

**DEPARTMENT OF
MECHANICAL ENGINEERING**

Scheme of Instructions, Examinations & Syllabi

(Autonomous BE Curriculum with effect from the Academic Year:2025-2026)

for

**III & IV Semester of
Four Year Degree Programme for
Bachelor of Engineering (B.E)**

In

**Mechanical Engineering
M24 Curriculum**



Methodist College of Engineering & Technology,
Affiliated by Osmania University Hyderabad, approved by AICTE, New Delhi,
King Koti Road, Abids, Hyderabad, Telangana 500001.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To be a reputed centre of excellence in the field of mechanical engineering by synergizing innovative technologies and research for the progress of society.

MISSION

- M1:** To impart quality education by means of state-of-the-art infrastructure.
- M2:** To involve in trainings and activities on leadership qualities and social responsibilities.
- M3:** To inculcate the habit of life-long learning, practice professional ethics and serve the society.
- M4:** To establish industry- institute interaction for stakeholder development

PROGRAM EDUCATIONAL OBJECTIVES

The Graduates of the programme shall be able to:

- PEO1:** Excel as engineers with technical skills, and work with complex engineering systems
- PEO2:** Capable to be entrepreneurs, work on global issues, and contribute to industry and society through service activities and/or professional organizations.
- PEO3:** Lead and engage diverse teams with effective communication and managerial skills
- PEO4:** Develop commitment to pursue life-long learning in the chosen profession and/or progress towards an advanced degree

PROGRAM SPECIFIC OUTCOMES

Mechanical Engineering Graduates will be able to:

PSO1:

Apply the knowledge of CAD/CAM/CAE tools to analyze, design and develop the products and processes related to Mechanical Engineering.

PSO 2:

Solve problems related to mechanical systems by applying the principles of modern manufacturing technologies.

PSO 3:

Exhibit the knowledge and skill relevant to HVAC and IC Engines.

SEMESTER - III									
S N o	Code No.	Subject	Scheme of Instructions				Scheme of Examination		Credits
			Hours Per week			Duration in Hrs.	Max. Marks		
			L	T	P/D		CIE	SEE	
Theory Courses									
1	M24BS306HS	Numerical Methods and Partial Differential Equations	3	-	-	3	40	60	3
2	M24PC301ME	Thermodynamics	3	-	-	3	40	60	3
3	M24PC302ME	Strength of Materials	3	-	-	3	40	60	3
4	M24PC303ME	Metallurgy & Material Science	3	-	-	3	40	60	3
5	M24ES306ME	Python Programming for Mechanical Engineering	2	-	-	2	40	60	2
6	M24MC302HS	Essence of Indian Traditional Knowledge (EITK)	2	-	-	2	40	60	1
Practical / Laboratory									
7	M24ES355ME	Python Programming Lab for Mechanical Engineering	-	-	2	2	40	60	1
8	M24PC351ME	Metallurgy and Material Testing Lab	-	-	2	2	40	60	1
9	M24PC352ME	Computer Aided Machine Drawing Lab	-	-	4	4	40	60	2
10	M24SE351ME	Technical Training -I	-	-	2	2	40	60	1
Total			16	-	10	26	400	600	20

****Bridge Courses being offered to Lateral Entry admitted students****

S. No	Semester	Subject Code	Subject Name	Credits
1	III	M24BR351HS	English Lab	0
2	III	M24BR352CS	PPS Lab(Programming for Problem Solving Lab)	0

NOTE: In accordance with the National Credit Framework (NCrF), which defines 1 credit as equivalent to 30 hours of learning, the conventional L: T: P (Lecture: Tutorial: Practical) distribution has been mapped to Notional Hours, as reflected in the table below

SEMESTER - III

Scheme of BE in Mechanical Engineering | M24 Curriculum

S No	Code No.	Subject	Scheme of Instructions					Scheme of Examination		Credits
			Notional Hours				Total Notional Hours	Max. Marks		
			L	T	P/PW	TW/SL		CIE	SEE	
Theory Courses										
1	M24BS306HS	Numerical Methods and Partial Differential Equations	45	15	-	30	90	40	60	3
2	M24PC301ME	Thermodynamics	45	15	-	30	90	40	60	3
3	M24PC302ME	Strength of Materials	45	15	-	30	90	40	60	3
4	M24PC303ME	Metallurgy & Material Science	45	15	-	30	90	40	60	3
5	M24ES306ME	Python Programming for Mechanical Engineering	30	-	-	30	60	40	60	2
6	M24MC302HS	Essence of Indian Traditional Knowledge (EITK)	30	-	-	-	30	40	60	1
Practical / Laboratory										
7	M24ES355ME	Python Programming Lab for Mechanical Engineering	-	-	30	-	30	40	60	1
8	M24PC351ME	Metallurgy and Material Testing Lab	-	-	30	-	30	40	60	1
9	M24PC352ME	Computer Aided Machine Drawing Lab	-	-	60	-	60	40	60	2
10	M24SE351ME	Technical Training -I	-	-	30	-	30	40	60	1
Total			240	60	150	150	600	400	600	20

****Bridge Courses being offered to Lateral Entry admitted students****

S. No	Semester	Subject Code	Subject Name	Credits
1	III	M24BR351HS	English Lab	0
2	III	M24BR352CS	PPS Lab(Programming for Problem Solving Lab)	0

SEMESTER - IV									
S N o	Code No.	Subject	Scheme of Instructions				Scheme of Examination		Credits
			Hours Per week			Duration in Hrs.	Max. Marks		
			L	T	P/D		CIE	SEE	
Theory Courses									
1	M24HS402HS	Human Value and Professional Ethics	2	-	-	2	40	60	2
2	M24PC404ME	Thermal Engineering	3		-	3	40	60	3
3	M24PC405ME	Manufacturing Processes	3	-	-	3	40	60	3
4	M24PC406ME	Fluid Mechanics & Hydraulic Machines	3	-	-	3	40	60	3
5	M24PC407ME	Kinematics of Machines	3		-	3	40	60	3
6	M24ES403CS	Fundamentals of Artificial Intelligence	2	-	-	2	40	60	2
7	M24ES407EC	Introduction to IOT	2	-	-	2	40	60	2
Practical / Laboratory									
8	M24ES457CS	Artificial Intelligence Lab	-	-	2	2	40	60	1
9	M24PC453ME	Thermal Engineering Lab	-	-	2	2	40	60	1
10	M24PC454ME	Manufacturing Processes Lab	-	-	2	2	40	60	1
11	M24PC455ME	Fluid Mechanics & Hydraulic Machines Lab	-	-	2	2	40	60	1
Total			18	-	8	26	440	660	22

****Bridge Courses being offered to Lateral Entry admitted students****

S. No	Semester	Subject Code	Subject Name	Credits
1	IV	M24BR401CE	Environmental Science	0
2	IV	M24BR451HS	Sports/Yoga/NSS	0

NOTE: In accordance with the National Credit Framework (NCrF), which defines 1 credit as equivalent to 30 hours of learning, the conventional L: T: P (Lecture: Tutorial: Practical) distribution has been mapped to Notional Hours, as reflected in the table below

SEMESTER - IV										
S No	Code No.	Subject	Scheme of Instructions					Scheme of Examination		Credits
			Notional Hours				Total Notional Hours	Max. Marks		
			L	T	P/PW	TW/SL		CIE	SEE	
Theory Courses										
1	M24HS402HS	Human Value and Professional Ethics	30	-	-	30	60	40	60	2
2	M24PC404ME	Thermal Engineering	45	15	-	30	90	40	60	3
3	M24PC405ME	Manufacturing Processes	45	15	-	30	90	40	60	3
4	M24PC406ME	Fluid Mechanics & Hydraulic Machines	45	15	-	30	90	40	60	3
5	M24PC407ME	Kinematics of Machines	45	15	-	30	90	40	60	3
6	M24ES403CS	Fundamentals of Artificial Intelligence	30	-	-	30	60	40	60	2
7	M24ES407EC	Introduction to IOT	30	-	-	30	60	40	60	2
Practical / Laboratory										
8	M24ES457CS	Artificial Intelligence Lab	-	-	30	-	30	40	60	1
9	M24PC453ME	Thermal Engineering Lab	-	-	30	-	30	40	60	1
10	M24PC454ME	Manufacturing Processes Lab	-	-	30	-	30	40	60	1
11	M24PC455ME	Fluid Mechanics & Hydraulic Machines Lab	-	-	30	-	30	40	60	1
Total			270	60	120	210	660	440	660	22

****Bridge Courses being offered to Lateral Entry admitted students****

S. No	Semester	Subject Code	Subject Name	Credits
1	IV	M24BR401CE	Environmental Science	0
2	IV	M24BR451HS	Sports/Yoga/NSS	0

III SEMESTER

Course Code	Course Title					Core / Elective	
M24BS306HS	NUMERICAL METHODS & PARTIAL DIFFERENTIAL EQUATIONS					BS	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Basic Differentiation, Integration and Trigonometry.	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to:

1. The objective of this course is to make the student
2. Learn an alternative methods and analytical methods in mathematical concepts.
3. Apply numerical techniques in solving ordinary differential equations.
4. Study Interpolation and numerical methods to fit a curve
5. Formulate and solve partial differential equations.
6. Study physical applications of partial differential equations

Course Outcomes:

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

- CO1. **Find** the solution of algebraic and transcendental equations using numerical methods.
- CO2. **Apply** numerical techniques to solve ordinary differential equations and definite integrals.
- CO3. **Apply** numerical methods to interpolate values and fit different curves from given data.
- CO4. **Find** solutions of first order linear and non linear partial differential equations.
- CO5. **Apply** the solution of partial differential equations to physical problems.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	2	-	-	-	-	-
CO2	3	3	-	-	-	-	-	2	2	-	-	-	-	-
CO3	3	-	-	-	-	-	-	2	2	-	-	-	-	-
CO4	3	-	-	-	-	-	-	2	2	-	-	-	-	-
CO5	3	3	-	-	-	-	-	2	2	-	-	-	-	-

UNIT 1:

Numerical Solutions of Algebraic and Transcendental Equations: Introduction, Bisection Method, Regula-False method, Newton Raphson method. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidel method.

UNIT 2:

Interpolation: Newton's Forward and Backward difference interpolations, Gauss Forward and Backward difference interpolations Lagrange's interpolation
 Curve Fitting: Fitting a linear, second degree, exponential curve by method of least squares for the discrete data

UNIT 3:

Numerical integration: Trapezoidal Rule, Simpson's 1/3rd and 3/8th Rule.

Numerical solutions of Ordinary Differential Equations: Solution of ordinary differential equations by Taylor's Series, Picard's method of Successive approximations, Euler's method, Fourth Order Runge-Kutta Method.

UNIT 4:

Partial Differential Equations: Formation of first and second order partial differential equations, solution of first order equations, Lagrange's equation, Nonlinear first order equations, Charpit's method, Finite difference methods for first order linear transport equation.

UNIT 5:

Applications to Partial Differential Equations: Classification of linear second order partial differential equations, Separation of variables method, Heat equation, wave equations, Laplace equation, Finite difference methods for one dimensional heat equation

Text Books:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 43rd Edition, 2014.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.
2. M. K. Jain, S. R. K. Iyengar and R.K. Jain, Numerical Methods for Science and Engineering Computation, 6th Edition, New Age International Publishers. 2020-2021
3. Peter. V. O'Neil, Advance Engineering Mathematics, 7th Edition, 2012
4. B. V. Ramana, Higher Engineering Mathematics, 3rd Edition 2015.
5. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title					Core / Elective	
M24PC301ME	THERMODYNAMICS					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Basics of Physics, Chemistry and Engineering mathematics	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to:

1. Familiarize the students to understand the fundamentals of thermodynamics
2. Understand laws of thermodynamic
3. Understand power cycles and derivation
4. Perform thermal analysis on their behavior and performance.
5. Make use of standard and approved Steam Table, Mollier Chart, and Psychrometric Chart

Course Outcomes:

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

- CO1. **Describe** the fundamental thermodynamic concepts, temperature measurement methods, laws of thermodynamics, and standard thermodynamic cycles.
- CO2. **Solve** the problems involving ideal and real gases, flow systems, gas mixtures, and thermodynamic cycles using appropriate principles and equations.
- CO3. **Interpret** thermodynamic processes and systems such as heat engines and refrigeration cycles using diagrams and mathematical relationships
- CO4. **Assess** the efficiency, irreversibility, and overall performance of thermodynamic cycles using concepts like entropy and availability.
- CO5. **Recommend** thermodynamic system modifications by comparing alternative designs and justifying performance based on established principles.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO2	PSO3
CO1	3	3	-	2	3	-	-	1	-	-	-	-	-	3
CO2	3	3	1	-	3	-	-	1	1	-	-	-	-	3
CO3	3	2	-	1	3	1	-	1	1	-	-	-	-	3
CO4	3	2	3	-	3	1	-	-	2	1	1	-	-	3
CO5	3	3	3	-	3	2	-	-	-	2	2	-	-	3

Unit-I:

Introduction: Basic Concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible

Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work transfer and Heat transfer, Point and Path function. Thermodynamic Equilibrium. Zeroth Law of Thermodynamics– Concept of Temperature. Principles of Thermometry –Reference Points- Const. Volume gas Thermometer, Scales of Temperature, Ideal Gas Scale.

Unit-II:

Joule’s Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process and cycle – applied to a flow system – Steady Flow Energy Equation. PMM-I, throttling and free expansion processes – Equation of state for ideal gas, deviations from perfect gas model – Vanderwaals equation of state – compressibility charts –specific heats and gas constant.

Unit-III:

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot’s principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility, PMM-III – Thermodynamic Potentials, [Gibbs and Helmholtz Functions, Introduction to Maxwell Relations] – Elementary Treatment of the Third Law of Thermodynamics.

Unit-IV:

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Mixture of Gases: Mole fraction and mass fraction, Partial pressure and Dalton’s Law, Amagat-Leduc Law of Partial volumes, Relation between partial pressure, mole fraction and volume fraction; Gas Constant, molecular mass and specific heats of the gas mixtures; relation between volumetric and gravimetric analysis

Unit-V:

Power Cycles: Otto, Diesel, Dual Combustion cycles, Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Brayton and Rankine cycles- performance evaluation.

Refrigeration Cycles:– Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

Text Books:

1. Yunus a. Cengel & michael a. Boles, “Thermodynamics” 10th Edition. 2023.
2. Nag.P.K “Engineering Thermodynamics” 6th Edition, Tata McGraw-Hill, N-Delhi.2017

Reference Books:

1. Fundamentals of Engineering Thermodynamics -Moran M. J. & Shapiro H.N.9th Edition, 2024.
2. R.K.Rajput, “A Text Book of Engineering Thermodynamics, 10th Edition, 2024.
3. Fundamentals of Thermodynamics- Sonntag R.E., Borgnakke C. & Van Wylen C. J.10th Edition, 2003.
4. Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner.2nd Edition, 2004.
5. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title						Core/Elective
M24PC302ME	STRENGTH OF MATERIALS						Core
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engineering Mechanics	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to:

1. Introduce the basic concepts of stress, strain, and deformation in structural elements under various loading conditions.
2. Understand and analyze internal forces, shear force, and bending moment diagrams in beams subjected to different loads.
3. Apply bending and shear stress theories for analyzing stresses in beams and shafts of various cross-sections.
4. Compute deflections in beams using analytical methods such as double integration and Macaulay's method.
5. Evaluate the torsional behavior, strain energy, and spring characteristics under axial and torsional loads.

Course Outcomes:

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

- CO1. **Define** stresses and strains, **explain** stress-strain diagram and **classify** the beams, loads and springs.
- CO2. **Apply** basic concepts to find various types of stresses, strain energy and properties of beams and also to select suitable spring for the application
- CO3. **Analyze** stresses in cylinders, beams and springs for the given loading conditions
- CO4. **Measure** stresses, torque, slope, deflection, shear force and bending moment for various types of beams under loading conditions
- CO5. **Construct** stress- strain diagram, Mohr's circle, Shear force and bending moment diagrams for the given material under given loading conditions

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	2	2	-	-	3	-	-
CO2	3	3	3	1	3	-	-	1	1	-	-	3	-	-
CO3	3	3	3	2	3	-	-	1	1	-	-	3	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-	3	-	-
CO5	3	3	3	0	3	-	-	-	-	-	-	3	-	-

UNIT – I

Simple stresses and strains: Types of Stresses and Strains. Hook's Law, Stress- Strain curve for Ductile materials, Modulus of Elasticity, Poisson's ratio, Volumetric strain, Relation between Elastic Constants, Bars of varying sections, Compound bars and Temperature stresses.

Compound Stresses: Stresses on oblique planes, principal stresses and principal planes. Mohr circle of stresses.

UNIT-II

Shear Force and Bending Moment: Relation between Intensity of loading, Shear force and Bending moment. Shear force and Bending moment diagrams for Cantilever, Simply supported and Overhanging beams with Point load, Uniformly distributed load and introduction to Uniformly varying load.

Thin Cylinders: Derivation of formulae for longitudinal stress, Circumferential (hoop) stress, Volumetric strains, Changes in diameter and volume.

UNIT-III

Theory of simple bending: Introduction, Derivation of bending equation: $M/I = F/y = E/R$ Modulus of Section, Moment of Resistance.

Direct and Bending Stresses: Basic concepts, Core of sections for Rectangular, Solid and Hollow Circular and I sections.

Distribution of Shear stress: Equation of Shear stress, Distribution of shear stress in rectangular, I and T sections.

UNIT-IV

Deflections: Deflections of Cantilever and Simply Supported Beams including Overhanging beams for Point loads and Uniformly Distributed Loads by double integration and Macaulay's methods.

UNIT-V

Torsion-Theory of Pure Torsion- Derivation of basic equation $T/J = q/R = G\theta/L$ and Hollow circular shafts, Transmission of power, Combined Bending and Torsion.

Springs: Close and open coiled Helical springs subjected to Axial loads and Axial couples, strain energy in springs.

Strain Energy: Strain Energy in bars due to Gradually Applied loads, Sudden Loads, Impact loads and Shock loads

Text Books

1. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons, New Revised & Enlarged Edition 2025.
2. Dr. R K bansal, Strength of Materials- Laxmi Publications, 6th Edition, 2022.

Reference Books

1. R.K. Rajput, Strength of Materials, S. Chand & Co. 7th Edition 2022.
2. S.S. Bhavikatti, Strength of Materials, Vikas Publications. 5th Edition, 2021.
3. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi. 10th Edition 2015.
4. D.S. Prakash Rao, Strength of Materials – A practical Approach, Universities Press. Original Edition 1999.
5. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title					Core/Elective	
M24PC303ME	METALLURGY & MATERIAL SCIENCE					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Physics & Chemistry	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to:

1. Understand structure property relations.
2. Understand various modes of failure and suggest mechanisms for preventions of failures.
3. Understand and interpret phase diagrams.
4. Acquire basic knowledge in various heat treatment operations, their purpose and applications.
5. Understand applications of conventional metals & non metals.

Course Outcomes:

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

CO 1: **Discuss** crystal structure, mechanical behaviour and heat treatment methods applied to ferrous and non ferrous materials.

CO 2: **Analyse** mechanical failure, crack growth and crack propagation in ductile and brittle materials under static and dynamic loading.

CO 3: **Sketch** and interpret Iron-Iron Carbide and other equilibrium diagrams.

CO 4: **Compare** and select suitable material and heat treatment process for specific requirement

CO 5: **Discuss** properties and applications of ferrous and non ferrous alloys, polymers, ceramics and composite materials.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				1				3	
CO2	3	3	3	3	3				3				3	
CO3	3	3	3	3	2			1	1				1	
CO4	3	3	3	3	3								3	
CO5	3	3	3	3	2			3	3		3		3	

Unit-I

Crystal structure and Properties: Crystal structure, Space lattice, unit cell, crystal directions and planes, crystal imperfections.

Effect of slip and twinning on plastic deformation, Hall-Petch equation, Orange peel effect, cold and hot working, strain hardening and Bauschinger effect. Recovery, Recrystallisation, Grain growth and their effect on mechanical properties of metals.

Mechanical properties of materials: Tensile properties, stress-strain diagrams, elasticity, plasticity, ductility, toughness, modulus of elasticity, Critical resolved shear stress, tensile and compression test, hardness and its measurement, Charpy and Izod impact tests.

Unit-II

Fracture: Ductile and Brittle fracture, modes of fracture, ductile to brittle transition, crack initiation and propagation.

Fatigue: S-N curve, Structure of fatigue fracture specimen, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Experimental determination of fatigue strength (RR-Moore Test).

Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep Test, Differences between creep curve and stress rupture curve.

Unit-III

Structure of Alloys: Types of solid solution, Hume Rothery rules for Substitutional solid solutions, Intermediate phases and phase rule, Construction and interpretation of Binary equilibrium diagram, Isomorphous, Eutectic and Peritectic diagrams, Iron-Iron Carbide equilibrium diagram, construction and interpretation. Types of Plain Carbon Steels, Cast Iron and their properties.

Unit-IV

Alloy Steels: Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V, Ti & W). Study about Stainless steels, HSLA, Maraging steels, ODS alloys and Tool steels.

Heat Treatment: Construction and interpretation of T.T.T Curve, CCT curve; Annealing, Normalizing, Hardening, Tempering, Austempering and Martempering, Case Hardening: Carburizing, Nitriding, Carbonitriding, Flame Hardening and Induction Hardening.

Unit-V

Non-ferrous metals and alloys: Properties and applications of Copper and its alloys, Aluminium and its alloys, Age hardening, Ti and its alloys, Ni-based alloys, their composition and properties.

Ceramics, Polymers and Composites: Ceramics, crystalline ceramics, glasses, properties and applications of ceramics, polymers-polymerization, thermoplastics and thermosetting plastics, properties and applications of polymers. concept of composites, matrix and reinforcement, classification of composites, applications of composites

Text Books:

1. V.D. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House, 47th Edition, 2025.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd Edition, 1997.

Reference Books:

1. V. Raghavan, Material Science and Engineering, Prentice Hall of India Ltd., 6th Edition, 2015.
2. E. Dieter, Mechanical Metallurgy (Metric Editions), Tata McGraw Hill, 3rd Edition, 2013.
3. Robert M. Jones, Mechanics of Composite Materials, Taylor and Francis, 2nd Edition, 1999 (Reprint 2021).
4. S.P. Nayak, Engineering Metallurgy and Material Science, Charotar Publishing House, 5th Edition, 1986.
5. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title						Core/Elective
M24ES306ME	PYTHON PROGRAMMING FOR MECHANICAL ENGINEERING						Core
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engg Maths, EM, SOM, TD	30	-	-	30	40	60	2

Course Objectives:

The objective of the course is to make the students to:

1. Learn how to use various data types and arrays in python
2. Learn how to write decision and loop control statements in python
3. Learn how to read and write files and handle exceptions in python.
4. Learn and apply Object Oriented concepts in python programs
5. Learn different libraries used for problem solving in mechanical engineering

Course Outcomes:

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

CO1.Understand and use the basic data types and core data structures like lists, settuple and dictionaries.

CO2.Use the control statements and arrays in python programs

CO3.Understand and apply different file handling and exception handling operations

CO4.Analyze Object Oriented Programming concepts in python programs

CO5.Solve mechanical engineering problems using python libraries

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	2	0	2	0	2	0	0	0
CO2	2	2	3	3	3	1	1	2	0	0	3	1	1	1
CO3	3	3	3	2	3	0	1	0	0	0	3	0	0	0
CO4	3	0	3	3	3	1	0	0	3	3	1	1	0	1
CO5	3	0	3	2	3	1	2	0	0	0	0	2	0	2

UNIT I

Introduction to Python: installing Python, basic syntax, interactive shell, editing, saving, and running a script. The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators and expressions, comments in the program, understanding error messages. Conditions, Boolean logic, logical operators, ranges, Control statements.

UNIT II

Strings and Files: Strings and text files, manipulating files and directories, os and sys modules, text files: reading/writing text and numbers from/to a file, creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string, strings and number system: converting strings to numbers and vice versa.

Lists, tuples, and dictionaries: basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries

UNIT III

Design with functions: Hiding redundancy, complexity, arguments and return values, formal vs. actual arguments, named arguments. Program structure and design. Recursive functions.

Classes and OOP: Classes, objects, attributes and methods, defining classes, design with classes, data modeling, persistent storage of objects, inheritance, polymorphism, operator overloading (`_eq_`, `_str_`, etc), abstract classes, exception handling, try block.

Data structures: Hash Tables.

UNIT IV

Simple Graphics and Image Processing: “turtle” module, simple 2d drawing - colors, shapes, digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc).

Graphical user interfaces: Event-driven programming paradigm, tkinter, module, creating simple GUI, buttons, labels, entry fields, dialogs, widget attributes - sizes, fonts, colors layouts, nested frames.

UNIT V**Mathematical and Numerical Libraries:**

NumPy- numerical computations: arrays, matrices, and mathematical functions

SciPy- scientific computing optimization: root-finding, and solving thermodynamic equations

Libraries to solve mechanical engineering problems:

SymPy- symbolic mathematics: solve equations and deriving thermodynamic relationships, Thermo-calculating thermo-physical properties: temperature/pressure-dependent properties, Matplotlib-create plots, graphs, and charts to visualize data, Pandas- data manipulation and analysis.

MechElastic- analyzing mechanical and elastic properties of 2D materials.

SMATool- strength of materials analysis.

SymBeam- structural analysis, simply supported beam.

Text Books:

1. Reema Thareja, Python Programming Using Problem Solving Approach, Oxford University Press India, 3rd Edition, 2025.
2. Mark Summerfield, Programming in Python 3: A Complete Introduction to the Python Language, Addison-Wesley, 2nd Edition, 2010.

Reference Books:

1. Abdellatif M. Sadeq, Python Programming for Mechanical Engineers, Abdellatif M. Sadeq (ResearchGate Publication), 1st Edition, 2024.
2. Martin C. Brown, Python: The Complete Reference, McGraw-Hill, 2001 (Paperback Reprint 2018).
3. E. Balaguruswamy, Introduction to Computing and Problem Solving Using Python, McGraw-Hill India, 1st Edition, 2016.
4. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title					Core / Elective	
M24MC302HS	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					Mandatory	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Basic Knowledge of English	15	-	-	15	40	60	1

Course Objectives:

The objective of the course is to make the students to:

1. Reinforce the students understanding with the pan-Indian heritage in terms of culture, traditions and knowledge.
2. Impart the basic understanding of the importance of the various Indian Languages and Literature
3. Impart basic knowledge of Indian religion and Philosophies.
4. Impart basic knowledge on Indian Paintings, Music, Dance and Drama, Handicrafts and Indian Architecture.
5. Explore the Sciences, the contribution of scientists and the education system in Ancient, Medieval and Modern India.

Course Outcomes:

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

- CO1. **Understand** the concepts of Indian culture and Traditions and their Importance
- CO2. **Distinguish** the Indian Languages
- CO3. Show the basic **understanding** of Indian religion and Philosophy
- CO4. Show the basic **understanding** about the fine arts in India
- CO5. **Analyze** and apply the principles of traditional Indian Education to contemporary learning systems.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	3	2	2	2	-	2	-	-	-
CO2	-	-	2	-	-	2	2	2	2	-	3	-	-	-
CO3	-	-	1	-	-	3	3	2	2	-	3	-	-	-
CO4	-	-	2	-	-	3	2	2	2	1	3	-	-	-
CO5	-	-	3	-	-	3	2	3	3	2	3	-	-	-

UNIT- I

-Introduction to Indian Culture and heritage

UNIT -II

Indian Languages, Culture and Literature:

- the evolution and role of Sanskrit, significance of scriptures to current society
- Indian philosophies, other Sanskrit literature, literature of south India
- Northern Indian languages & literature

UNIT - III

Religion and Philosophy:

- Religion and Philosophy in ancient India (Buddhism, Jainism and Shatdarshanas)
- Religion and Philosophy in medieval India
- Religious reform movements in modern India (Brahma Samaj & Arya Samaj)

UNIT-IV

Fine Arts in India (Art, Technology & Engineering):

- Indian Painting, Indian handicrafts
- Music: Divisions of Indian classic music, modern Indian music
- Dance and Drama (classical and folk dances)
- Indian Architecture (Harappa and Mohenjo-Daro, Buddhist Sculpture, Asokan rock cut pillars, Iron pillar of Mehrauli); Medieval – Brihadeeswara temple, Ramappa Temple, Vijayanagar, Hampi and modern) Science and Technology in India

UNIT - V

Education System in India:

- Education in ancient, medieval and modern India – Women Education in India, National Education Policy -2020.

Text Books:

1. Science in Samskrit, Samskrita Bharati, Samskrita Bharati, New Delhi, 1st Edition, 2007.
2. Indian Knowledge Systems (2 Vols-Set), Kapil Kapoor and Avadhesh Kumar Singh, D K Printworld, 1st Edition, 2005.

Reference Books:

1. Indian Art and Culture, Nitin Singhania, McGraw Hill, 4th Edition, 2022.
2. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, New Delhi, Reprint Edition, 2015.
3. Basanta Kumar Mohanta and Vipin K. Singh, Traditional Knowledge System and Technology in India, Pratibha Prakashan, 1st Edition, 2012.
4. B.N. Luniya, Evolution of Indian Culture (Text Book), Ina Publishers, 4th Edition, 2010.
5. Satya Prakash, Founders of Sciences in Ancient India, Vijay Kumar Publisher, New Delhi, 1st Edition, 2009.
6. Position Paper, National Focus Group on Arts, Music, Dance and Theatre, NCERT, 1st Edition, 2006.
7. Education and Examination Systems in Ancient India, S. Narain, Kalpaz Publications, 1st Edition, 2004.
8. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title					Core/Elective	
M24ES355ME	PYTHON PROGRAMMING LAB FOR MECHANICAL ENGINEERING					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Experience with (C/C++/Java/MATLAB)	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to:

1. Learn how to design and program using lists, tuples, and dictionaries.
2. Learn how to use indexing and slicing to access data in Python programs.
3. Learn structure and components of a Python and to read and write files.
4. Learn how to design object-oriented programs with Python classes and Exception handling techniques.
5. Learn how to solve problems in mechanical engineering.

Course Outcomes:

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

CO1: Execute Python programs to generate solutions for simple computational problems.

CO2: Implement Python code using conditionals and loops to solve problems.

CO3: Demonstrate the use of functions by defining and invoking them in Python programs.

CO4: Construct Python programs utilizing lists, tuples, and dictionaries to represent compound data.

CO5: Apply Python libraries to model and solve mechanical engineering problems.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PS01	PSO2	PSO3
CO1	3	3	3	2	3	1	0	0	0	0	2	0	0	0
CO2	2	2	3	3	2	1	0	2	0	0	3	1	0	1
CO3	2	3	2	2	2	0	0	0	0	0	3	0	0	0
CO4	2	0	2	3	3	1	0	0	0	0	1	1	0	1
CO5	2	0	3	2	2	1	0	0	0	0	0	2	0	2

List of Experiments:

1. Develop program to demonstrate different number data types in python.
2. Develop program to understand the control structures of python.
3. Develop program on String manipulation.
4. Develop program to perform various operations on files.
5. Develop programs to learn different types of structures (list, dictionary, tuples) in python.
6. Develop program to demonstrate classes and OOP principles.
7. Develop programs for data structure algorithms using python – searching, sorting and hash tables.
8. Draw graphics using Turtle.
9. Develop event driven GUI programs.

Experiments for Mechanical Engineering Problems

1. Develop program to solve the first law of thermodynamics using python.
2. Develop program to evaluating heat and work using python programming.
3. Develop program to find thermal efficiency of the Otto cycle & plot the Otto cycle.
4. Develop python program for projectile motion.
5. Develop program to analyse simply supported beam-shear force and bending moment diagrams.

Note: Any 10 experiments to be executed.

Reference Books:

1. Reema Thareja, Python Programming Using Problem Solving Approach, Oxford University Press, 3rd Edition, 2025.
2. Abdellatif M. Sadeq, Python Programming for Mechanical Engineers, Self-Published (ResearchGate), 1st Edition, 2024.
3. Amit Kumar Tyagi, Python for Engineers and Scientists, CRC Press, 1st Edition, 2021.
4. E. Balagurusamy, Introduction to Computing and Problem Solving Using Python, McGraw-Hill Education, 1st Edition, 2016.

Course Code	Course Title					Core / Elective	
M24PC351ME	METALLURGY & MATERIAL TESTING LAB					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engg. Chemistry	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to:

1. Acquire basic knowledge by understanding Iron-Iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
4. Understand differences between different heat treatment methods.
5. Expose to T-T-T curve and its application in engineering metallurgy.
6. Understand the relation between micro structure and properties.

Course Outcomes:

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

- CO1. Prepare** metallurgical specimens and operate metallurgical microscopes to examine and interpret the microstructures of steels, cast irons, and non-ferrous materials.
- CO2. Perform** the Jominy end-quench test to determine the hardenability of steels and measure the variation of hardness along the specimen.
- CO3. Conduct** mechanical tests such as tensile, impact, hardness, torsion, and deflection to evaluate material properties like strength, toughness, modulus of elasticity, and hardness.
- CO4. Measure** and validate the stiffness, rigidity modulus, and mechanical behavior of structural elements like beams and springs under various loading conditions.
- CO5. Prepare** technical reports and plot graphical representations (e.g., stress-strain curves, shear force and bending moment diagrams) to communicate experimental results and conclusions.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1	2	3	1	1	1	1	-	-	-	3	-
CO2	2	1	1	3	3	1	1	1	1	-	-	-	3	-
CO3	3	2	3	3	2	1	1	2	2	-	-	3	3	-
CO4	3	1	3	2	1	1	1	1	1	-	-	3	-	-
CO5	1	1	1	3	1	1	1	2	3	-	-	1	-	-

List of Experiments:

A: Metallurgy Experiments:

1. Study of: Metallurgical Microscope, Iron-Iron Carbide diagram, Procedure for specimen preparation
2. Metallographic Study of Various types of Steels
3. Metallographic Study of different types of Cast Irons

4. Metallographic Study of Non-Ferrous Materials such as Al, Cu, Brass, Bronze etc.

5. Jominy End Quench test

B: Materials Testing Lab

1. Uni-axial tension test, to draw stress- strain diagram, and estimate modulus of elasticity, % of elongation and toughness.

2. To determine the impact strength of specimen by conducting Charpy & Izod tests.

3. To find the Hardness number for the given metal specimen using Brinell and Rockwell hardness testers.

4. To determine the Rigidity Modulus of the given specimen by conducting Torsion Test.

5. To determine the Young's Modulus (E) of given material by conducting the deflection test on Cantilever beam and simply supported beam

6. To determine the stiffness and rigidity modulus of the given spring by conducting compression and tension tests.

LIST OF ADDITIONAL EXPERIMENTS:

Experiment Name
1. To determine the fatigue strength or endurance limit of a material (typically mild steel) under repeated cyclic loading.
2. To draw shear force and bending moment diagrams for a given beam.

Reference Books:

1. Rajput, R. K. – Strength of Materials (Mechanics of Solids – SI Units), 7th Edition, 2022, S. Chand Publishing.

2. Bhavikatti, S. S. – Strength of Materials, 5th Edition, 2021, Vikas Publishing House.

3. Raghavan, V. – Materials Science and Engineering: A First Course, 6th Edition, 2015, PHI Learning.

4. Higgins, R. A. – Engineering Metallurgy (Part I & II), 8th Edition, 2006, Viva Books/Elsevier.

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title	Core / Elective					
M24PC352ME	COMPUTER AIDED MACHINE DRAWING LAB	Core					
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engineering Graphics	-	-	60	-	40	60	2

Course Objectives:

The objective of the course is to make the students to:

1. Understand the basic principles and standards used in machine drawing.
2. Develop skills to draw orthographic views of machine components.
3. Model individual parts of standard mechanical assemblies using 3D software.
4. Perform assembly modeling and prepare detailed assembly drawings with annotations and bill of materials.
5. Use industry-standard CAD software tools effectively for drafting and modeling tasks.

Course Outcomes:

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

- CO1.** Draw orthographic projections and sectional views of machine components.
CO2. Use AutoCAD commands to draft orthographic views of machine parts with all technical details.
CO3. Interpret and sketch part drawings of assemblies such as stuffing box, screw jack, and plumber block.
CO4. Draft detailed assembly drawings with bill of materials and balloon annotations.
CO5. Generate 2D and 3D models using industry-standard CAD software (AutoCAD, SolidWorks, Creo, etc.).

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	-	3	-	-	3	-	-	3	3	-	-
CO2	3	3	3	2	3	-	-	3	-	2	3	3	-	-
CO3	3	3	2	3	3	1	-	2	-	1	3	3	-	-
CO4	3	-	3	-	3	-	-	-	3	3	3	3	-	-
CO5	3	3	3	3	3	1	-	3	3	3	3	3	-	-

Part-A

1. Orthographic views of sectioned machine components.
2. Riveted & Screwed Joints.
3. Joints - Socket Spigot Joint & Knuckle Joint.
4. Couplings - Flanged Coupling & Universal Coupling.

Part-B

5. Modelling of all parts from Stuffing Box assembly.
6. Modelling & part drawing of all parts from Screw Jack assembly.
7. Modelling of all parts of Plummer Block assembly.
8. Modelling of all parts of Crosshead assembly.

9. Modelling of all parts of Leaf Spring assembly.
10. Assembly & its Drawings of Stuffing Box assembly along with Bill of Materials & balloon labelling.
11. Assembly & its Drawings of screw jack assembly along with Bill of Materials & balloon labelling.
12. Assembly & its Drawings of Plummer Block assembly along with Bill of Materials & balloon labelling.
13. Assembly & drawings of the Crosshead assembly.
14. Assembly & drawings of the Leaf Spring assembly.

Software: Any one of the following software can be used.

Part-A : AutoCAD, DraftSight, Solid Edge 2D Drafting & Free CAD.

Part-B : SolidWorks, CATIA, Pro-E & Creo.

Reference Books:

1. Sham Tickoo, AutoCAD for Engineers and Designers, CADCIM Technologies, 2023 Edition.
2. Sham Tickoo, SolidWorks for Designers, CADCIM Technologies, 2023 Edition.
3. N.D. Bhatt, Machine Drawing, Charotar Publishing House, 53rd Edition, 2021.
4. K.R. Gopalkrishna, Machine Drawing, Subhas Publications, 23rd Edition, 2014.

Course Code	Course Title						Core / Elective
M24SE351ME	TECHNICAL TRAINING -I						Core
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
-	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to:

1. Equip students with practical exposure to technical tools and software relevant to core mechanical engineering domains such as design, analysis, manufacturing, and automation.
2. Enable students to apply software-based solutions to engineering problems through modeling, simulation, or process planning.
3. Enhance skill-based learning in line with current industry practices and technological advancements.
4. Develop the ability to adapt and learn new tools independently for professional development.
5. Foster competency in interpreting results, generating technical documentation, and presenting engineering solutions effectively.

Course Outcomes:

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

CO1: Operate the fundamental functions of a selected engineering software/tool.

CO2: Develop and simulate engineering components/systems using the selected tool.

CO3: Apply digital methods to solve practical problems relevant to mechanical engineering domains.

CO4: Examine simulation/design/analysis outcomes and compare them with expected physical behavior.

CO5: Prepare professional reports and deliver presentations based on technical work carried out using the tool.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	3	-	-	-	-	2	-	3	-	-
CO2	3	3	3	2	3	-	-	-	-	-	-	3	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-	2	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	2	-	-
CO5	-	-	-	-	2	-	-	-	2	3	2	2	-	-

Module 1: Introduction to the Software

- Overview of the tool's domain (design/analysis/manufacturing/automation).
- Interface, workspace, navigation.
- Application areas in mechanical engineering.

Module 2: Basic Features and Workflow

- Tool-specific commands, modeling/simulation techniques.
- Creating geometry or setting up analysis.
- Workflow examples (design > simulate > evaluate).

Module 3: Engineering Application Tasks

- Component-level or system-level design/simulation.
- Case-based learning: Realistic tasks or industry examples.
- Iterative improvement based on results.

Module 4: Interpretation and Validation

- Reading results (graphs, stress plots, tool paths, etc.).
- Comparing with theoretical/empirical expectations.
- Troubleshooting and refining.

Module 5: Documentation and Reporting

- Exporting results and creating visual content.
- Preparing technical reports.
- Oral presentation and technical documentation.

Note: One software/tool will be selected each academic year (e.g., Solid Edge, ANSYS, Fusion 360, MATLAB, etc.) based on industry trends and availability.

Examples of Tools for Annual Rotation (Indicative Only):

- **Design/Modeling:** AutoCAD, Solid Works, Creo.
- **Analysis/Simulation:** ANSYS, Abaqus, MATLAB/Simulink.
- **Manufacturing/CAM:** Mastercam, Fusion 360, Siemens NX CAM.
- **CFD:** ANSYS Fluent, Open FOAM.
- **Automation/Mechatronics:** TIA Portal, RoboDK, Factory I/O.

Reference Books:

1. Sham Tickoo, AutoCAD for Engineers and Designers, CADCIM Technologies, 2023 Edition.
2. Sham Tickoo, SolidWorks for Designers, CADCIM Technologies, 2023 Edition.
3. Asok Kumar Mallik, Introduction to Finite Element Analysis Using MATLAB® and Abaqus, CRC Press, 2nd Edition, 2021.
4. R.K. Jain, Engineering Drawing and Graphics Using AutoCAD, McGraw-Hill Education, 16th Edition, 2021.
5. T.R. Chandrupatla & A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 5th Edition, 2020.
6. M.P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson, 5th Edition, 2019.
7. P.K. Gupta, CAD/CAM: Computer-Aided Design and Manufacturing, Prentice Hall of India, 3rd Edition, 2018.

IV SEMESTER

Course Code	Course Title					Core / Elective	
M24HS402HS	HUMAN VALUES AND PROFESSIONAL ETHICS					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Adaptive	30	-	-	30	40	60	2

Course Objectives:

The objective of the course is to make the students to :

1. Create awareness on Human Values and Engineering Ethics.
2. Move from discrimination to commitment.
3. Understand social responsibility of an Engineer.
4. Appreciate ethical dilemma while discharging duties in professional life.
5. Encourage students to discover what they consider valuable in life.

Course Outcomes:

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

- CO1. **Relate** the significance of value inputs and start applying them in their life and profession.
- CO2. **Compare** and contrast between values and skills, happiness and accumulation of physical facilities with regard to the self and the body, intention and competence of an individual, etc.
- CO3. **Apply** ethical values in the light of the problems from the perspective of the social context.
- CO4. **Evaluate** the role of a human being in ensuring harmony in society and nature.
- CO5. **Distinguish** the difference between ethical and unethical practices, and apply ethical practices in personal and professional lives

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	3	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	3	-	3	-	-	-

Unit-I: Introduction to Value Education (6 Hrs)

1. Value Education, Definition, Concept and Need for Value Education
2. The Content and Process of Value Education
3. Self-Exploration as a means of Value Education
4. The basic human aspirations-Continuous Happiness and Prosperity

Unit-II: Harmony in the Human Being (6 Hrs)

1. Human Being is more than just the Body
2. Harmony of the Self ('I') with the Body
3. Understanding myself as co-existence of the self and the body:
 - a. Needs of the self and needs of the body
 - b. Activities in the self and activities in the body

Unit-III: Harmony in the Family and Society and Harmony in the Nature (6 Hrs)

1. Family as a basic unit of Human Interaction
2. Understanding the values in human relationships-Trust, Respect, Affection, Care, Guidance, Reverence, Glory, Gratitude and Love
3. Identification of comprehensive human goals
4. The five dimensions of human endeavours

Unit-IV: Social Ethics(6 Hrs)

1. The Basics for Ethical Human conduct
2. Challenges to ethical conduct in existence
3. Harmony in nature-Understanding the interconnectedness and mutual fulfilment
4. Harmony in existence-Understanding existence as co-existence

Unit-V: Professional Ethics (6Hrs)

1. Professional ethics in the light of right understanding
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education

Text Books:

1. Gaur. R.R., Sangal. R., Bagaria. G.P., A Foundation Course in Human Values and Professional Ethics, 3rd Revised Edition, 2023, Excel Books.
2. R. Subramanian, Professional Ethics includes Human values, 2nd Edition, 2017, Oxford University Press.

Reference Books:

1. Gaur. R.R., Sangal. R., Bagaria. G.P., Teachers Manual, 2nd Revised Edition, 2019, Excel Books.
2. A.N. Tripathy, Human Values, 2nd Edition, 2009, New Age International Publishers.
3. Mortimer J. Adler, What Man Has Made of Man, Reprint, 2008.
4. Bajpai. B.L., Indian Ethos and Modern Management, 1st Edition, 2004, New Royal Book Co., Lucknow.
5. Corliss Lamont, Philosophy of Humanism, 8th Revised Edition, 1997, Humanist Press.
6. Bertrand Russell, Human Society in Ethics & Politics, 2nd Edition, 1992, Taylor and Francis.
7. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title					Core/Elective	
M24PC404ME	THERMAL ENGINEERING					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Thermo Dynamics	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to :

1. Introduce the working principles and performance of single and multistage air compressors.
2. Explain the construction, working, and performance evaluation of internal combustion engines.
3. Analyze steam power cycles, steam nozzles, and turbines for efficient energy conversion.
4. Study the fundamentals of compressible flow and its effects in high-speed thermal systems.
5. Understand gas turbine cycles and aircraft propulsion systems with performance improvement methods.

Course Outcomes :

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

- CO1. **Compare** working principles of reciprocating vs. rotary compressors, SI vs. CI engines, and turbojet vs. ramjet propulsion.
- CO2. **Utilize** the concepts of different thermal systems including compressors, IC engines, gas turbines, and propulsion systems to solve practical engineering
- CO3. **Compute** the performance parameters and solve problems related to compressors, IC engines, nozzles, and turbines.
- CO4. **Analyze** thermodynamic cycles, combustion processes, compressible flows, and velocity diagrams to identify performance trends.
- CO5. **Evaluate** energy conversion efficiency, performance enhancement techniques, and engine characteristics using appropriate tools.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			1	2								3
CO2	3	3		1	3			2						3
CO3	3	3		3	3			1						3
CO4	3		2	3	3	3		2						3
CO5	3	3	2	3	3	2		3						3

UNIT-I:

Reciprocating Air Compressors: Applications of compressed air, Classification of compressors- single stage and multistage compressors, Derivation of work done with and without clearance volume, Work done of multistage compressors, effect of clearance volume on work done, Inter-cooling and After-cooling.

UNIT-II:

Internal Combustion Engines: Classification of IC engines, working principle of 2 stroke, 4 stroke SI and CI engines, Valve and Port-timing diagrams

Performance of I.C Engines: Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, and volumetric efficiency, specific fuel consumption based on brake power and indicated power. Heat balance sheet, Morse Test.

Stages of combustion in SI and CI engines and knocking.

UNIT-III:

Steam power plant Cycles: Working of Rankine cycle, cycle analysis, Modified Rankine cycle, Cycle efficiency improvement methods: Reheating and Regeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity and Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio. Diameters of nozzle throat and exit for maximum discharge.

Steam Turbines: Impulse and Reaction turbines, velocity triangles diagrams, Degree of reaction.

Steam Condensers: Jet and Surface condensers

UNIT-IV:

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow.

UNIT-V:

Gas Turbines: Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter cooling, Reheating and Regeneration. Simple Problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines

Text Books:

1. Rajput. R. K., "Thermal Engineering", 10th Edition, 2020, Laxmi Publishers.
2. Ganeshan. V, "Internal Combustion Engines", 4th Edition, 2012, Tata McGraw-Hill Education Pvt. Ltd.
3. Yahya. S. M., "Fundamentals of Compressible Flow: SI Units with Aircraft and Rocket Propulsion", 6th Edition, 2016, New Age International Publishers.

Reference Books:

1. Eastop. T. D., McConkey. A, "Applied Thermodynamics for Engineering Technologists", 5th Edition, 1993, Pearson Education.
2. Heywood. J. B., "Internal Combustion Engine Fundamentals", 2nd Edition, 2018, Tata McGraw-Hill Education Pvt. Ltd.
3. Ballaney. P. L., "Thermal Engineering: Engineering Thermodynamics & Energy Conversion Techniques", 5th Edition, 2010, Khanna Publishers.
4. Mahesh M. Rathor, "Thermal Engineering",
5. ISI Steam Tables in SI units, Indian Standards Institution, New Delhi.
6. <https://ekumbh.aicte-india.org/allugcbook.php>.

Course Code	Course Title					Core / Elective	
M24PC405ME	MANUFACTURING PROCESSES					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
-	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to :

1. Understand the basic principles of major manufacturing processes such as metal casting, welding and forming of engineering materials.
2. Know the advantages and limitations of each process.
3. Able to select the optimal process to produce a product.
4. Know the basic principle of advanced forming processes.

Course Outcomes:

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

- CO1. **Explain** fundamental casting processes, pattern design principles, and moulding techniques.
 CO2. **Analyze** special casting methods, plastic manufacturing processes, and powder metallurgy techniques.
 CO3. **Demonstrate** gas and arc welding techniques and their practical applications.
 CO4. **Evaluate** solid-state and resistance welding processes and welding defects.
 CO5. **Apply** forming processes and sheet metal operations in manufacturing contexts.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			3	3			1				3	
CO2	3		3		3				3				3	
CO3	3			3	3		3		3		1		3	
CO4	3	3			3				3				3	
CO5	3		3		3	3	0		1		3		3	

Unit-I

Casting Process: Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, Testing of sand properties, moulding machines, Directional solidification, use of chaplets, chills, gating and risering systems. Melting of metals and alloys.

Unit-II:

Special Casting Process: Shell moulding, CO2 moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of castings.

Processing of Plastics: Extrusion, Injection moulding, Blow moulding and Thermoforming.

Introduction to Powder Metallurgy- Production of powders, blending, mixing, compaction techniques and finishing operations employed in powder metallurgy processes

Unit-III

Welding Processes: Introduction, Classification of welding processes, principle of gas welding, gas welding equipment and techniques, types of flames and applications, advantages, limitations and applications of gas welding.

Arc welding equipment, electrode materials, electrode specification, polarity, types of arc welding.- SMAW, SAW, GMAW, GTAW, CMTW, PAW, EBW, LBW, Atomic hydrogen welding, principle of Electro slag welding, Thermit welding. Gas cutting, Brazing and Soldering.

Unit-IV

Solid State Welding Process: Forge Welding, Friction Welding, Friction Stir Welding, Explosive Welding and Ultrasonic welding.

Resistance welding processes - Spot welding, Seam welding, Projection welding, Butt Welding. Weldability and Welding defects.

Unit-V

Forming Processes: Cold & Hot working, Process description of Forging, Rolling, Extrusion and Drawing operations.

Sheet Metal Operations: Blanking, Piercing, Bending, Deep drawing, Stretch forming and Spinning.

Advance Forming Processes- High energy rate forming processes such as Explosive forming, Electro- magnetic forming, Electro-hydraulic forming and Rubber pad forming

Text Books:

1. P.N. Rao, "Manufacturing Technology, Vol. 1", 5th Edition, 2022, Tata McGraw Hill Education Pvt. Ltd.
2. Amitabha Ghosh & Mallik, "Manufacturing Science", 2nd Edition, 2022, East-West Press Pvt. Ltd.

Reference Books:

1. Serope Kalpakjian & Steven Schmid, "Manufacturing Engineering and Technology", 9th Edition, 2025, Pearson Education.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th Edition, 2015, Pearson Education.
3. J. P. Kaushish, "Manufacturing Processes", 2nd Edition, 2010, PHI Learning Pvt. Ltd.
4. George E. Dieter, "Mechanical Metallurgy", 3rd SI Metric Edition, 1988, McGraw-Hill Book Company.
5. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title						Core/Elective
M24PC406ME	FLUID MECHANICS AND HYDRAULIC MACHINERY						Core
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Mechanics	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to :

1. Understand the basic properties of fluids and principles of fluid statics, including pressure measurement techniques.
2. Provide knowledge of fluid kinematics and dynamics using Lagrangian and Eulerian approaches, and apply Bernoulli's and momentum equations.
3. Analyze laminar and turbulent viscous flows in pipes and understand head losses and boundary layer concepts.
4. Study the dynamics of jet impact and the working principles of hydraulic turbines.
5. Understand the working principles and classifications of various hydraulic pumps.

Course Outcomes:

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

- CO1. **Apply** the principles of fluid mechanics including Pascal's Law, continuity equation, velocity triangles, and hydraulic equations to solve problems related to fluid statics, kinematics, dynamics, and fluid machinery.
- CO2. **Explain** the fundamental properties of fluids, types of fluid flow, and the construction and working principles of turbines and pumps
- CO3. **Analyze** flow behavior using streamlines, boundary layers, energy lines, velocity profiles, and indicator diagrams to evaluate pressure, velocity, and energy distribution in fluid systems
- CO4. **Evaluate** the efficiency, performance, and energy losses of hydraulic machines and pipeline systems under various conditions using theoretical and experimental approaches.
- CO5. **Demonstrate** the working principles, classifications, and performance characteristics of various hydraulic pumps, and analyze their operational issues such as cavitation, surging, and priming.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				2					3
CO2	3	2	2						2		2			3
CO3	3	3	2	2	2				2					3
CO4	3	3	2	3	2		2		2		2			3
CO5	3	3	2	2	1		2		2		2			3

UNIT – I

Properties of Fluid: Density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillary, surface tension, units and dimensions.

Fluid statics: Concept of fluid static pressure, Pascal's Law, absolute, gauge and Vacuum pressure, pressure measurements by piezometer, manometers and pressure Gauges.

UNIT-II

Fluid Kinematics: Description of fluid flow, types of flow, Lagrangian and Eulerian approach, velocity field and acceleration, Continuity equation 1D and 3D differential forms, streamline, streak line, path line, time line, stream tube, stream function, velocity potential function.

Fluid Dynamics: Equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications. Venturi meter, Orifice meter, Pitot tube, Impulse-Momentum Equation, buoyancy, submerged bodies.

UNIT-III

Viscous flow: Shear stress-pressure gradient relationship, laminar flow between parallel plates, Laminar flow through circular tubes (Hagen poiseuille's), Hydraulic and energy gradient lines, total energy line.

Flow through pipes: Darcy- Weisbach's equation, friction factor, Minor and Major losses, flow through pipes in series and parallel, Boundary layer flows, boundary layer thickness, boundary layer separation, drag and lift coefficients.

UNIT- IV

Impact of Jets: Hydro dynamic force of jets on stationary and moving flat, inclined and curved vanes

Hydraulic Turbines: Elements of hydro power plant. Definition and classifications, Pelton turbine, Francis turbine, propeller turbine, Kaplan turbine, working principles, velocity triangles, work done, specific speed, Efficiencies, Unit quantities, performance curves.

UNIT -V

Hydraulic Pumps: Centrifugal pump: classification, working principles, velocity triangles, specific speed, efficiency, priming, surging, cavitation in pumps and performance curves.

Reciprocating pump: Classification, working principle, indicator diagram.

Rotary pumps: working principles of gear and Self priming pumps

Text Books

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", 5th Edition, 2018, Laxmi Publications (P) Ltd., Delhi.
2. Modi & Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 22nd Edition, 2019, Standard Book House.

Reference Books

1. White, F.M., "Fluid Mechanics", 5th Edition, 2008, Tata McGraw-Hill Education Pvt. Ltd.
2. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", 3rd Edition, 2017, Tata McGraw-Hill Education Pvt. Ltd.
3. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", 9th Edition, 2018, McGraw-Hill Education.
4. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title						Core / Elective
M24PC407ME	KINEMATICS OF MACHINES						Core
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engg Mechanics	45	15	-	30	40	60	3

Course Objectives:

The objective of the course is to make the students to :

1. Understand the basic terminology & principles of kinematics related to machines.
2. Study functioning of quadric chains & their inversions.
3. Study useful mechanisms & understand their functioning.
4. Study analysis of position, velocity & acceleration of parts in a machine.
5. Study conversion of uniform rotary motion to specified linear & oscillating motion.
6. Study gears for positive motion transmission.

Course Outcomes:

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

- CO1: Identify** and explain kinematic pairs, inversions, transmission elements, and principles such as Grashof's law, Kennedy's theorem, SVAJ diagrams, and the functional aspects of cams, gears, and steering systems.
- CO2: Determine** gear parameters, **calculate** train ratios, and **design** cam profiles through graphical and analytical techniques.
- CO3: Compare** steering and drive systems; analyze cam dynamics using SVAJ diagrams; assess gear interference, Coriolis acceleration, and mechanism inversions; validate Grashof's law experimentally.
- CO4: Analyze** mechanisms and **optimize** performance using kinematic methods; **design** gear systems and **evaluate** power loss for reliability improvements.
- CO5: Formulate** straight-line mechanisms, gear trains, cam profiles, and compliant linkages for applications such as differentials and robotic systems.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	0	2	1	1	1	2	1	2	0	0	2
CO2	2	1	1	3	3	1	0	1	1	1	3	1	1	1
CO3	2	1	1	2	3	2	1	1	2	1	2	1	0	1
CO4	0	1	2	2	3	2	1	2	2	2	2	1	1	0
CO5	0	0	3	0	3	2	1	3	3	3	3	3	1	0

Unit I: Mechanism Fundamentals:

Core Concepts: Links, joints, kinematic pairs, Kinematic chains vs. mechanisms

Inversions & Mobility: Four-bar chain: Crank-rocker, drag link, double-rocker. **Slider-crank:** Internal combustion engines, quick-return mechanisms. **Mobility Analysis:** Grubler- Kutzbach criterion, Grashof's law. Reverse Engineering of basic mechanisms.

Unit II: Applied Mechanisms:

Straight-line generators: Peaucellier-Lipkin, Watt linkage.

Parallel motion: Parallel Ruler, Pantograph (scaling instruments), lazy tongs (rescue robots).

Steering systems: Ackerman vs. Davis steering applications. Condition for Correct Steering.

Power Transmission: Belt drives vs. chain drives (efficiency comparison). Universal joints (Hooke's joint) in automotive drive shafts. 3D-Printed and Compliant Mechanisms.

Unit III: Motion Analysis:

Velocity Analysis: Relative velocity method (vector polygons). Instantaneous center method (Kennedy's theorem).

Acceleration Analysis: Graphical methods: Centripetal/tangential components. Coriolis acceleration (conveyor belts, centrifugal pumps).

UNIT-IV: Cams & Followers

Cam types: Plate, cylindrical, face cams, **Conjugate Cams,**

Follower motions: Uniform, SHM, cycloidal (SVAJ diagrams).

Synthesis Techniques: Graphical profile design (Roller, flat-faced, Eccentric circle cams followers). Pressure angle optimization (minimizing wear).

Case Study: Wear and Failure in Cam Mechanisms, Sensor-based Control in Automated Cam Systems

UNIT V: Gears & Drives

Gear Fundamentals: Terminology: Module, pitch, addendum. Law of gearing, involute vs. cycloidal profiles. Interference avoidance (minimum teeth calculations).

Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains (Tabular method)

Smart Gearboxes and Control-Integrated Drives

Text Books

1. V.P. Singh, "Theory of Machines", 6th Edition, 2020, Dhanpat Rai & Co. Pvt. Ltd.
2. S.S. Rattan, "Theory of Machines", 5th Edition, 2020, Tata McGraw-Hill Education Pvt. Ltd.

Reference Books

1. " Robert L. Norton, "Kinematics and Dynamics of Machinery", 6th Edition, 2019, McGraw-Hill Education.
2. J.E. Shigley, "Theory of Machines and Mechanisms", 5th Edition, 2016, Oxford University Press.
3. Thomas Bevan, "The Theory of Machines", 3rd Edition, 2009, Pearson Education.
4. Amitabha Ghosh & Ashok Kumar Mallik, "Theory of Mechanisms and Machines", 3rd Edition, 2020, East-West Press Pvt. Ltd.
5. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title						Core/Elective
M24ES403CS	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE						-
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
-	30	-	-	30	40	60	2

Course Objectives:

The objective of the course is to make the students to :

1. Understand the foundations, history, and applications of Artificial Intelligence.
2. Learn the structure of intelligent agents and search strategies for problem-solving.
3. Study logical reasoning, adversarial search, and constraint satisfaction techniques.
4. Explore knowledge representation methods and probabilistic reasoning models.
5. Analyze decision-making under uncertainty using probabilistic approaches.

Course Outcomes:

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

- CO1. **Understand** the foundations, history and real-world applications of Artificial Intelligence.
- CO2. **Analyze** the structure and behavior of intelligent agents and various searching techniques used in problem-solving.
- CO3. **Apply** logical reasoning, planning, game strategies, and constraint satisfaction techniques for decision-making in structured environments.
- CO4. **Formulate** and solve sequential decision-making problems under uncertainty using probabilistic models.
- CO5. **Compare** different knowledge representation methods, problem solving techniques and reasoning models.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										3	3		
CO2	3	3									3	3		
CO3	3	3		3					3		3	3		3
CO4	3	3		3					3		3	3		
CO5	3	3		3					3		3	3		3

Unit I

Introduction: Foundations of AI, History, State of the Art, Risks and Benefits.

Intelligent agents: Agents and Environment, The Concept of Rationality, Structure of an Agent, Types of Agents.

Solving problems by Search- Problem-Solving Agents, State space representation, Search graph and Search tree, Searching for Solutions.

Unit II

Uninformed Search Strategies: Uniform cost search, Iterative deepening Depth-first search, Bidirectional search.

Informed (Heuristic) Search Strategies: Heuristic Functions, Hill- climbing, Greedy best-first search,

A* search, Simulated Annealing search.

Adversarial Search: Game Theory, Alpha–Beta Pruning.

Unit III

Constraint Satisfaction Problems (CSP): Introduction, components, constraint types, and solving techniques using backtracking, inference, and heuristics.

Planning: Simple planning agents, basic plan representation, goal-based planning, state-space planning, and planning as search.

Logic Programming Basics: propositional and predicate logic, natural deduction, resolution.

Knowledge-Based Agents: Architecture, reasoning mechanisms, connection to logic systems, overview of expert systems.

Unit IV

Knowledge Representation: Introduction, approaches to knowledge Representation, Knowledge Representation using Semantic Network and Frames.

Probabilistic Reasoning: Basics of probability, Bayes rule, Bayesian networks representation, construction, exact and approximate inference, temporal model, hidden markov model, decision making under uncertainty.

Unit V

Case Studies:

GPS route planning using state-space search, puzzle solving :8-puzzle, Sudoku with A* and heuristics, game AI: Chess or Tic-Tac-Toe using minimax with pruning, Sudoku solving via CSP, and virtual assistants: Siri or Alexa using knowledge graphs and Bayesian reasoning.

Text Books

1. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, 2020, Pearson Education.
2. Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence", 3rd Edition, 2009, McGraw-Hill Education.

Reference Books

1. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 6th Edition, 2009, Pearson Education.
2. David L. Poole & Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 3rd Edition, 2023, Cambridge University Press.
3. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title					Core / Elective	
M24ES07EC	INTRODUCTION TO IoT					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
	30	-	-	30	40	60	2

Course Objectives:

The objective of the course is to make the students to :

1. To introduce the basics of sensors and actuators along with their types and applications in embedded systems.
2. To impart knowledge on the architecture and interfacing techniques of Arduino, ESP, and Raspberry Pi platforms.
3. To develop programming skills using C and Python for microcontroller and Raspberry Pi-based applications.
4. To familiarize students with cloud platforms and services used for data communication and visualization in IoT.
5. To enable students to design and implement real-time IoT applications for automation and monitoring.

Course Outcomes:

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

- CO1. **Recall** and **identify** fundamental IoT components, platforms, and programming constructs.
- CO2. **Explain** architecture, interfacing techniques, and system-level understanding of IoT devices..
- CO3. **Apply** programming and interfacing skills to implement sensor-actuator systems with IoT platforms
- CO4. **Analyze** performance, integration, and data flow in IoT systems with cloud and hardware platforms.
- CO5. **Design**, evaluate, and develop complete IoT applications integrating hardware and cloud services.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	3	-	-
CO3	3	3	2	-	3	-	-	-	-	-	-	3	3	-
CO4	3	2	3	3	3	-	-	-	-	-	-	3	3	-
CO5	3	2	3	3	3	-	-	2	2	2	2	3	3	2

Unit 1: Basics of Sensors and Actuators

Introduction to sensors: types, characteristics, and applications. Introduction to actuators- types, characteristics, and applications. Interfacing sensors and actuators with microcontrollers.

Unit 2: Basics of Arduino, ESP, and Raspberry Pi

Overview of Arduino (UNO)- features, architecture, and applications. Overview of ESP8266/ESP32 -

features, architecture, and Wi-Fi capabilities. Overview of Raspberry Pi(3B)- features, architecture, GPIO, application and operating system.

Unit 3: Introduction to Programming Languages (C and Python)

Programming for IOT in C and Python- Programming for Arduino and ESP using C, Programming for Raspberry Pi using Python and Simple programs for sensor data collection and control.

Unit 4: Basics of Cloud Platforms and Examples

Introduction to cloud computing for IoT. Overview of cloud platforms: Blynk, ThingSpeak, Ubidots. Connecting IoT devices to cloud platforms. Data visualization and control using cloud services.

Unit 5: Simple Applications

Case studies and real-world implementations-Home automation system, Smart irrigation system, and Weather monitoring system using sensors and cloud platforms.

Text Books:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", 2nd Edition, 2023, McGraw Hill Education.
2. Vijay Madisetti & Arshdeep Bahga, "Internet of Things: A Hands-On Approach", 1st Edition, 2014, Universities Press.

Reference Books:

1. Pethuru Raj & Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", 1st Edition, 2017, CRC Press.
2. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", 1st Edition, 2013, Wiley.
3. <https://ekumbh.aicte-india.org/allugcbook.php>

Course Code	Course Title				Core / Elective		
M24ES457CS	ARTIFICIAL INTELLIGENCE LAB						-
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
-	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to :

1. Introduce basic and advanced search techniques used in artificial intelligence for problem-solving.
2. Develop practical skills in implementing AI algorithms for classical and real-world problems.
3. Apply informed and uninformed search strategies for solving state-space and path finding problems.
4. Understand adversarial search concepts through implementation of game-playing agents.
5. Design simple AI agents capable of decision-making in uncertain and interactive environments.

Course Outcomes:

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

- CO1. Implement** uninformed search strategies to solve AI problems.
- CO2. Execute** constraint and search problem solutions using efficient algorithms.
- CO3. Apply** informed search techniques to implement solutions for complex problems.
- CO4. Demonstrate** adversarial search strategies for game-based scenarios.
- CO5. Construct** intelligent agents for interactive applications.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			2						1			
CO2	3	3	2	2	2						1			
CO3	3	3	2	2	3						1			
CO4	3	2	2		2									
CO5	3	2	2		2				2		1			

List of Programs:

1. Write a program to implement Uninformed search techniques:
 - a. BFS
 - b. DFS
2. Develop a program to solve the Water Jug Problem using Breadth First Search technique.
3. Write a program to solve 5-queens problem using Depth First Search technique.
4. Design and implement solution for 8-puzzle problem using A* search algorithm.
5. Develop a python program to solve maze navigation problem using greedy best first search.
6. Write a Program to Implement Alpha-Beta Pruning using Python.
7. Implement Minimax algorithm for finding an optimal decision in a tic-tac toe game.
8. Implement an AI agent for Hangman Game.

Reference Books:

1. David L. Poole & Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 3rd Edition, 2023, Cambridge University Press.
2. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, 2020, Pearson Education.
3. Wolfgang Ertel, "Introduction to Artificial Intelligence", 2nd Edition, 2018, Springer.
4. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 6th Edition, 2009, Pearson Education.

Course Code	Course Title					Core / Elective	
M24PC453ME	THERMAL ENGINEERING LAB					Core	
Prerequisite	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
-	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to :

1. Understand applications of thermal engineering concepts through experimentation.
2. Provide knowledge in testing of properties of fuels and lubricating oils
3. Demonstrate and conduct experiments, Interpret and analyse data and report results of IC engine testing

Course Outcomes:

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

CO1: Conduct experiments on air compressors and determine their performance parameters such as volumetric efficiency and isothermal efficiency.

CO2: Perform experimental testing on combustion engines to measure performance and optimize efficiency metrics.

CO3: Construct and analyze valve and port timing diagrams for 2-stroke and 4-stroke engines to represent their working cycles.

CO4: Measure fuel and lubricating oil properties such as flash point, fire point, and viscosity using standard test methods.

CO5: Prepare heat balance sheets and demonstrate energy distribution in IC engines while practicing teamwork, reporting, and presentation skills.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	3	3			1	2	1	2			3
CO2	2	3	1	3	3			1	2	1	2			3
CO3	2	2	2	1	2				1		1			3
CO4	2	2	1	3	3				1		2			3
CO5	2	2	3	1	2	1	1	3	3	2	2			3

List of Experiments:

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve timing diagram of a Petrol/Diesel engine.
3. To determine port timing diagram of a Petrol/Diesel engine.
4. To conduct performance test on single cylinder Diesel engine.
5. To conduct heat balance test on a Diesel engine.
6. To conduct Morse test on multi cylinder Petrol engine.
7. To conduct performance test on multi cylinder Petrol engine.

8. To conduct performance test on a two-stroke Petrol engine.
9. To conduct performance test on multi cylinder Diesel engine.
10. To study the performance of a Petrol engine under different compression ratios.
11. Determination of viscosity of lubricating oil.
12. Determination of flash and fire points of a fuel
13. Study of Boiler Models

List of Additional Experiments:

1. Disassembly, Assembly and Study of Multi cylinder I.C. Engine Components
2. Disassembly, Assembly and Study of single cylinder I.C. Engine Components

Reference Books:

1. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9th Edition, 2022, Laxmi Publications.
2. R.K. Rajput, "Thermal Engineering", 10th Edition, 2020, Laxmi Publications.
3. K. Ramalingam, "Thermal Engineering", 3rd Edition, 2018, Scitech Publications.

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title				Core / Elective		
M24PC454ME	MANUFACTURING PROCESS LAB				Core		
Prerequisites	Notional Hours				CIE	SEE	Credits
	L	T	P/PW	TW/SL			
Engg. Workshop	-	-	30	-	40	60	1

Course Objectives:

The objective of the course is to make the students to :

1. Gain knowledge and skill in various manufacturing processes such as casting, welding&forming.
2. Understand and perform operations like pattern making, sand testing and casting.
3. Join metal pieces by various welding techniques and gain hands on experience.
4. Understand the working principle and produce some components by various metalforming techniques

Course Outcomes:

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

CO1: Demonstrate the preparation of various metal joints using Arc, TIG, Spot, and Gas welding processes.

CO2: Construct single-piece wooden patterns and green sand moulds with gating elements like sprue, gate, and riser using appropriate techniques.

CO3: Perform and examine sheet metal operations such as bending, blanking, and piercing using mechanical and hydraulic presses.

CO4: Develop plastic components through injection and blow molding processes and demonstrate their working and applications.

CO5: Test and analyze the properties of green sand and sheet metal formability using standard procedures such as the Erichsen cupping test.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	2	2	2	2	1	2	-	2	-
CO2	2	2	2	2	-	2	2	2	2	1	1	-	2	-
CO3	2	2	2	2	-	2	2	2	2	1	2	-	2	-
CO4	2	2	2	2	-	2	2	2	2	1	2	-	2	-
CO5	2	2	2	2	-	2	2	2	2	1	2	-	2	-

S No.	Experiment Name
1	Preparation of a single-piece wooden pattern considering allowances (draft, shrinkage, and machining.)
2	Testing of Green sand properties.
3	Preparation of V-butt joint using Arc welding process.
4	Preparation of lap joint using the Resistance Spot welding process.
5	Preparation of butt joint using GMAW welding process and evaluating its hardness.
6	Preparation of butt joint using Gas welding process.
7	Manufacturing of a simple plastic component using a injection moulding machine.

8	Green sand mould making process incorporating complete gating system: sprue, gate and riser.
9	Evaluation of the formability of sheet metal using the Erichsen cupping test.
10	Performing blanking and piercing operations using Fly press.
11	Melting and casting of aluminium metal.

LIST OF ADDITIONAL EXPERIMENTS:

S No.	Experiment Name
1	Manufacturing of a hollow plastic component using blow moulding machine.
2	Performing bending operations by using a Hydraulic press.

Reference Books:

1. Serope Kalpakjian & Steven Schmid, "Manufacturing Engineering and Technology", 9th Edition, 2025, Pearson Education.
2. P.N. Rao, "Manufacturing Technology, Vol. 1", 5th Edition, 2022, Tata McGraw Hill Education Pvt. Ltd.
3. Amitabha Ghosh & Mallik, "Manufacturing Science", 2nd Edition, 2022, East-West Press Pvt. Ltd.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th Edition, 2015, Pearson Education.

Note: Minimum 10 experiments to be conducted in the semester.

Course Code	Course Title					Core/Elective			
M24PC455ME	FLUID MECHANICS AND HYDRAULIC MACHINERY LAB					Core			
Prerequisite	Contact Hours per Week				CIE	SEE	Credits		
	L	T	D	P					
--	-	-	-	2	40	60	1		

Course Objectives:

The objective of the course is to make the students to :

1. Provide hands-on experience in evaluating the performance of different hydraulic machines such as pumps and turbines.
2. Enable students to determine flow characteristics and discharge coefficients of various flow measuring devices and their impact in the industry.
3. Enhance understanding of jet impact and energy transfer mechanisms in hydraulic systems.
4. Introduce the working principles and configurations of hydraulic and pneumatic circuits.

Course Outcomes:

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

CO1: Conduct experiments to determine the coefficient of discharge of Venturi meter and Orifice meter.

CO2: Measure the impact force exerted by a water jet on flat and curved vanes using fluid mechanics principles.

CO3: Plot and interpret performance curves of Centrifugal, Reciprocating, Self-Priming, and Gear Pumps.

CO4: Assess performance characteristics of Pelton, Francis, and Kaplan Turbines using efficiency and head-discharge curves.

CO5: Operate hydraulic and pneumatic circuits to demonstrate their operational sequences and control functions.

CO-PO Mapping Table: (Scale: 1-Slight, 2-Moderate, 3-High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	3				1		2			3
CO2	3	3	2	3	3				1		2			3
CO3	3	3	2	3	3			1	2		2			3
CO4	3	3	2	3	3			1	2		2			3
CO5	2	2	1	2	3	1	1	2	3		2			3

List of Experiments

1. Performance and characteristic curves of Self priming pump
2. Performance and characteristic curves of Centrifugal pump
3. Performance and characteristic curves of Reciprocating pump
4. Performance and characteristic curves of Gear pump
5. Determination of impact force of jet on fixed flat and fixed curved vanes
6. Performance and characteristic curves of Pelton wheel
7. Performance and characteristic curves of Francis Turbine
8. Performance and characteristic curves of Kaplan Turbine

9. Determination of coefficient of discharge for Venturi meter
10. Determination of coefficient of discharge for Orifice meter

List of Additional Experiments:

Experiment Name
<ol style="list-style-type: none">1. Study of Pneumatic Trainer / Pneumatic Control Circuits2. Study of Hydraulic Trainer / Hydraulic Control Circuits

Reference Books

1. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9th Edition, 2022, Laxmi Publications.
2. Modi & Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 22nd Edition, 2019, Standard Book House.
3. Bansal, R.K., "Hydraulic Machines", 5th Edition, 2018, Laxmi Publications.
4. Kumar D.S., "Fluid Mechanics and Fluid Power Engineering", 2nd Edition, 2017, S.K. Kataria & Sons.