and ML. — *Remember*
			CO2	Use common algorithms for data analysis and prediction. — *Understanding*
			CO3	Apply AI/ML methods in mechanical systems like fault detection, maintenance, and process control. — *Apply*
			CO4	Work with Python tools to develop simple AI/ML models for real-world problems. — *Analyzing*

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1															
2	CO2															
3	CO3															

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**Introduction to AI:** What is Artificial Intelligence? AI applications in everyday life and mechanical engineering; Intelligent systems and automation examples	**08**	**CO1**
II	**Basics of Machine Learning:** Difference between AI and ML; Types of ML: Supervised, Unsupervised, Reinforcement; Data collection and pre-processing; Introduction to Python libraries: NumPy, Pandas, Scikit-learn	**08**	**CO1**
III	**Supervised Learning:** Linear and logistic regression; Decision trees and random forests; Model accuracy and performance testing; Applications: Predictive maintenance, energy efficiency	**08**	**CO3**
IV	**Neural Networks and Deep Learning:** Basic idea of neurons and learning; Simple neural network structure; Applications: Quality inspection, image-based analysis	**08**	**CO3, CO4**
V	**Applications of AI in Mechanical Engineering;** Smart manufacturing and Industry 4.0; Process optimization and automation; Design optimization and energy system management; Introduction to robotics and AI in control systems	**08**	**CO4**
	Total Hours	**40**	

Text Books:

1. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, Pearson.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, O'Reilly

Reference Books:

1. E. Alpaydin, *Introduction to Machine Learning*, MIT Press.
2. D. K. Pratihar, *Soft Computing: Fundamentals and Applications*, Alpha Science.