PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH

COIMBATORE – 641 062

(Autonomous Institution Affiliated to Anna University)

2025 Regulations

Scheme of Assessment and Syllabi

For

B.E. MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

Vision

The Department of Mechanical Engineering strives to be recognized globally for outstanding education and research leading to well-qualified engineers, who are innovative, entrepreneurial, successful and fulfilled in advanced fields of engineering and research.

Mission

- Imparting quality holistic education to the students and enhancing their skills founded on values to make them globally competitive mechanical engineers.
- Maintaining vital, state-of-the-art research facilities to provide the students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- To develop linkages with industries, world class R&D organizations and educational institutions in India and abroad for excellence in teaching, research and consultancy practices.

Program Outcomes (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization (WK1 to WK4) to develop solutions for complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems to reach substantiated conclusions with consideration for sustainable development (WK1 to WK4).

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and develop systems, components, or processes to meet identified needs, considering public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required (WK5).

PO4: Conduct Investigations of Complex Problems: Conduct investigations using research-based knowledge, including design of experiments, modelling, analysis, and interpretation of data to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, while recognizing their limitations in solving complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems, considering impacts on sustainability, economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national and international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse and multidisciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society, including the ability to comprehend and write effective reports and design documentation, and make presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge of engineering management principles and economic decision-making to manage projects, work effectively as a member or leader in a team, and operate in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the ability to engage in: i) Independent and life-long learning, ii) Adaptability to new and emerging technologies, iii) Critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs):

PSO1: Demonstrate preparedness for industry roles and postgraduate opportunities by acquiring domain-specific competencies tailored to real-world mechanical engineering challenges.

PSO2: Design and develop interdisciplinary engineering systems with focus on innovation, collaboration, and applied research.

B.E. MECHANICAL ENGINEERING
(Minimum No. of credits to be earned: 168)

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER I										
THEORY										
1	25MA101	Calculus and its Applications	3	1	0	4	40	60	100	BS
2	25PH102	Physics for Mechanical Engineering	3	0	0	3	40	60	100	BS
3	25CY104	Chemistry of Engineering Materials	3	0	0	3	40	60	100	BS
4	25EE102	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
5	25HS101	English Language Proficiency	3	1	0	4	40	60	100	HS
6	25HS102	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	40	60	100	HS
PRACTICALS										
7	25ME111	Engineering Drawing with CAD	0	0	4	2	60	40	100	ES
8	25GE111	Design Thinking for Innovation	0	0	2	1	100	0	100	ES
9	25BS112	Basic Sciences Laboratory	0	0	4	2	60	40	100	BS
MANDATORY COURSES										
10	25GEM01	Induction Programme**	-	-	-	-	-	-	-	MC
11	25HSO01/ 25HSO02	Physical Education/Yoga and Health	0	0	2	Grade	-	-	-	MC
		Total 30 periods	**16**	**2**	**12**	**23**	**460**	**440**	**900**	

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER II										
THEORY										
1	25MA201	Complex Variables and Transforms	3	1	0	4	40	60	100	BS
2	25ME201	Engineering Mechanics	3	1	0	4	40	60	100	ES
3	25ME202	Manufacturing Processes	3	0	0	3	40	60	100	PC
4	25ME203	Fluid Mechanics	3	1	0	4	40	60	100	ES
5	25ME204	Industrial Metallurgy	3	0	0	3	40	60	100	ES
6	25HS201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	40	60	100	HS
PRACTICALS										
7	25EE213	Electrical and Electronics Engineering Laboratory	0	0	2	1	60	40	100	ES
8	25ME211	Makers Laboratory	0	0	2	1	60	40	100	ES
9	25HS21_	Language Elective	0	0	4	2	60	40	100	HS
10	25EEC01	Workplace Communication Skills	0	0	2	-	100	0	100	EEC
MANDATORY COURSES										
11	25GEM02	Activity Point Programme I*	-	-	-	-	-	-	-	MC
12	25HSO01/ 25HSO02	Physical Education/Yoga and Health	0	0	2	Grade	-	-	-	MC
		Total 31 periods	**16**	**3**	**12**	**23**	**520**	**480**	**1000**	

****As per AICTE norms;**
*** As per AICTE norms; Grade: Non-Credit Course**

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC - Mandatory Course; CA-Continuous Assessment; ESE- End-Semester Examination.
L-Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER III										
THEORY										
1	25MA306	Computational Mathematics	3	1	0	4	40	60	100	BS
2	25HS301	Project and Finance Management	3	0	0	3	40	60	100	HS
3	25ME301	Mechanics of Materials	3	0	0	3	40	60	100	ES
4	25ME302	Kinematics of Machinery	3	1	0	4	40	60	100	PC
5	25ME303	Engineering Thermodynamics	3	1	0	4	40	60	100	ES
PRACTICALS										
6	25ME311	Metallurgy and Mechanics of Materials Laboratory	0	0	4	2	60	40	100	ES
7	25ME312	Manufacturing Processes Laboratory	0	0	4	2	60	40	100	PC
8	25EEC02	Foundations of Problem Solving	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
9	25MC0_ _	Mandatory Course I	2	0	0	Grade	100	0	100	MC
10	25GEM03	Activity Point Programme II*	-	-	-	-	-	-	-	MC
Total 30 periods			**17**	**3**	**10**	**23**	**520**	**380**	**900**	

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER IV										
THEORY										
1	25MA405	Probability and Statistics	2	1	0	3	40	60	100	BS
2	25ME401	Metal Cutting Theory	3	0	0	3	40	60	100	PC
3	25ME402	Dynamics of Machinery	3	1	0	4	40	60	100	PC
4	25ME403	IC Engines and Thermal Systems	3	0	0	3	40	60	100	PC
5	25MEP_ _	Professional Elective I	3	0	0	3	40	60	100	PE
PRACTICALS										
6	25ME411	Thermal Engineering Laboratory	0	0	4	2	60	40	100	PC
7	25ME412	Python Programming Laboratory	0	0	4	2	60	40	100	ES
8	25EEC03	Problem Solving	0	0	2	1	100	0	100	EEC
9	25MEE01	Mini Project I	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
10	25MC0_ _	Mandatory Course II	2	0	0	Grade	100	-	100	MC
11	25GEM04	Activity Point Programme III*	-	-	-	-	-	-	-	MC
Total 30 periods			**16**	**2**	**12**	**22**	**620**	**380**	**1000**	

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L- Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER V										
THEORY										
1	25ME501	Design of Machine Elements	3	1	0	4	40	60	100	PC
2	25ME502	Cooling and Propulsion Technologies	3	1	0	4	40	60	100	PC
3	25ME503	Operations Research	3	0	0	3	40	60	100	PC
4	25ME504	Turbomachinery	3	1	0	4	40	60	100	PC
5	25ME505	Metrology and Instrumentation	3	0	0	3	40	60	100	PC
PRACTICALS										
6	25ME511	Fluid Mechanics and Machinery Laboratory	0	0	4	2	60	40	100	ES
7	25ME512	Machine Drawing	0	0	4	2	60	40	100	PC
8	25MEE02/ 25MEE03	Internship I / Community Project	0	0	0	1	100	0	100	EEC
9	25EEC04	Aptitude Skills	0	0	2	1	100	-	100	EEC
MANDATORY COURSES										
10	25GEM05	Activity Point Programme IV*	-	-	-	-	-	-	-	MC
		Total 28 periods	**15**	**3**	**10**	**24**	**520**	**380**	**900**	

S. No.	Course Code	Course Title	Hours/Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER VI										
THEORY										
1	25ME601	Mechanical System Design	3	1	0	4	40	60	100	PC
2	25ME602	Heat and Mass Transfer	3	1	0	4	40	60	100	PC
3	25ME603	Design for Manufacture and Assembly	3	0	0	3	40	60	100	PC
4	25MEP_ _	Professional Elective II	3	0	0	3	40	60	100	PE
5	25_ _O_ _	Open Elective I	3	0	0	3	40	60	100	OE
PRACTICALS										
6	25ME611	Heat Transfer Laboratory	0	0	4	2	60	40	100	PC
7	25ME612	Dynamics and Metrology Laboratory	0	0	4	2	60	40	100	PC
8	25EEC05	Enhancing Problem Solving Ability with Code	0	0	2	1	100	0	100	EEC
9	25MEE04	Mini Project II	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
10	25GEM06	Activity Point Programme V*	-	-	-	-	-	-	-	MC
		Total 29 periods	**15**	**2**	**12**	**23**	**520**	**380**	**900**	

*** As per AICTE norms; Grade: Non-Credit Course**

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L-Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours/Week L	T	P	C	Maximum Marks CA	ESE	Total	CAT
SEMESTER VII										
THEORY										
1	25ME701	Finite Element Analysis	3	0	0	3	40	60	100	PC
2	25ME702	Industrial Automation	3	0	0	3	40	60	100	PC
3	25MEP_ _	Professional Elective III	3	0	0	3	40	60	100	PE
4	25MEP_ _	Professional Elective IV	3	0	0	3	40	60	100	PE
5	25_ _O_ _	Open Elective II	3	0	0	3	40	60	100	OE
PRACTICALS										
6	25ME711	Finite Element Analysis Laboratory	0	0	2	1	60	40	100	PC
7	25ME712	Manufacturing Automation Laboratory	0	0	2	1	60	40	100	PC
8	25MEE05	Project Work I	0	0	4	2	100	0	100	EEC
9	25MEE06	Internship II	0	0	0	1	100	0	100	EEC
Total 23 periods			**15**	**0**	**8**	**20**	**520**	**380**	**900**	

S. No.	Course Code	Course Title	Hours/Week L	T	P	C	Maximum Marks CA	ESE	Total	CAT
SEMESTER VIII										
THEORY										
1	25MEP_ _	Professional Elective V	3	0	0	3	40	60	100	PE
2	25MEP_ _	Professional Elective VI	3	0	0	3	40	60	100	PE
PRACTICALS										
3	25MEE07	Project Work II	0	0	8	4	60	40	100	EEC
Total 14 periods			**6**	**0**	**8**	**10**	**140**	**160**	**300**	

SUMMARY OF CREDIT DISTRIBUTION

B.E. MECHANICAL ENGINEERING										
S. No.	**Course Category**	**Credits per Semester 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total Credits**
1	HS	5	3	3	0	0	0	0	0	**11**
2	BS	12	4	4	3	0	0	0	0	**23**
3	ES	6	13	9	2	2	0	0	0	**32**
4	PC	0	3	6	12	20	15	8	0	**64**
5	PE	0	0	0	3	0	3	6	6	**18**
6	OE	0	0	0	0	0	3	3	0	**6**
7	EEC	0	0	1	2	2	2	3	4	**14**
8	MC	-	-	-	-	-	-	-	-	**-**
Total		**23**	**23**	**23**	**22**	**24**	**23**	**20**	**10**	**168**

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L-Lecture; T-Tutorial; P-Practical; C-Credits

LIST OF PROFESSIONAL ELECTIVE COURSES: VERTICALS

S. No.	Vertical I Design	Vertical II Manufacturing and Automation	Vertical III Thermal	Vertical IV Materials
1	25MEP01 Production Design	25MEP10 Additive Manufacturing	25MEP19 Power Plant Engineering	25MEP28 Casting and Welding Metallurgy
2	25MEP02 CAD/CAM	25MEP11 Non-traditional Machining Processes	25MEP20 Renewable Energy	25MEP29 Principles of Materials Selection
3	25MEP03 Product Life Cycle Management	25MEP12 Process Planning and Cost Estimation	25MEP21 Fuel Cell Technologies	25MEP30 Composite Materials
4	25MEP04 Ergonomics in Design	25MEP13 Industrial Management	25MEP22 Computational Fluid Dynamics	25MEP31 Mechanical Behaviour of Materials
5	25MEP05 Automobile Engineering	25MEP14 Computer Integrated Manufacturing	25MEP23 Hydraulics and Pneumatics	25MEP32 Non-Destructive Testing of Materials
6	25MEP06 Statistical Quality Control (SQC)	25MEP15 Industrial Robotics	25MEP24 Heat Exchanger Design	25MEP33 Materials Characterization Methods
7	25MEP07 Dynamics of Ground Vehicles	25MEP16 Industry 4.0	25MEP25 Alternate Fuels	25MEP34 Nanomaterials and Applications
8	25MEP08 Mechanical Vibration	25MEP17 Drone Structures and Dynamics	25MEP26 Cryogenic Engineering	25MEP35 Materials for Energy Storage and Conversion
9	25MEP09 Artificial Intelligence for Mechanical Engineers	25MEP18 Electric Vehicle Technology	25MEP27 Energy Storage Technologies	25MEP36 Non-Metallic Materials

LIST OF OPEN ELECTIVES

S. No.	Course Code	Course Title
1	25MEO01	Fundamentals of Robotics
2	25MEO02	3D Printing Technology
3	25MEO03	New Product Development
4	25MEO04	Model-Based Systems Engineering
5	25MEO05	Energy Technologies
6	25MEO06	Smart Materials

LIST OF LANGUAGE ELECTIVE COURSES

S. No.	Course Code	Course Title
1	25HS211	Communication Skills for Engineers
2	25HS212	Basic German
3	25HS213	Basic Japanese

LIST OF MANDATORY COURSES

S. No.	Course Code	Course Title
1	25MC001	Environmental Science
2	25MC002	Indian Constitution
3	25MC003	Industrial Safety
4	25MC004	Disaster Risk Reduction and Management
5	25MC005	Indian Knowledge System for Sustainable Human Development
6	25MC006	Strategic Data Management and Governance
7	25MC007	Professional Ethics
8	25HSO01	Physical Education
9	25HSO02	Yoga and Health

SEMESTER I
25MA101 CALCULUS AND ITS APPLICATIONS
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

3 1 0 4

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables. **(9+3)**

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form. **(9+3)**

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems. **(9+3)**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits. **(9+3)**

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:
1. J. Hass, C. Heil, and D.W. Maurice, '*Thomas Calculus*'. Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, '*Advanced Engineering Mathematics*'. Wiley India, New Delhi, 2018.

REFERENCES:
1. H. Anton, I. Bivens, and S. Davis, '*Calculus*'. John Wiley and Sons, USA, 2016.
2. C. R. Wylie and L.C. Barrett, '*Advanced Engineering Mathematics*'. Tata McGraw-Hill, New Delhi, 2019.
3. D. G. Michael, '*Foundations of Applied Mathematics*'. Dover Publications, New York, 2013.
4. Gilbert Strang, '*Calculus*'. Wellesley Cambridge Press, USA, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts related to Calculus, Differential Equations and Vector Calculus.	**K2**
CO2	Apply the techniques of Calculus, Differential Equations and Vector Calculus to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Calculus, Differential Equations and Vector Calculus.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Calculus, Differential Equations and Vector Calculus.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25PH102 PHYSICS FOR MECHANICAL ENGINEERING

3 0 0 3

STATICS OF PARTICLES: Introduction to Newtonian mechanics - vector mechanics; Forces on a particle, parallelogram law, resolution of a force, rectangular components of a force; Resultant of several concurrent forces: Equilibrium of a particle, free-body diagrams, forces in space - equilibrium of a particle in space. **(9)**

KINEMATICS OF PARTICLES: Introduction to dynamics; Rectilinear motion of particles: Analytical and graphical solutions to problems, motion of several particles; Curvilinear motion of particles: projectile motion, rotary motion and rolling motion. **(9)**

KINETICS OF PARTICLES - NEWTON'S SECOND LAW AND FRICTION: Rectilinear and rotary motion: Newton's second law, D'Alembert's principle, dependent motion of several particles; Friction: concepts of friction, problems involving dry friction; Wedges, square-threaded screws, journal bearings - axle friction, thrust bearings - disk friction, wheel friction - rolling resistance, belt friction. **(9)**

KINETICS OF PARTICLES – ENERGY METHODS: Work-energy and power**:** Work of a force, Conservative and non-conservative forces, kinetic energy, principle of work and energy, potential energy, conservation of energy, power and efficiency; Solving problems using the concepts of friction wherever applicable. **(9)**

KINETICS OF PARTICLES – MOMENTUM METHODS: Concept of conservation of momentum, co-efficient of restitution, Impulse-momentum principle, Impact – direct central impact, oblique central impact, problems involving impulse and momentum. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Ferdinand P. Beer, E. Russell Johnston, David F. et al. '*Vector Mechanics for Engineers Statics and Dynamics*'. 12th edition, McGraw Hill Education (India) Private Ltd., New Delhi, 2019,
2. A. Nelson, '*Engineering Mechanics -Statics and Dynamics*'. 1st edition, Tata McGraw Hill Education (India) Private Ltd., New Delhi, 2017,

REFERENCES:

1. S. Rajasekaran and G. Sankarasubramanian, '*Engineering Mechanics-Statics and Dynamics*'. Vikas Publishing House Pvt. Ltd., New Delhi, 2015.
2. R. C. Hibbler, '*Engineering Mechanics -Statics and Dynamics*'. 15th edition, Pearson, 2022.
3. James L. Meriam, L. et al. , '*Engineering Mechanics Statics*'. Wiley India Private Limited, 2018.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the fundamental concepts of force systems, equilibrium conditions, particle kinematics, and kinetics principles in mechanics.	**K2**
CO2	Apply Newton's laws, energy methods, and momentum principles to solve numerical problems and infer the concepts involving forces, motion, friction, and impact.	**K3**
CO3	Analyze dynamic systems involving rectilinear and curvilinear motion, energy transformations, and momentum changes to identify optimal mechanical responses.	**K4**
CO4	Present the understanding on the effects of friction, energy loss, and momentum transfer in mechanical systems considering societal, safety, and sustainability aspects.	-

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25CY104 CHEMISTRY OF ENGINEERING MATERIALS

3 0 0 3

FUELS AND COMBUSTION: Petroleum - refining, cracking and polymerisation- petrol and diesel knocking-octane and cetane rating of fuels-reforming of gasoline. Liquefaction of coal- Bergius process. Alternate fuels-methanol, ethanol, CNG, biodiesel. Calorific value -determination by Bomb calorimeter-calculation of heat of combustion. Calorific intensity- calculation of theoretical flame temperature. Combustion of fuels- theoretical air calculations for solid and gaseous fuels. Emission tests, catalytic convertors-principles, Euro and Bharath emission standards. Propellants-requisites-examples. Explosives –Lead azides-applications. **(9)**

BATTERIES & FUEL CELLS: Electrode potential, Nernst equation. Performance characteristics of batteries. Construction, reactions, characteristics of Zn-Carbon, lithium primary cells. Lead - acid battery and lithium-ion secondary batteries. Super capacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudo capacitors. Fuel cell-working principles of proton exchange membrane and direct methanol fuel cells. Specialty batteries for satellites and torpedoes. **(9)**

CORROSION AND PROTECTIVE COATINGS: Forms of corrosion- uniform, pitting, crevice, inter-granular and stress corrosion. Corrosion protection by design, anodic and cathodic protection, corrosion inhibitors - mention of types and applications. Protective coatings - Anodizing, electroplating of Cu, Ni and Cr. Galvanizing and Tinning. Paints-constituents and functions. Electrophoretic painting, super hydrophobic and self-healing coatings. **(9)**

POLYMERS AND COMPOSITES: Polymers: Classification, degree of polymerization molecular weight - Mn and Mw. Structure related to thermal and mechanical properties of polymers. Degradation of polymers-Thermal and mechanical, Additives- protective additives-thermal stabilizers, UV stabilizers, Antioxidants, functional additives-metal deactivators, flame retardants, vulcanization. **Composites:** classification, role of matrix and reinforcements, polymer matrix-thermoplastic and thermoset, reinforcements – glass, carbon, aramids, nanomaterials. **(9)**

MISCELLANEOUS MATERIALS: Lubricants-classification- properties, mechanisms of lubrication- additives and improvers. Solid lubricants (graphite and MoS_2). Abrasives: Natural abrasives (diamond and corundum)-synthetic abrasives (silicon carbide and boron carbide). Refractories- characteristics – classification – alumina, magnesite and zirconia bricks- applications. Adhesives-pressure sensitive, epoxy, acrylic and plastics based. Boiler feed water-requisites-estimation of hardness – demineralization process. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Shikha Agarwal, '*Engineering Chemistry Fundamentals and Applications*'. Cambridge University Press, 2015.
2. Shashi Chawla, '*A Text Book of Engineering Chemistry*'. Dhanpat Rai and Co., New Delhi, 2005.

REFERENCES:

1. S. Samir, '*Fuels and Combustion*'. India Universities Press, Hyderabad, 2009.
2. Vladimir S. Bagotsky, Alexander M. Skundin and Yurij V.M. Volfkovich., '*Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors*'. John Wiley and Sons Inc., 2015.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Learn the basic concepts of engineering materials	**K1**
CO2	Use suitable fuels, energy storage devices, coatings and materials for engineering applications.	**K2**
CO3	Compare and contrast the properties of engineering materials and select efficient materials for engineering applications.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3										3	3	
CO3								1	1			3	
	3							**1**	**1**		**3**	**3**	

1-low, 2-medium, 3-high

25EE102 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

3 0 0 3

INTRODUCTION TO AC AND DC CIRCUITS: Charge and Current, Voltage, Energy and Power - Sinusoidal Voltage and Current - Average value - RMS value - Power factor - Phasor representation. - Circuit elements and symbols - Ohm's law - Kirchhoff's law - Mesh and Nodal analysis - Thevenin's theorem - Norton's theorem - Superposition theorem - Maximum Power transfer theorem. **(11)**

DC MACHINES: Types of DC motors, Construction and Principle of operation: Shunt motor - Series motor - Compound motor, Speed-torque characteristics, Starting, Speed Control, Braking. **(7)**

AC AND SPECIAL MACHINES: Types of AC motors - Single phase induction motor - Three phase induction motor - Synchronous motor – Starting – single phase transformers: Construction, EMF equation- variable reluctance stepper motor- brushless DC motor- servo motors. **(7)**

ELECTRONIC DEVICES: PN junction diode - Zener diode - LED – BJT: Biasing, Amplifier and switch, Frequency response characteristics – MOSFET: Types, Biasing, Current-voltage characteristics, Amplifier, High frequency model, Junction Field-Effect Transistor (JFET) - Comparison of BJT and FET - Optocouplers - SCR- TRIAC – DIAC. **(10)**

ELECTRONIC CIRCUITS: Half wave and full wave rectifiers: analysis, ripple factor, filtering – Clippers and Clampers – Zener voltage regulator- series voltage regulators – RC coupled amplifier - RC phase shift oscillator. **(10)**

Total L: 45 periods

TEXT BOOKS:

1. William Hayt, Jack Kemmerly, Jaime Phillips and Steven Durbin, '*Engineering Circuit Analysis*'. Tata McGraw Hill, New Delhi, 2019.
2. D. P. Kothari and I. J. Nagrath, '*Basic Electrical and Electronics Engineering*'. Tata McGraw Hill, New Delhi, 2014.

REFERENCES:

1. Charles Alexander and Mathew Sadiku, '*Fundamentals of Electric Circuits*'. Tata McGraw Hill, New Delhi, 2021.
2. V. N. Mittle and Aravind Mittal, '*Basics of Electrical Engineering*'. Tata Mc Graw Hill, New Delhi, 2017.
3. Warsame Hassan Ali, Samir Ibrahim Abood and Matthew N. O. Sadiku, '*Fundamentals of Electric Machines*'. CRC press, New York, 2019.
4. Robert L. Boylestad and Louis Nashelsky, '*Electronic Devices and Circuit Theory, Pearson*'. New Delhi, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts and applications of basic electrical and electronics circuits.	**K2**
CO2	Apply basic laws and theorems to solve simple problems related to electrical and electronic circuits.	**K3**
CO3	Demonstrate an application of electrical and electronic circuits as a team using any simulation tool.	-

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25HS101 ENGLISH LANGUAGE PROFICIENCY
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

3 1 0 4

VOCABULARY: Etymology-Prefixes and suffixes–Synonyms–Antonyms–Guessing meanings from context–Word formation- Single-word substitutes- Different forms of a word–Phrasal verbs–Collocations. **(9+3)**

LISTENING AND SPEAKING: Understanding listening – Listening techniques - Introducing oneself and others – Seeking and sharing information– Description-Conversation skills– Extempore speaking– Speech practice in varied formal contexts. **(9+3)**

GRAMMAR: Wh-questions – Yes/no questions– Parts of speech – Articles– Prepositions–Gerunds–Conjunctions-Degrees of comparison– Tenses– Modal verbs – Adverbs - Direct and indirect questions. **(9+3)**

READING: Reading strategies: Skimming and scanning, predicting– Reading comprehension: techniques –Practice reading. **(9+3)**

WRITING: Discourse markers – Dialogue writing - Completing sentences – Jumbled sentences – Paragraph writing –Writing compare & contrast paragraphs – Letter writing. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXTBOOKS:

1. K. N. Shoba and Lourdes Joavani Rayen, ‘*Communicative English*’. Cambridge University press, Cambridge, 2021.
2. Raymond Murphy, ‘*Intermediate English Grammar*’. Cambridge University Press, New Delhi, 2020.
3. Dr M. Sambaiah, ‘*Technical English an integrated text book*’. Wiley India Pvt. Ltd., 2025.

REFERENCES:

1. Raymond Murphy, ‘*English Grammar in Use*’. Cambridge University Press, New Delhi 2020.
2. N. P. Sudharshana and C. Savitha, ‘*English for Engineers*’. Cambridge University Press, New York, 2018.
3. Helen Naylor with Raymond Murphy, ‘*Essential English Grammar*’. Cambridge University Press, New Delhi, 2019.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom’s Level**
CO1	Demonstrate the ability to recognize and use a wide range of vocabulary and key grammatical structures accurately, while developing inferential reading skills to comprehend, interpret, and analyze written texts across diverse contexts.	**K2**
CO2	Organize their ideas logically in essay writing, develop paragraphs with clear topic sentences and adapt their letter-writing skills to various real-world scenarios.	**K3**
CO3	Develop and demonstrate clear and confident speaking skills in formal and informal contexts.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									3		3	3	
CO2									3		3	3	
CO3									1		1	3	
									3		**3**	**3**	

1-low, 2-medium, 3-high

25HS102 *தமிழர் மரபு*
(Common to all B.E./B.Tech./B.Des. Degree Programmes)

1 0 0 1

மொழி மற்றும் இலக்கியம்: *இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச்சார் பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க்காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.* **(3)**

மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை: *நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக்கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வியல் கோவில்களின் பங்கு.* **(3)**

நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள்: *தெருக்கூத்து, கரகாட்டம், வில்லுப் பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.* **(3)**

தமிழர்களின் திணைக்கோட்பாடுகள்: *தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்க கால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.* **(3)**

இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: *இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப் பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.* **(3)**

Total L: 15 Periods

25HS102 HERITAGE OF TAMILS
(Common to all B.E./B.Tech./B.Des. Degree Programmes)

1 0 0 1

LANGUAGE AND LITERATURE: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan. **(3)**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **(3)**

FOLK AND MARTIAL ARTS: Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamil. **(3)**

THINAI CONCEPT OF TAMILS: Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Chola. **(3)**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books. **(3)**

Total L: 15 Period

TEXT – CUM – REFERENCE BOOKS:

1. கே. கே. பிள்ளை, ‘தமிழக வரலாறு - மக்களும் பண்பாடும்’. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
2. முனைவர் இல. சுந்தரம், ‘கணினித்தமிழ்’. விகடன் பிரசுரம்
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு
4. பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு
5. Dr. K.K. Pillay, ‘*Social Life of Tamils*’. A joint publication of TNTB, ESC and RMRL
6. Dr. S. Singaravelu, ‘*Social Life of the Tamils – The Classical Period*’. International Institute of Tamil Studies.
7. Dr. S.V. Subaramanian and Dr. K.D. Thirunavukkarasu, ‘*Historical Heritage of the Tamils*’. International Institute of Tamil Studies
8. Dr. M. Valarmathi, ‘*The Contributions of the Tamils to Indian Culture*’. International Institute of Tamil Studies.
9. Keeladi – Sangam ‘*City Civilization on the banks of river Vaigai*’. Department of Archaeology, Tamilnadu Text Book and Educational Services Corporation, Tamilnadu
10. Dr. K.K. Pillay, Studies in the History of India with Special Reference to Tamilnadu
11. ‘*Porunai Civilization*’. Department of Archaeology, Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu
12. R. Balakrishnan, ‘*Journey of Civilization Indus to Vaigai*’. RMRL, Tamilnadu

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the Dravidian language family, outline the features of Tamil classical literature, and explain the development of Tamil art, sculpture, and temple-related traditions in a historical context.	**K2**
CO2	Demonstrate the cultural relevance of Tamil folk and martial arts, apply the concepts of Sangam landscape classification to social contexts, and relate Tamil contributions to India's freedom struggle, cultural legacy, and Siddha medicine.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1							3				3		
CO2							3				3		
							3				**3**		

1-Low, 2-Medium, 3-High

25ME111 ENGINEERING DRAWING WITH CAD

0 0 4 2

Orthographic Projection **(12)**

1. Projection of lines - only first angle projections
2. Projection of planes - inclined to the principal planes

Solids and Perspective Projections **(12)**

1. Projection of solids - inclined to one of the principal planes
2. Perspective projection of simple solids

Development and Sections of Solids **(12)**

1. Section of solids - cutting plane inclined to the one of the principal planes
2. Development - sectioned solids (cutting plane inclined to one of the principal planes)

Pictorial Projections **(12)**

1. Orthographic views from pictorial views
2. Isometric views from orthographic views

Computer Graphics **(12)**

1. Modeling of simple engineering components
2. Extraction of 2D views from 3D models

Total P: 60 periods

TEXT BOOKS:

1. K. Venugopal and V. Prabhu Raja, '*Engineering Graphics*'. New Age International Publishers, 16th edition, 2021.
2. K. C. John, '*Engineering Graphics for Degree*'. PHI Learning Private Limited, 2009.

REFERENCES:

1. '*Bureau of Indian Standards*'. Engineering Drawing Practices for Schools and Colleges SP 46-2003, BIS, 2003.
2. M. B. Shaw and B. C. Rana, '*Engineering Drawing*'. Pearson Education India, 2009.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply projection techniques to create basic shapes, solids, and sectioned objects.	**K3**
CO2	Model a simple 2D and 3D object using CAD software.	**K2**
CO3	Use the standards and specifications for engineering drawing.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	1
CO2					1							3	1
CO3											1	3	1
	3				**1**						**1**	**3**	**1**

1-low, 2-medium, 3-high

25GE111 DESIGN THINKING FOR INNOVATION
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

0 0 2 1

Foundations of Design Thinking: History & Origins: Roots in Creative Problem Solving: Traces back to mid-20th century practices in architecture, engineering, and psychology. Herbert Simon's "Sciences of the Artificial" (1969): Introduced design as a way of thinking distinct from scientific inquiry. IDEO and the Rise of Human-Centered Design: Popularized design thinking as a repeatable, user-focused innovation process. Stanford school's Influence: Helped institutionalize design thinking in education and entrepreneurship.

Variations of Design Thinking Phases: IDEO's 3-Phase Model: Inspiration, Ideation, Implementation A flexible, non-linear approach emphasizing creativity and action. Stanford school's 5-Phase Model: Empathize, Define, Ideate, Prototype, Test A structured yet iterative framework centered on user empathy. Double Diamond Model (Design Council UK): Divides the process into Discover, Define, Develop, and Deliver—highlighting divergent and convergent thinking.

Related Concepts & Frameworks: Human-Centered Design (HCD): Focuses on designing solutions that deeply resonate with users' needs and contexts. Systems Thinking: Encourages understanding the broader ecosystem and interdependencies within a problem space. Agile & Lean UX: Integrates design thinking with iterative development and minimal viable experimentation. Service Design: Applies design thinking to orchestrate holistic user experiences across touchpoints. Participatory Design: Involves stakeholders directly in the design process to ensure relevance and inclusivity.

EMPATHIZE: Apply Human-Centric Design Principles: Focus on designing solutions that prioritize user needs, experiences, and values throughout the process. Consult Experts: Engage with subject matter experts to gain foundational knowledge about the problem space. Competitive Analysis: Identify & studying similar products or services to identify gaps and opportunities. Stakeholder Interviews: Engaging with people who influence or are affected by the product or service. Conduct Observations: Observe users in their natural environment to understand behaviors, challenges, and interactions. Engage with Users: Use interviews, conversations, and other methods to connect with users and hear their stories. Immerse Yourself: Step into the users' context to experience their environment and challenges firsthand. Create Empathy Maps: Visualize what users say, think, feel, and do to synthesize insights. Identify User Needs and Pain Points: Extract meaningful patterns and needs from user interactions and observations. Set Aside Assumptions: Approach the research with an open mind, suspending personal biases and preconceptions. Document Insights: Capture quotes, observations, and emotional cues to inform the next stage (Define). **(6)**

DEFINE: Organize Research Findings: Review and structure the data collected during the Empathize stage. Analyze Observations: Identify patterns, themes, and insights from user interactions and behaviors. Craft a Human-Centered Problem Statement: Frame the problem from the user's perspective, focusing on their needs—not business goals. Avoid Business-Centric Framing: Refrain from defining problems based on company objectives alone (e.g., market share). Persona Development: Synthesizing research into user personas to guide design decisions. Use Empathy to Guide Definition: Ensure the problem statement reflects real user challenges and motivations. Develop Point-of-View Statements: Create concise summaries that capture who the user is, what they need, and why. Prepare for Ideation: Formulate "How Might We" questions to spark creative thinking in the next phase. **(6)**

IDEATE: Review the Problem Statement: Revisit the user-centric problem defined in the previous stage to guide ideation. Explore Multiple Perspectives: Encourage diverse viewpoints to broaden the range of potential solutions. Use Ideation Techniques: Apply methods like Brainstorming, Brain writing, SCAMPER, and Worst Possible Idea to spark creativity. Encourage Free Thinking: Create a judgment-free space to generate as many ideas as possible without filtering. Expand the Problem Space Push boundaries and explore unconventional or extreme ideas to uncover hidden opportunities. Refine and Select Ideas: Use evaluation techniques to identify promising concepts that address user needs effectively. Prepare for Prototyping: Choose ideas that are feasible and impactful to develop into tangible prototypes in the next stage. **(6)**

PROTOTYPE: Build Low-Cost Prototypes: Create simple, scaled-down versions of the product or its features to explore ideas. Experiment with Solutions: Implement different solutions from the Ideate stage into prototypes for testing. Test Internally and Externally: Share prototypes with team members, other departments, or a small group of users. Observe User Interactions: Watch how users engage with the prototypes to uncover usability issues and insights. Evaluate and Iterate: Accept, refine, or discard prototypes based on user feedback and performance. Identify Limitations: Discover constraints and challenges in the proposed solutions through hands-on testing. Gain Deeper User Understanding: Learn how users think, feel, and behave when interacting with the product. **(6)**

TEST: Conduct Rigorous Testing: Evaluate the complete product using the most promising prototypes. Observe Real User Interactions: Study how users behave, think, and feel while using the product. Gather Feedback and Insights: Collect qualitative and quantitative data to assess usability and effectiveness. Identify Remaining Issues: Detect limitations, pain points, and areas for improvement. Refine and Iterate: Use test results to improve the product and revisit earlier stages if needed. Redefine Problems if Necessary: Reframe or adjust problem statements based on new insights. Enhance Understanding of Users: Deepen empathy and knowledge of user needs through real-world testing. **(6)**

Design Thinking & Customer Centricity: A human-centered approach that blends empathy and innovation to create solutions that truly resonate with customer needs. Practical Examples of Customer Challenges: Real-world scenarios where customers face friction, unmet needs, or emotional disconnects in their product or service journey. Use of Design Thinking to Enhance Customer Experience: Applying iterative problem-solving and user insights to craft experiences that are intuitive, delightful, and deeply relevant. Parameters of Product Experience: Key dimensions like usability, accessibility, emotional impact, and consistency that shape how customers perceive and interact with a product. Alignment of Customer Expectations with Product Design: Ensuring that every design decision reflects what customers value, expect, and aspire to achieve through the product.

Total P: 30 periods

TEXT BOOKS:

1. T. Brown '*Change by Design*'. Harper Business, 2009.
2. J. Liedtka and T. Ogilvie '*Designing for Growth*'. Columbia Business School Publishing, 2011.

REFERENCES:

1. T. Kelley and D. Kelley '*Creative Confidence*'. Crown Business, 2013.
2. Stanford d. School resources: https://dschool.stanford.edu/
3. https://apphaus.sap.com/toolkit/methods#design-thinking

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply empathy-driven research to understand user needs.	**K3**
CO2	Develop and test prototypes to refine innovative solutions to the real-world problems.	**K4**
CO3	Frame actionable problem statements and generate creative ideas.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25BS112 BASIC SCIENCES LABORATORY
(Common to EEE, ECE, Mech and EE-VLSI)

0 0 4 2

Physics (Any eight experiments)

1. Determination of specific resistance of a given wire – Carey foster’s bridge.
2. Determination of Young’s modulus of the material- Uniform Bending
3. Measurement of Hall coefficient of a semiconductor using Hall effect setup.
4. Determination of electrical resistivity of a given material using four probe setups.
5. Determination of wavelength of laser using diffraction grating - LASER.
6. Determination of Thickness of a thin wire – Air wedge method.
7. Study of I-V characteristics of solar cell and determination of its efficiency
8. Determination of velocity of sound and compressibility of liquid - Ultrasonic Interferometer.
9. Determination of Planck’s constant and work function of a metal -Photoelectric Effect
10. Determination of bandgap of a semiconductor – Post office box.

Demonstration:

1. Determination of Numerical Aperture and Acceptance angle - Optical Fiber
2. Study the energy loss of a ferrite magnetic material specimen by B-H curve.

REFERENCES:

1. Department of Physics, Physics Laboratory Observation, 2025.
2. Jerry D Wilson, A. Cecilia and Hernandez Hall, ‘*Physics Laboratory Experiments*’. Boston, Cengage Learning, 2016.

Chemistry (Any eight experiments):

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of strength of acids in a mixture of acids using conductivity meter.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Estimation of iron content of the given solution using potentiometer.
5. Corrosion experiment-weight loss method.
6. Electroplating of copper and Nickel and determination of coulombic efficiency.
7. Designing a battery and determination of its characteristics.
8. Construction of phase diagram of a simple eutectic system.
9. Determination of kinematic viscosity and acid value of a lubricating oil.
10. Anodizing of aluminium and determination of thickness of anodized film.

Total P: 60 periods

REFERENCE:

1. J. Mendham, Vogel's '*Textbook of Quantitative Chemical Analysis*'. 6th Edition, Pearson Education, 2009**.**

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Relate the scientific principles and compare the experimental results with theoretical calculations and apply graphical analysis to visualize the importance of precise measurements.	**K3**
CO2	Analyze the experimental result outcomes using analytical and experimental skills for various engineering materials and applications.	**K4**
CO3	Demonstrate the measurement of water quality parameters in the given water sample	**K2**
CO4	Analyze the properties of materials for Engineering applications	**K3**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25GEM01 INDUCTION PROGRAMME
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

All students shall undergo an induction programme at the beginning of the first semester for a duration of three weeks as per the guidelines of All India Council for Technical Education (AICTE). A student completing the induction programme will be awarded a completed grade in the grade sheet, and only the students who complete the induction programme shall be considered as eligible for award of degree subject to satisfying other conditions. A student who does not complete the induction programme in the first semester shall redo the same in the subsequent semester.

SEMESTER II

25MA201 COMPLEX VARIABLES AND TRANSFORMS
(Common to CIVIL, EEE, ECE, ICE, MECH and EE-VLSI)

3 1 0 4

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations. **(9+3)**

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only). **(9+3)**

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems. **(9+3)**

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms. **(9+3)**

PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two-dimensional heat problems, solution by Fourier series. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Erwin Kreyszig, '*Advanced Engineering Mathematics*'. Wiley India, New Delhi, 2018.
2. G. Z. Dennis, '*Advanced Engineering Mathematics*'. Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES:

1. G. Z. Dennis and D. S. Patrick, '*A first course in Complex Analysis with Applications*'. Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. C. R. Wylie and L. C. Barret, '*Advanced Engineering Mathematics*'. Tata McGraw-Hill, New Delhi, 2019.
3. Peter V.O Neil, '*Advanced Engineering Mathematics*'. Cengage, New Delhi, 2018.
4. G. D. Dean, '*Advanced Engineering Mathematics with MATLAB*'. CRC Press, USA, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts related to Complex Variables, Laplace Transforms, Fourier Analysis and Partial Differential Equations.	**K2**
CO2	Apply the techniques of Complex Variables, Laplace Transforms, Fourier Analysis and Partial Differential Equations to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Complex Variables, Laplace Transforms, Fourier Analysis and Partial Differential Equations.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Complex Variables, Laplace Transforms, Fourier Analysis and Partial Differential Equations.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME201 ENGINEERING MECHANICS

3 1 0 4

STATICS OF RIGID BODIES: Equivalent systems of forces acting on a rigid body in 2D space: Transmissibility, moment of a force, Varignon's theorem, moment of a couple, resolution of a given force, reduction of a system of forces; Equilibrium of a rigid body in 2D space - reactions at supports and connections; Analysis of structures: Simple trusses - method of joints, method of sections, joints under special loading conditions, analysis of frames and machines. **(11+3)**

APPLICATIONS OF FRICTION: Clutches: Role of clutches, overview of positive and gradually engaged clutches, friction clutches - single plate, multiple plate, cone and centrifugal clutches; Brakes: Role of brakes, Single shoe, double shoe and band brakes - self-locking, self-energizing and de-energizing actions; Overview of disc brakes and internally expanding shoe brakes. **(9+3)**

CENTROIDS, CENTRES OF GRAVITY AND MOMENTS OF INERTIA: Centroids of areas, lines, composite areas, moment of inertia of plane figures, polar moment of inertia, radius of gyration, Mass Moments of inertia of thin plates, and composite bodies. **(8+3)**

KINEMATICS OF RIGID BODIES - PLANE MOTION: Kinematics of rigid bodies: Plane motion, translation and rotation; General plane motion: Absolute velocity, relative velocity, instantaneous centre of rotation, absolute acceleration, relative acceleration. **(8+3)**

KINETICS OF RIGID BODIES - PLANE MOTION: Equations of motion of a rigid body - angular momentum, D'Alembert's principle; Principle of work and energy for a rigid body, work of forces acting on a rigid body, kinetic energy of a rigid body in plane motion, conservation of energy; Impulse-momentum principle for the plane motion of a rigid body; Overview of Lagrange's equations of motion. **(9+3)**

Total L: 45 +T: 15 = 60 periods

TEXT BOOKS:

1. Ferdinand P. Beer, E. Russell Johnston, David F. et al., '*Vector Mechanics for Engineers Statics and Dynamics*'. McGraw Hill Education (India) Private Ltd., New Delhi, 12th edition, 2019
2. A. Nelson, '*Engineering Mechanics -Statics and Dynamics*'. Tata McGraw Hill Education (India) Private Ltd., New Delhi,1st edition, 2017.

REFERENCES:

1. S. Rajasekaran and G. Sankarasubramanian, '*Engineering Mechanics-Statics and Dynamics*'. Vikas Publishing House Pvt. Ltd., New Delhi, 2006.
2. James L. Meriam, L. et al., '*Engineering Mechanics – Statics*'. Wiley India Private Limited, 2017.
3. James L. Meriam, L. et al., '*Engineering Mechanics – Dynamics*'. Wiley India Private Limited, 2018.
4. S. S. Rattan, '*Theory of Machines*'. Tata McGraw Hill Publishers, New Delhi, 4th edition, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain fundamental engineering mechanics concepts like force systems, equilibrium, friction, centroid, moment of inertia, and dynamics.	**K2**
CO2	Apply principles of equilibrium, friction, centroid, inertia, and motion to solve real-world engineering problems.	**K3**
CO3	Analyse static and dynamic systems including trusses, frames, rotating bodies, and mechanical systems using laws of mechanics.	**K4**
CO4	Design mechanical systems for stability and efficiency using appropriate tools.	-

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME202 MANUFACTURING PROCESSES

3 0 0 3

METAL CASTING: Casting process: Terminology, green sand molding, investment casting, die casting, patterns, molds, and cores; solidification and cooling; riser and gating systems; casting defects. **(8)**

JOINING PROCESSES: Gas welding: flame types, equipment; Electric Arc Welding (EAW), Gas Metal Arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW); Resistance welding - Spot, seam, projection and flash; Welding defects; Laser beam and friction-stir welding; Principles of brazing, soldering and adhesive bonding. **(8)**

SHEET METAL PROCESSES: Principle of shearing, punch-die clearance; Sheet metal operations: blanking, punching, bending, drawing, spinning; Blanking force calculation; Die-set: simple, progressive, compound; Press: open back inclinable press, hydraulic press; Deep drawing and bending processes. **(8)**

BULK DEFORMATION PROCESSES: Plastic deformation, hot and cold working; Rolling - Rolling mills, defects in rolled parts; Drawing - Wire and rod drawing; Forging - Open and closed die forging, forging hammers, rotary swaging; Extrusion- direct and indirect extrusion. **(8)**

POWDER METALLURGY AND PLASTIC PROCESSING: Production of metal powder: Atomization, crushing; Blending; Compacting: Die pressing, isostatic pressing; Sintering; Plastic processing: Injection, blow molding.

ADDITIVE MANUFACTURING: Fundamentals of additive manufacturing (AM); AM technologies: Stereolithography, fused deposition modeling, selective laser sintering and overview of metal additive manufacturing. **(13)**

Total L: 45 periods

TEXT BOOKS:

1. P. N. Rao, '*Manufacturing Technology*'. Tata McGraw Hill Education Private Limited, New Delhi, 2013.
2. Serope Kalpakjian and Stephen Schmid, '*Manufacturing Engineering and Technology*'. Pearson Education, 2018.

REFERENCES:

1. Mikell P Groover, '*Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*'. Wiley, 2015.
2. R. P. Arora, '*Manufacturing Technology*'. Macmillan India Limited, New Delhi, 2011.
3. Ian Gibson, David Rosen and Brent Stucker, '*Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*'. 2nd edition, Springer, 2015.
4. Amitabha Ghosh and Ashok Kumar Mallik, '*Manufacturing Science*'. East-West Press Pvt. Ltd., 2010.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the principles of various metal production and fabrication processes, including their design and defects.	**K2**
CO2	Apply the principles of manufacturing to perform force calculations in various production processes	**K3**
CO3	Analyze various manufacturing processes by simulating the process parameters to achieve products of desired quality	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											3	1
CO3		1			1							3	1
	3	**1**			**1**							**3**	**1**

1-low, 2-medium, 3-high

25ME203 FLUID MECHANICS

3 1 0 4

FLUID STATICS AND KINEMATICS: Properties of fluids, concept of gauge and absolute pressure, measurement of pressure using manometers; Types of flow - laminar, turbulent, steady, unsteady, uniform and non-uniform flows; Flow visualization: Stream, streak and path lines; Lagrangian and Eulerian descriptions of fluid motion. **(9 + 3)**

DIFFERENTIAL ANALYSIS OF FLUID FLOW: Irrotational and rotational flows, vorticity, stream function, potential function, continuity equation - derivation and applications to one dimensional flow, differential momentum equation, impact of jets - force on fixed and moving vanes; Navier Stokes equation, Euler's equation and Bernoulli's energy equation, applications of energy equations. **(9 + 3)**

FLOW THROUGH PIPES: Hagen Poiseuille equation: Velocity profile, power calculation; Laminar flow between parallel plates: Couette flow; Pipes in series and parallel, Darcy-Weisbach equation, use of Moody diagram; Minor losses: Sudden expansion, contraction and losses in pipe fittings. **(9 + 3)**

FLOW MEASUREMENTS: Orifice meter, mouthpiece, venturi meter, flow nozzle, pitot tube, multi-hole probe, anemometer, rotameter, hotwire anemometer, displacement meter, vortex flow meter, selection of flow meters. **(9 + 3)**

DIMENSIONAL ANALYSIS AND BOUNDARY LAYER THEORY: Buckingham Pi theorem, Reynolds, Froude and Mach numbers and their applications in model testing; Boundary layer theory, development of boundary layer, drag on a flat plate, boundary layer separation and its control, streamlined and bluff bodies, flow around circular bodies and airfoil, calculation of lift and drag. **(9 + 3)**

Total L: 45 +T: 15 = 60 periods

TEXT BOOKS:

1. B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch, '*Fundamentals of Fluid Mechanics*'. 9th Edition, John Wiley and Sons, 2021.
2. Yunus A Cengel and John M Cimbala, '*Fluid Mechanics*'. 4th edition, McGraw Hill Education, 2019.

REFERENCES:

1. D. S. Kumar, '*Fluid Mechanics and Fluid Power Engineering*'. 2nd edition, Kataria and Sons, 2016.
2. Frank M White, '*Fluid Mechanics*'. 8th edition, McGraw Hill Education, 2016.
3. E. Victor Streeter, K. Benjamin Wylie and W. Bedford, '*Fluid Mechanics*'. 9th edition, McGraw Hill Higher Education, 2010.
4. K. Subramanya, '*Fluid Mechanics and Hydraulic Machines*'. 2nd edition, McGraw Hill Education, 2018.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Describe fluid properties, fluid statics and dynamics, flow through pipes, dimensional analysis, and boundary layer concepts.	**K2**
CO2	Apply fluid mechanics principles to solve problems involving pressure, flow, energy losses, flow measurement, boundary layer behaviour, and model studies.	**K3**
CO3	Analyse fluid systems using force and energy equations, flow characteristics, similarity laws, and boundary layer effects for performance evaluation.	**K4**
CO4	Apply fluid mechanics principles to a practical application through a team-based micro project and communicate findings through a presentation and report.	**K1**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME204 INDUSTRIAL METALLURGY

3 0 0 3

MATERIAL CLASSIFICATION AND CRYSTAL STRUCTURES: Classification of materials, functional classification of materials; Crystal structures: Fundamental concepts, unit cells, metallic crystal structures, density computations, crystallographic points, directions, and planes; Imperfections in crystal structures: Point defects, dislocations, Schmid's Law, surface defects, bulk or volume defects. **(9)**

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS: Solid solutions: substitutional and interstitial solutions, Hume-Rothery rules; Phases, Gibbs phase rule; Binary phase diagrams: Isomorphous systems, eutectic systems, eutectoid and peritectic reactions, Iron- Iron carbide diagram, development of microstructures. **(9)**

HEAT TREATMENT AND STRENGTHENING METHODS: Annealing: Full annealing, stress relief annealing, recrystallization annealing, spheroidizing; Normalizing, hardening and tempering of steel; Concept of TTT and CCT diagrams, hardenability - Jominy end quench test, austempering and martempering; Surface hardening techniques: Carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening; Strengthening of metals and alloys: Cold working/strain hardening, solid solution strengthening, dispersion hardening, precipitation hardening and grain size strengthening. **(9)**

MECHANICAL PROPERTIES AND NDT OF MATERIALS: Mechanism of plastic deformation, deformation by slip, critical resolved shear stress, deformation by twinning; Types of fracture; Tensile testing: Stress-strain curve; Hardness tests (Brinell, Vickers and Rockwell); Impact test :Izod and Charpy, fracture toughness tests; Fatigue: Types, mechanism, S-N curves; Creep: Mechanisms, stages, creep curve; Fatigue and creep tests; ASTM standards for different mechanical tests; Introduction to NDT techniques: LPT, MPT, UT and RT. **(9)**

FERROUS AND NON-FERROUS ALLOYS: Cast iron: Compositions, types, properties, applications, effect of alloying elements in steels; Plain carbon steels, stainless steels and tool steels: Types, properties, applications and heat treatment; Copper and aluminum alloys: Types, properties, microstructure and applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. William D. Callister Jr. and David G. Rethwisch, '*Callister's Materials Science and Engineering*'. John Wiley and Sons, 2020
2. Sydney H Avner, '*Introduction to Physical Metallurgy*'. McGraw Hill, 2017

REFERENCES:

1. Kenneth G Budinski and Michael K Budinski, '*Engineering Materials*'. 4th edition, Prentice-Hall of India Pvt. Ltd., 2013.
2. V. Raghavan, '*Materials Science and Engineering*'. Prentice Hall of India Pvt. Ltd, 2018.
3. Donald R Askeland, et al., '*The Science and Engineering of Materials*'. Thomson brooks, 2011.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the fundamental principles of metallurgical engineering, including phase diagram, heat treatment and testing of materials.	**K2**
CO2	Apply the concepts of metallurgical and materials engineering to select the suitable material for a specific engineering application.	**K3**
CO3	Analyze binary phase diagrams, TTT diagrams and test curves obtained through various mechanical tests of different engineering materials.	**K4**
CO4	Examine the microstructural features, such as phase fraction and grain size, using an appropriate software.	**K3**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25HS201 தமிழரும் தொழில்நுட்பமும்

1 0 0 1

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: *சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.* **(3)**

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: *சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள், சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.* **(3)**

உற்பத்தித் தொழில் நுட்பம்: *கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணங்கள் – நாணயங்கள் அச்சடித்தல்- மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.* **(3)**

வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: *அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.* **(3)**

அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்: *அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.* **(3)**

Total L: 15 periods

25HS201 TAMILS AND TECHNOLOGY

1 0 0 1

WEAVING AND CERAMIC TECHNOLOGY: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **(3)**

DESIGN AND CONSTRUCTION TECHNOLOGY: Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age–Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period. **(3)**

MANUFACTURING TECHNOLOGY: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **(3)**

AGRICULTURE AND IRRIGATION TECHNOLOGY: Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conch diving - Ancient Knowledge of Ocean - Knowledge Specific Societ.**(3)**

SCIENTIFIC TAMIL & TAMIL COMPUTING: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project. **(3)**

Total L: 15 Periods

TEXT – CUM – REFERENCE BOOKS

1. கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
2. முனைவர் இல. சுந்தரம், கணினித்தமிழ், விகடன் பிரசுரம்
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு
4. பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு
5. Dr. K.K. Pillay, '*Social Life of Tamils*'. A joint publication of TNTB, ESC and RMRL
6. Dr. S. Singaravelu, '*Social Life of the Tamils – The Classical Period*'. International Institute of Tamil Studies.
7. Dr. S.V. Subaramanian and Dr. K.D. Thirunavukkarasu, '*Historical Heritage of the Tamils*'. International Institute of Tamil Studies
8. Dr. M. Valarmathi, '*The Contributions of the Tamils to Indian Culture*'. International Institute of Tamil Studies.
9. Keeladi – '*Sangam City Civilization on the banks of river Vaigai*'. Department of Archaeology, Tamilnadu Text Book and Educational Services Corporation, Tamilnadu
10. Dr. K.K. Pillay, Studies in the History of India with Special Reference to Tamilnadu
11. '*Porunai Civilization*'. Department of Archaeology, Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu
12. R. Balakrishnan, '*Journey of Civilization Indus to Vaigai*'. RMRL, Tamilnadu

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Identify the significance of ancient Tamil technologies in weaving, pottery, metallurgy, and architecture, with emphasis on traditional design and construction methods across historical periods.	**K2**
CO2	Use insights from traditional Tamil knowledge systems in agriculture, irrigation, and marine sciences, and connect the development of Tamil language to its applications in digital platforms and computing.	**K3**

COs-POs & PSOs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						1			1		1		
CO2						1			1		1		
						1			**1**		**1**		

1-Low, 2-Medium, 3-High

25EE213 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

0 0 2 1

List of Experiments:

1. Verification of Ohm's law and Kirchoff's laws.
2. Mechanical Characteristics of DC shunt Motor.
3. Load test on self-excited DC shunt generator.
4. Load test on single-phase transformer.
5. Load test on Three phase squirrel cage Induction Motor.
6. Characteristics of PN junction diode and Zener diode.
7. Implementation of Half wave rectifier with and without filter.
8. Implementation of Full wave rectifier with and without filter.
9. Verification of logic gate IC's.
10. Measurement of linear displacement using LVDT.

Total P: 30 periods

REFERENCE:

1. EEE Department, '*Electrical and Electronics Engineering Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Determine the characteristics of electrical, electronic devices and verify the laws of electric circuits and digital IC's.	**K3**
CO2	Analyze the performance characteristics electrical machines under different loading conditions.	**K4**
CO3	Work effectively in teams to perform experiments, analyze data and present findings through well-documented reports and presentations.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME211 MAKERS LABORATORY

0 0 2 1

1. Foundry: Study of the tool; Preparation of green sand mould using different types of patterns.
2. Welding: Study of arc welding tools and equipment; Exercises: Preparation of joints using arc welding.
3. Carpentry: Study of wood working tools. Exercises: Preparation of "L" and "V" Joints.
4. Plumbing: Study of tools and operations; Exercises: External thread cutting and preparation of PVC pipe joints.
5. Sheet metal work and Soldering: Study of tools and operations; Exercise: Preparation of a rectangular tray.
6. Introduction to Arduino – based experiments.

Total P: 30 Periods

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Comprehend the basic principles, tools, and techniques involved in various workshop practices	
CO2	Demonstrate the practical skills by performing mould preparation, pipe joining, metal tray fabrication, welding and carpentry joints	**K1**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											3	2
	3											**3**	**2**

1-low, 2-medium, 3-high

25EEC01 WORKPLACE COMMUNICATION SKILLS
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

0 0 2 0

BUILDING COMMUNICATION SKILLS:

1. Introduction to Workplace Communication
2. Profile Building for Internships
3. English in the Workplace (Grammar & Vocabulary)
4. Professional Communication (Speaking & Writing)
5. Workplace Communication Tools
6. Career Exploration
7. Resume Update

Total P: 30 periods

REFERENCES:

1. P. C. Wren and H. Martin, '*High school English Grammar and Composition*'. S Chand Publishing, New Delhi, 2017. Norman Lewis, '*Word Power Made Easy*'. Goyal Publisher, New Delhi, 2011.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Understand the importance of soft skills for employability and fine tune their writing skills – Resume writing.	**K3**
CO2	Present with clarity and coherence while speaking in formal contexts.	**K2**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2									**3**			2	2
									3			**2**	**2**

1-low, 2-medium, 3-high

SEMESTER III

25MA306 COMPUTATIONAL MATHEMATICS

3 1 0 4

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGENVECTORS: Approximations and errors. System of linear equations **-** Naïve Gauss elimination method, Cholesky method, Gauss–Seidel method. Eigenvalues and eigenvectors - Jacobi method, Applications - analysis of statically determinate truss, spring-mass systems. **(10+3)**

NON-LINEAR EQUATIONS: False-position method, Newton-Raphson method, Graeffe's root squaring method, Applications – Open channel flow model, vibration analysis. **(8+3)**

INTERPOLATION, DIFFERENTIATION, AND INTEGRATION: Interpolation **-** Newton‘s forward and backward, Lagrange, cubic-spline, approximation - Bezier curves, Numerical differentiation, Numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson‘s$1/3^{rd}$ rule, Gaussian Quadrature, Applications – temperature gradient, velocity and pressure distribution, relation between stress and strain. **(12+4)**

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4^{th} order Runge-Kutta method, Milne's method. Finite element method – Rayleigh Ritz method, Galerkin method, Applications - swinging pendulum, heat flow models. **(6+2)**

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference method: elliptic equations - Laplace equation, Poisson equation **–** Liebmann method, deflection of a plate, steady state heat conduction, parabolic equations – Crank Nicolson's method, transient heat conduction, hyperbolic equations – vibrating string. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Steven C Chapra and Raymond P Canale, '*Numerical Methods for Engineers'*. Tata McGraw Hill, New Delhi, 2021.
2. Curtis F Gerald and Patrick O Wheatly, '*Applied Numerical Analysis'*. Pearson Education, New Delhi, 2017.

REFERENCES:

1. Richard L. B and Douglas J. F, *'Numerical Analysis'*. Thomas Learning, New York, 2017.
2. G. Miller, '*Numerical Analysis for Engineers and Scientists'*. Cambridge University Press, UK, 2014.
3. Amos G and Vish S, '*Numerical Methods for Engineers and Scientists'*. Wiley India, New Delhi 2014.
4. Tai-Ran, '*Applied Numerical Analysis'*. Wiley India, New Delhi, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts related to Matrix Theory and Numerical Methods.	**K2**
CO2	Apply the techniques of Matrix Theory and Numerical Methods to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Matrix Theory and Numerical Methods.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Matrix Theory and Numerical Methods.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25HS301 PROJECT AND FINANCE MANAGEMENT
(Common to all B.E. and B.Tech. Programme)

3 0 0 3

INTRODUCTION TO PROJECT MANAGEMENT: Project: Trends in project management, project management versus general management, agile project management, the three goals of a project, life cycle of projects, project selection methods, project portfolio process, case study – friendly assisted living facility. **(9)**

ROLE OF PROJECT MANAGER AND ORGANISATION: Project managers roles and responsibilities, selection of a project manager, project management as a profession, fitting projects into the parent organization, the project team and agile team roles, case study – the company with traditional functional organizational structure setting up teams for the new initiatives. **(9)**

PROJECT ACTIVITIES: The planning process, work-breakdown structure and other aids, risk management, methods of budgeting, cost estimation, scheduling the project with PERT and CPM networks, allocating resources, resource loading and leveling, Goldratt's Critical Chain, application – using Project Libre for project management, case study – success of Chandrayan-3. **(9)**

INTRODUCTION TO FINANCE MANAGEMENT: Overview - finance and related disciplines, scope and objectives of financial management, time value of money, valuation of securities, and risk and return and calculations with spreadsheet, analysis using cash flow statement and financial statements. **(9)**

PERSONAL FINANCE: Compounding, debt, equity and financial markets and investments- debt and bonds. Equity, mutual funds, hedge funds, real estate, and commodities, Personal financial plan to enhance wealth and job marketability, components of a financial plan, tools for planning – financial statements, applying time value concept of money and tax planning. **(9)**

Total L: 45 periods

TEXTBOOKS
1. Jack R. Meredith and Scott M. Shafer, '*Project Management in Practice*'. Wiley, 2021.
2. Khan M. Y. and Jain P. K., '*Basic Financial Management*'. Tata McGraw Hill, 2012.
3. Michael Fisher, *'Saving and Investing*'. Author House, 2005.
4. Jeff Madura, '*Personal Finance*'. Pearson, 2020.

REFERENCES
1. National Finance Olympiad, '*Personal Finance Handbook'*. Pockvue Solutions, 2024
2. Glen Arnold, '*Investing'*. Financial Times Guides, 2020
3. Rachel Siegel and Carol Yacht, '*Personal Finance'*. Open Textbook Library, Saylor Foundation, 2009
4. Google, '*Google Project Management: Professional Certificate'*. Google Project Management: Professional Certificate, Coursera.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts, principles, and practices of project and financial management.	**K2**
CO2	Apply project management tools, scheduling techniques, and financial planning methods to practical problems.	**K3**
CO3	Analyze project performance, risks, resource allocation, and financial decisions to identify appropriate solutions.	**K4**
CO4	Collaborate effectively as a team to plan, execute, and present project solutions using appropriate project management practices.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME301 MECHANICS OF MATERIALS

3 0 0 3

CONCEPTS OF STRESS AND STRAIN: Stresses and strains, types; Axial and shear stresses and strains: Elastic limit, Hooke's law, lateral strain, Poisson's ratio, volumetric strain, elastic constants, factor of safety; Stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature; Strain energy due to axial force: Stresses due to gradual load, sudden load and impact loads. **(9)**

SHEAR FORCE AND BENDING MOMENT: Relationship between load, shear force and bending moment; Shear force and bending moment diagrams: Cantilever, simply supported and overhanging beams under concentrated load, uniformly distributed load, uniformly varying load, concentrated moments, maximum bending moment and point of contra flexure. **(9)**

BENDING STRESS AND DEFLECTION OF DETERMINATE BEAMS: Theory of simple bending: Assumptions and derivation, section modulus, bending stresses in symmetrical and unsymmetrical sections; Shear stresses in beams; Deflection of beams: Double integration method, Macaulay's method and moment area method; Euler's theory of columns. **(9)**

TORSION: Theory of torsion: Assumptions and derivation, polar modulus; Stresses in solid and hollow circular shafts, power transmission, design for strength and stiffness; Stresses and deflection in close coiled helical spring, springs in series and parallel. **(8)**

THIN CYLINDERS, PRINCIPAL STRESSES AND STRAINS: Stresses in thin cylindrical and spherical shells subjected to internal pressure; State of stress at a point: Normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method. **(10)**

Total L: 45 periods

TEXT BOOKS:

1. James M Gere, '*Mechanics of Materials'.* Cengage Learning, Inc, 7th edition,2008.
2. Beer, Johnston and Dewolf, '*Mechanics of Materials'.* Tata McGraw-Hill Education, 7th edition,2012.

REFERENCES:

1. S S Rattan, '*Strength of Materials'*. McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2017.
2. Don H Morris, et al., '*Mechanics of Materials'*. John Wiley and Sons Inc., 6th edition,2007.
3. Russell C Hibbler, *'Mechanics of Materials'*. Pearson, 10th edition,2016.
4. Popov E P, '*Engineering Mechanics of Solids'*. Prentice-Hall, 2nd edition,1999.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Understand the fundamental concepts of deformable body mechanics, including stress, strain, and the fundamentals of elasticity.	**K2**
CO2	Construct Mohr's circle, stress–strain distributions, shear force, and bending moment diagrams.	**K3**
CO3	Analyze structural members under various loading conditions.	**K4**
CO4	Model and simulate structural members using appropriate tools.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME302 KINEMATICS OF MACHINERY

3 1 0 4

BASICS AND SYNTHESIS OF MECHANISMS: Terminology-rigid link, kinematic pairs, kinematic chain, mechanism, degree of freedom; Kinematic inversions-four bar chain, single slider and double slider chains; Indices of merit; Synthesis: Type, number and dimensional synthesis, function generation-two, three position synthesis of slider crank and four bar mechanisms using graphical method, analytical synthesis-Freudenstein's equation, precision positions, structural error, Chebyshev's spacing, defects in mechanisms. **(9+3)**

KINEMATIC ANALYSIS: Displacement, velocity and acceleration analysis of simple mechanisms-graphical method, instantaneous centre method; Kinematic analysis of four bars linkages-loop closure equation; Computer aided kinematic analysis of mechanisms. **(9+3)**

GEARS AND GEAR TRAINS: Fundamentals of gears, gear nomenclature, law of gearing, tooth forms, contact ratio, interference and undercutting; Gear trains-velocity ratio of simple, compound and epicyclic gear trains, holding torque. **(9+3)**

KINEMATICS OF CAM: Cam nomenclature, classifications, follower displacement and derivatives-uniform velocity, simple harmonic and cycloidal motions, and, uniform acceleration and retardation motion; Layout of cam profiles for different types of followers-knife edged, roller, flat faced followers; Pressure angle and jump speed. **(9+3)**

GYROSCOPIC COUPLE AND SPATIAL MECHANISMS: Gyroscopic couple and its effect on aircraft, ship, two and four wheeled automobiles; Spatial mechanisms – introduction, series and parallel manipulator, mobility, topological arrangements, DH parameters. **(9+3)**

Total: L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. John J. Uicker Jr., Gordon R. Pennock, Joseph E. Shigley, '*Theory of Machines and Mechanisms'*. Oxford University Press, New Delhi, 5^{th} edition, 2017.
2. Rattan S S, '*Theory of Machines'*. Tata McGraw -Hill Publishers, New Delhi, 4^{th} edition, 2017.

REFERENCES:

1. Robert L. Norton, '*Design of Machinery'*. McGraw Hill Higher Education, 6^{th} edition, 2020.
2. David H Myszka, '*Machines and Mechanisms'.* Pearson, 4^{th} edition, 2015.
3. Kenneth J. Waldron, et al., '*Kinematics, Dynamics, and Design of Machinery'.* Wiley, 3^{rd} edition 2016.
4. Kevin Russell, Qiong Shen, et al., '*Kinematics and Dynamics of Mechanical Systems'*. CRC Press, 2^{nd} edition, 2019.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the structure, motion characteristics, and functional behaviour of mechanical systems.	**K2**
CO2	Apply analytical and graphical techniques to evaluate motion parameters in mechanical linkages.	**K3**
CO3	Analyse the interaction and performance of mechanical components involved in motion transmission.	**K4**
CO4	Evaluate dynamic responses of mechanical systems and recommend solutions for improved vibration performance.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1													
CO2	3											3	
CO3		3										3	
CO4			2		1	1						3	
	3	**3**	**2**		**1**	**11**						**3**	

1-low, 2-medium, 3-high

25ME303 ENGINEERING THERMODYNAMICS

3 1 0 4

FIRST LAW OF THERMODYNAMICS: system, properties, zeroth law of thermodynamics and application, thermodynamic state and equilibrium, process and cycle, work, heat and other forms of energy; First law of thermodynamics, application to open and closed systems, general energy equation and applications. **(9 + 3)**

PROPERTIES OF PURE SUBSTANCES: Ideal gas properties, equations of state, properties of mixtures, compressibility, pure substances, P-V-T surfaces, phase change processes, vapor pressure, properties of steam, use of property tables, T-S diagrams, Mollier chart, Rankine cycle. **(9 + 3)**

SECOND LAW OF THERMODYNAMICS: Kelvin-Planck and Clausius statements, heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem, thermodynamic temperature scale; Third law of thermodynamics, types of irreversibility; first and second law efficiencies. **(9+3)**

ENTROPY: Clausius theorem, property of entropy, Clausius inequality, entropy and its applications, microscopic interpretation of entropy, maximum work obtainable from finite heat reservoirs, entropy generation in open and closed systems, isentropic work in a steady flow open system. **(9 + 3)**

AVAILABILITY AND IRREVERSIBILITY: Availability, available energy referred to a cycle, maximum work in a reversible process, reversible work-open and closed systems; Availability and irreversibility; Thermodynamic relations, Maxwell's equations, Joule Kelvin effect, Clausius-Clapeyron equation, conditions of thermodynamic equilibrium and stability. **(9 + 3)**

Total: L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Sonntag R E, Borgnakke C, Van Wylen G.J , '*Fundamentals of Engineering Thermodynamics'.* 9th Edition, John Wiley & Sons, USA, 2017.
2. Nag P.K. '*Engineering Thermodynamics'*. 6th Edition, Tata McGraw Hill, India, 2017.

REFERENCES:

1. Yunus A Cengel, Boles M A, '*Thermodynamics: An Engineering Approach'*. 8th Edition, Tata McGraw Hill, USA, 2017.
2. Michael Moran J, Howard Shapiro N, Daisie Boettner D, Margaret Bailey D, '*Fundamentals of Engineering Thermodynamics'.* 8th Edition, John Wiley & Sons, USA, 2014.
3. Onkar Singh, '*Engineering Thermodynamics*'. 1stEdition, New Age International, India, 2007.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental laws of thermodynamics and its interrelation in real life activities/ simple systems.	**K2**
CO2	Apply the thermodynamics concepts to open and closed systems for evaluating the system performance	**K3**
CO3	Investigate the effect of design parameter modifications on the performance of simple thermodynamic systems.	**K4**
CO4	Present orally as individual and team the latest research developments in the field of thermodynamics	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME311 METALLURGY AND MECHANICS OF MATERIALS LABORATORY

0 0 4 2

METALLURGY LABORATORY:

1. Study of metallurgical microscope and practice of metallographic sample preparation.
2. Microstructural analysis of steels using optical microscope.
3. Microstructure analysis of cast irons using optical microscope.
4. Determination of grain size and phase fraction using an appropriate software.
5. Heat treatments of high carbon steels: Annealing, Normalizing and Hardening

MECHANICS OF MATERIALS LABORATORY:

1. Tension test on metals: Stress-strain characteristics
2. Hardness test on metals: Brinell, Vicker and Rockwell hardness tests
3. Impact test on metals: Charpy and izod impact test
4. Torsion test on shafts: Torque and angle of twist characteristics
5. Compression tests on helical springs: Load deformation characteristics and stiffness
6. Deflection test on beams.

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, '*Metallurgy and Mechanics of Materials Laboratory*'. PSG iTech, 2025.
2. ASTM E8/E8M – Standard Test Methods for Tension Testing of Metallic Materials.
3. ASTM E23 – Standard Test Methods for Notched Bar Impact Testing of Metallic Materials (Charpy).
4. ASTM E10 – Standard Test Method for Brinell Hardness of Metallic Materials.
5. ASTM E18 – Standard Test Methods for Rockwell Hardness of Metallic Materials.
6. ASTM E384 – Standard Test Method for Microindentation Hardness of Materials (Vickers).

COURSE OUTCOMES:

At the end of the course, students will be able to		Bloom's Level
CO1	Prepare metallographic specimens and operate metallurgical microscopes for microstructural evaluation of metallic materials.	**K3**
CO2	Analyze microstructures to determine grain size and phase fractions in steels, cast irons, and non-ferrous alloys using appropriate software tools.	**K4**
CO3	Perform standard mechanical tests including tensile, hardness, impact, torsion, and deflection tests on engineering materials as per relevant standards.	**K3**
CO4	Analyze experimental results to assess mechanical behaviour of materials under different loading conditions.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME312 MANUFACTURING PROCESSES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Taper Turning and Eccentric Turning on circular parts using lathe machine.
2. Knurling, external and internal thread cutting on circular parts using lathe machine.
3. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
4. Perform Drilling and Reaming using vertical drilling machine.
5. Perform metal spinning operation using lathe.
6. Milling contours on plates using vertical milling machine.
7. Manufacture spur and helical gear using horizonal milling machine.
8. Generating gears using gear hobbing machine.
9. Generating gears using gear shaping machine.
10. Grinding components using cylindrical, centreless & surface grinding machine.
11. Cutting force calculation using dynamometer in milling machine.
12. Cutting force calculation using dynamometer in lathe machine.
13. Prepare part program (canned cycle) and perform machining using CNC Lathe.
14. Prepare part program (canned cycle) and perform machining using CNC Milling M/c

Total P: 60 periods

REFERENCES:

Department of Mechanical Engineering, '*Manufacturing Processes Laboratory'*. PSG iTech, 2025.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Understand various manufacturing techniques and produce components according to requirements.	**K2**
CO2	Apply the concepts of manufacturing to perform experiments and calculate machining parameters.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3										1	3	
	3										**1**	**3**	

1-low, 2-medium, 3-high

25EEC02 FOUNDATIONS OF PROBLEM SOLVING

0 0 2 1

PROBLEM SOLVING:

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

Total P: 30 Periods

REFERENCES:

1. R. S. Aggarwal, '*Quantitative Aptitude for Competitive Examination'*. S Chand Publishing, New Delhi, 2017.

SEMESTER IV

25MA405 PROBABILITY AND STATISTICS

2 1 0 3

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axiomatic approach to probability, Baye's theorem, discrete random variables, probability mass functions, cumulative distribution functions, mean and variance, binomial, Poisson and geometric distributions. **(6+3)**

CONTINUOUS RANDOM VARIABLES: Continuous random variables, probability density functions, cumulative distribution functions, mean and variance, uniform, exponential, and normal distributions. **(6+3)**

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation. **(6+3)**

STATISTICAL INFERENCE: Point estimation - interval estimation – hypotheses concerning means – large, small samples and matched pairs – hypotheses concerning proportions, chi square test for goodness of fit. **(6+3)**

VARIANCE TESTS AND ANALYSIS OF VARIANCE: Hypotheses concerning variances - analysis of variance- completely randomized design, randomized block design. **(6+3)**

Total L: 30 + T: 15 = 45 periods

TEXT BOOKS:

1. Douglas C Montgomery and George C Runger, '*Applied Statistics and Probability for Engineers'*. Wiley India, New Delhi, 2018.
2. Richard A Johnson, '*Miller & Freund's Probability and Statistics for Engineers'*. Pearson education, New Delhi, 2017.

REFERENCES:

1. Ronald E. W, Raymond H. M, Sharon L. M and Keying Ye, '*Probability & Statistics for Engineers & Scientists'*.
2. Pearson Education, New Delhi, 2016
3. Robert V. H, Elliot T and Dale Z, '*Probability and Statistical Inference'*. Pearson Education, New Delhi, 2021.
4. Jay L Devore, '*Probability and Statistics for Engineering and the Sciences'*. Cengage Learning**,** Delhi 2020.
5. Sheldon M Ross, '*Introduction to Probability and Statistics for Engineers and Scientists'*. Academic press, USA, 2020.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts related to Probability and Statistics	**K2**
CO2	Apply the techniques of Probability and Statistics to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Probability and Statistics.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Linear Algebra.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME401 METAL CUTTING THEORY

3 0 0 3

THEORY OF METAL CUTTING AND CUTTING TOOL TECHNOLOGY: Introduction: Material removal processes; Metal cutting fundamentals: Theory of chip formation, types of chips, orthogonal cutting and oblique cutting; Nomenclature of single-point cutting tools; Mechanics of metal cutting: Machining forces and Merchant's Circle Diagram (MCD) – simple calculations, cutting tool materials, tool wear, tool life, cutting fluids; Overview of high-speed machining. **(10)**

CENTRE LATHE AND CNC LATHES: Centre lathe, constructional features, various operations, machining time calculation; Fundamentals of NC technology, Computer Numerical Control: CNC turning center - Constructional features, part programming techniques, applications. **(9)**

MACHINING OF PRISMATIC COMPONENTS: Shaper, milling: up milling, down milling, milling cutters, operations; Constructional features of CNC machining centers; Drilling: Column and radial drilling machines, reaming, tapping and boring; Broaching machines: Push, pull broaching processes. **(9)**

ABRASIVE PROCESSES AND GEAR MACHINING: Abrasive processes: Grinding wheel designation and selection; Types of grinding processes: cylindrical grinding, surface grinding, centreless grinding; Honing, lapping; Gear machining methods: Gear hobbing, gear shaping and gear grinding. **(8)**

NONTRADITIONAL MACHINING: Mechanical energy processes: abrasive water jet machining, ultrasonic machining; Thermal Energy Processes: electric discharge machining (EDM), laser beam machining (LBM). **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Rao P N, '*Manufacturing Technology-Vol.2'*. 4th Edition, McGraw-Hill Education, USA, 2018.
2. Milton C Shaw, '*Metal Cutting Principles'*. 2nd Edition, Oxford University Press, USA, 2012.

REFERENCES:

1. Serope Kalpakjian and Stephen Schmid, '*Manufacturing, Engineering and Technology'*. 7th Edition, Pearson Education, USA, 2018.
2. Mikell P Groover, '*Principles of Modern Manufacturing*'. 5th Edition, Wiley & Sons Pvt. Ltd, India, 2013.
3. Radhakrishanan P, '*Computer Numerical Control Machining and Computer-Aided Manufacturing'*. 1st Edition, New Age International Publishers, India, 2018.
4. Peter Scallan, '*Process Planning'*. The Design/Manufacture Interface, 1st Edition, Elsevier, 2003

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the principles of machining in manufacturing	**K2**
CO2	Apply the concepts of manufacturing in determining machining parameters for machining processes	**K3**
CO3	Analyse machining processes by simulating to produce mechanical components which meet varied service conditions	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											3	
CO3		1			1							3	
	3	**1**			**1**							**3**	

1-low, 2-medium, 3-high

25ME402 DYNAMICS OF MACHINERY

3 1 0 4

STATIC FORCE ANALYSIS OF MECHANISM: Free body diagram: Conditions of equilibrium, two, three and four force members, effect of friction in rolling and sliding pair. **(9+3)**

DYNAMIC FORCE ANALYSIS OF MECHANISM: Inertia force and D'Alembert's principle, dynamic force analysis of mechanisms; Turning moment diagram: Fluctuation of energy and speed, mass of flywheel required for IC engines and mechanical presses. **(9+3)**

BALANCING: Balancing of rotating masses - masses in single plane and several planes; Balancing of reciprocating masses - primary and secondary forces and couples, balancing of in-line multi-cylinder engines, balancing of V and radial engines- direct and reverse crank technique; Balancing machines - field balancing. **(9+3)**

FREE VIBRATION: Basic features of vibratory systems: Elements, single degree of freedom system; Undamped free vibration - equation of motion, natural frequency; Damped free vibration - damping ratio, logarithmic decrement; Transverse vibration - Dunkerley's method, critical speed of shaft. **(9+3)**

FREE TORSIONAL VIBRATION AND FORCED VIBRATION: Torsional vibration: Two and three rotor systems, geared systems; Response to periodic force: Forcing by unbalance, support motion, force and amplitude transmissibility, vibration isolation; Vibration measurement and analysis: General considerations, vibration measurement, vibration pickups, signature analysis, preparation of Campbell diagram for rotating equipment, ISO severity code. **(9+3)**

Total L: 45 +T: 15 = 60 periods

TEXT BOOKS:

1. Shigley J E,Uicker J J, '*Theory of Machines and Mechanisms'*. Oxford University Press, 5th edition, 2016.
2. Rattan S S, '*Theory of Machines'*. McGraw Hill Education, 5th edition, 2019.

REFERENCES:

1. Singiresu S. Rao, '*Mechanical Vibrations'*. Pearson India, 6th edition, 2018.
2. Ghosh,Mallick, '*Theory of Mechanisms and Machines'*. Affiliated East-West Pvt. Ltd., 3rd edition, 2008.
3. Graham Kelly.S, '*Fundamentals of Mechanical Vibrations'*. McGraw-Hill Corporation, 2ndedition, 2000.
4. William L. Cleghorn, Nikolai Dechev, '*Mechanics of Machines'*. Oxford University Press, 2nd edition, 2014.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Understand the fundamental concepts of static and dynamic force analysis, balancing, and vibrations in mechanical systems.	**K2**
CO2	Apply principles of force analysis and vibration theory to solve engineering problems related to mechanisms, flywheels, and rotors.	**K3**
CO3	Analyse mechanical systems for balancing, free and forced vibration responses, and evaluate their dynamic behaviour.	**K4**
CO4	Use modern engineering tools to analyse mechanical systems, and interpret their data.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME403 IC ENGINES AND THERMAL SYSTEMS

3 0 0 3

AIR STANDARD CYCLES AND IC ENGINES: Air standard assumptions, Carnot, Otto, Diesel and Dual cycles, comparison of Otto, Diesel, and Dual cycles; Classification and comparison of engines, working principle of Wankel engine, four stroke and two stroke engines, petrol and diesel engines with P-V and T-S diagrams, valve and port timing diagrams. **(9)**

ENGINE AUXILIARY SYSTEMS: Working principles and types of carburetors, ignition systems, fuel pumps and injectors, MPFI, CRDI, lubricating and cooling systems; Super and turbo charging. **(9)**

PERFORMANCE OF IC ENGINES: Engine testing: Constant speed and variable speed tests, indicated power, brake power, frictional power - Willan 's line and Morse test, volumetric efficiency, heat balance test. **(9)**

BOILERS: Requirements of boiler; Types: Water tube, fire tube, fluidized bed boilers; Boiler draught; Boiler performance: Direct and indirect heat balance. **(9)**

COMPRESSORS: Classification, working principle of reciprocating compressors, equations for shaft work and efficiencies, effect of clearance on volumetric efficiency, multi-stage compression, inter-cooler and optimum intermediate pressure in a two-stage compressor; Rotary compressor: Roots-type blower, sliding vane and screw compressors - working principle and performance. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. John B. Heywood, '*Internal Combustion Engine Fundamentals'*. 2nd Edition, McGraw-Hill Education, 2018.
2. Ganesan V, '*Internal Combustion Engine'*. 4th Edition, McGraw Hill Publishers, India, 2012.

REFERENCES:

1. Allan T Kirkpatrick, Colin R Ferguson, *'Internal Combustion Engines: Applied Thermo Sciences'*. 3rd Edition, Wiley, India, 2015.
2. Kothandaraman C P, Domkundwar S, '*Thermodynamics and Thermal Engineering'*. 3rd Edition, Dhanpat Rai and Sons, India, 2013.
3. Rudramoorthy R, '*Thermal Engineering'*. 3rd Edition, Tata McGraw Hill Publishers Co. Ltd, India, 2017.
4. Willard W Pulkrabek, '*Engineering Fundamentals of the Internal Combustion Engine'*. 2nd Edition, Pearson Education, USA, 2003.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the working principles, classifications, and key characteristics of thermal systems.	**K2**
CO2	Apply thermodynamic and mechanical principles to calculate the performance of IC engines, boilers, and compressors.	**K3**
CO3	Analyse the performance and application suitability of various thermal systems.	**K4**
CO4	Work as a team to gather vehicle data, calculate engine performance, and compare costs of bikes and cars with similar engine sizes, and then present their findings	**K1**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME411 THERMAL ENGINEERING LABORATORY

0 0 4 2

LIST OF EXPERIMENTS

1. Valve Timing and Port Timing diagrams.
2. Performance Test on four – stroke Diesel Engine with hydraulic loading.
3. Heat Balance Test on 4 – stroke Diesel Engine.
4. Morse Test on Multi-Cylinder Petrol Engine.
5. Retardation Test on a Diesel Engine.
6. Actual p-v diagrams and determination of p-θ diagram and heat release characteristics of an IC engine.
7. Determination of Flash Point and Fire Point of various fuels / lubricants
8. Performance test on a two stage Reciprocating Air compressor.
9. Determination of COP of a Refrigeration system
10. Performance and Energy Balance Test on a Steam Generator.
11. Performance and Energy Balance Test on Steam Turbine.

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, '*Thermal Engineering Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.
2. Ganesan V, '*Internal Combustion Engines'*. Tata McGraw Hill, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the principles, construction, and operation of engines and thermal systems.	**K2**
CO2	Conduct experiments and apply principles to evaluate the performance of thermal and fluid machines.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											3	
	3											**3**	

1-low, 2-medium, 3-high

25ME412 PYTHON PROGRAMMING LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Simulate Cantilever Beam Reactions Using Flowcharts and Pseudocode
2. Thermodynamic Property Calculator with Data Types and Type Checking
3. Factor of Safety Estimation with Conditions and I/O
4. Gear Ratio and Torque Calculation Using Operators
5. Piston Kinematics: Displacement vs Crank Angle Simulation with Loops
6. Manufacturing Part Code Validator Using String Methods
7. Temperature Logging in Heat Treatment Process
8. CNC Machine Coordinate Data Processor Using Tuples
9. Material Properties Filter Using Sets and Frozensets
10. Component Metadata Manager Using Dictionaries
11. Truss Load Distribution Using Recursive Functions
12. Heat Transfer Calculator as a Custom Python Package
13. Stress-Strain Data Plotter Using NumPy and Matplotlib
14. File-Based Logger and Error Handler for Vibration Analysis

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, '*Python Programming Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Understand fundamental programming constructs and explain their relevance in mechanical engineering.	**K2**
CO2	Apply Python programming concepts to solve mechanical engineering problems.	**K3**
CO3	Analyse engineering data using Python libraries like NumPy and matplotlib.	**K4**
CO4	Create efficient, reusable Python programs for real-world mechanical engineering problems.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25EEC03 PROBLEM SOLVING

0 0 2 1

PROBLEM SOLVING:

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

Total P: 30 periods

REFERENCES:

1. R. S. Aggarwal, '*Quantitative Aptitude for Competitive Examination'*. S Chand Publishing, New Delhi, 2017.

SEMESTER V
25ME501 DESIGN OF MACHINE ELEMENTS

3 1 0 4

STATIC AND VARIABLE LOADING: Machine design: Definition, design process, machine element design, standards and codes in design, review of types of stress including buckling stress, contact stress and impact stress; Design for static loading: Modes of failure, factor of safety, eccentric loading, theories of failure, problems; Design for variable loading: Stress concentration, fatigue failure, endurance limit, design equations - Soderberg, Goodman and Gerber equations, combined stresses; Overview of fracture mechanics. **(10+3)**

SHAFTS, KEYS AND COUPLINGS: Design of shafts: Forces on shafts due to gears, belts and chains, design for strength and rigidity – lateral stiffness, torsional rigidity, critical speed; Design of keys; Overview of couplings and coupling design. **(8+3)**

SPRINGS: Helical springs: Stresses and deflection in round wire helical springs accounting for variable loading, concentric springs; Design of leaf springs-stress and deflection equation, nipping; Overview of the design of helical and leaf springs in automobile suspension system. **(9+3)**

RIVETED, BOLTED AND WELDED JOINTS: Riveted joints: Modes of failure, strength and efficiency, design of riveted joints – axial loading and eccentric loading, Lozenge joints; Bolted joints: Design of eccentrically loaded bolted joints; Overview of elastic analysis; Welded joints: Types, design of welded joints for different types of loading, unsymmetrical sections. **(9+3)**

BEARINGS: Rolling contact bearings: Types, method of assembly, load ratings, bearing failure, preloading, selection of deep groove ball bearings and roller bearings; Bearing mounting for machine tool spindles and axles of automobiles; Overview of hybrid bearings; Sliding contact bearings: Theory of lubrication, hydro dynamic bearings, Somerfield number, design of hydro dynamic bearings. **(9+3)**

Total L: 45 + T: 15 =60 periods

TEXT BOOKS:

1. Budynas R. G., Nisbett J. K., *'Shigley's Mechanical Engineering Design'*. McGraw Hill Publishers Co. Ltd, 11th edition, 2020.
2. Bandari V. B., *'Design of Machine Elements'*. Tata McGraw Hill Publishers Co. Ltd, 5th edition, 2020.

REFERENCES:

1. Norton R. L., *'Machine Design – An Integrated Approach'*. Pearson Publishers, 5th edition, 2014.
2. Jacobson B. O., Hamrock B.J., Schmid S.R., *'Fundamentals of Machine Elements'*. McGraw Hill, 3rd edition, 2013.
3. Faculty of Mechanical Engineering, *'PSG Design Data Book'*. PSG College of Technology, Kalaikathir Achagam, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to		**Bloom's Level**
CO1	Comprehend fundamental concepts, standards and codes in machine design.	**K2**
CO2	Apply the principles of static and dynamic loading to design basic machine elements under various loading conditions.	**K3**
CO3	Analyse mechanical systems for stress distribution, failure modes under complex loading scenarios.	**K4**
CO4	Design and develop machine components considering strength and safety under functional constraints	**K5**
CO5	Simulate and evaluate the mechanical behaviour of designed components and validate performance under real-life loading conditions.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME502 COOLING AND PROPULSION TECHNOLOGIES

3 1 0 4

REFRIGERATION: Reverse Carnot and Brayton cycles, air refrigeration, vapour compression refrigeration, use of T-s and P-h diagrams, sub-cooling, superheating, performance calculations and applications, working principle of vapour absorption refrigeration, adsorption cooling, evaporative cooling and steam jet refrigeration, refrigerants and properties. **(9 +3)**

AIR CONDITIONING: Atmospheric air, properties, psychrometry chart, psychrometric processes, air- conditioning processes, requirements for comfort and industrial air-conditioning, summer and winter air conditioning systems, by-pass factor, apparatus dew point, sensible heat factor, cooling load calculation; Working principle of window type, split, package and centralized AC systems. **(9 +3)**

COMPRESSIBLE FLOW: Thermodynamic concepts, conservation equations, stagnation state properties, pressure waves in gases, effect of compressibility, differential equations for one dimensional flow, isentropic flow with area variations and calculation of parameter variations; Fanno and Rayleigh flows, analysis of parameter variations. **(9 +3)**

NORMAL AND OBLIQUE SHOCKS: Development of normal shock wave, Prandtl- Meyer relation, property calculations; Concept of oblique shock wave, Shocks in convergent and divergent nozzles. **(9+3)**

JET PROPULSION: Turbo propeller and turbo jet: Thrust, fuel power, thrust power, propulsive power, efficiencies; Rocket propulsion, solid and liquid propellants, ram and scram jets. **(9 +3)**

Total L: 45 + T: 15 =60 periods

TEXT BOOKS:

1. Sarao A. S., *'Thermal Engineering'*. Satyaprakashan Publishers, 2016.
2. Munson B. R., Young D. F., Okiishi T. H., Huebsch W. W., *'Fundamentals of Fluid Mechanics'*. John Wiley & Sons, 2013.

REFERENCES:

1. Arora C. P., *'Refrigeration and Air Conditioning'*. Tata McGraw Hill, 2017.
2. Rudramoorthy R., *'Thermal Engineering'*. Tata McGraw Hill Publishers Co. Ltd, 2010.
3. Carscallen W. E., Oosthuizen P. H., *'Compressible Fluid Flow'*. CRC Press, 2014.
4. Rajput R. K., *'Thermal Engineering'*. Laxmi Publications (P) Limited, 2018.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Explain thermodynamic cycles and principles in refrigeration, air conditioning, psychrometry and compressible flow	**K2**
CO2	Apply thermodynamic and fluid flow principles to assess the performance of refrigeration systems, air conditioning units, and compressible flow devices	**K3**
CO3	Analyze compressible flow in ducts and nozzles to determine parameter changes due to shocks, heat, and friction	**K4**
CO4	Use computational tools to analyze compressible flow and shock effects in ducts and nozzles.	**--**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME503 OPERATIONS RESEARCH

3 0 0 3

CONCEPTS OF OPERATIONS RESEARCH AND LINEAR PROGRAMMING TECHNIQUES: Operations research and decision making, types of mathematical models and their construction; Formulation of linear programming problem, applications and limitations: Graphical method, Simplex method, Big–M method, Two–phase method; Dual problems. **(10)**

TRANSPORTATION PROBLEMS: Least cost method, North West corner rule, Vogel‟s approximation method, Modified distribution method optimization models, degeneracy in transportation model, unbalanced and maximization models. **(8)**

ASSIGNMENT MODELS, SCHEDULING AND INVENTORY CONTROL: Assignment models: Hungarian algorithm, unbalanced assignment problems, maximization case in assignment problems, traveling salesman problem; Sequencing and scheduling problems: m×2, m×3, m×n and 2×n problems; Inventory control: Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model. **(9)**

PROJECT MANAGEMENT BY CPM AND PERT: Constructing project network, network computations in CPM and PERT, cost crashing, resource leveling. **(8)**

GAME THEORY, QUEUING MODELS AND REPLACEMENT MODELS: Game theory: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game, n person zero sum game, graphical method, and linear programming in game theory; Queuing models: The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns; Replacement models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy. **(10)**

Total L: 45 periods

TEXT BOOKS:

1. Hillier F. S., Lieberman G. J., Nag B., Basu P., *'Introduction to Operations Research'*. McGraw-Hill, 11th edition, 2021.

REFERENCES:

1. Taha H. A., *'Operations Research: An Introduction'*. Pearson Education Pvt. Ltd., 10th edition, 2019.
2. Swarup K., Gupta P. K., Manmohan, *'Operations Research'*. Sultan Chand and Sons, 2014.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamental principles and applications of operations research in engineering problems.	**K2**
CO2	Apply appropriate operations research techniques to formulate and solve optimization problems.	**K3**
CO3	Analyze operational systems to identify the structure and effectiveness of OR models.	**K4**
CO4	Create integrated models using multiple OR tools to address complex and dynamic decision-making scenarios.	**--**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25ME504 TURBO MACHINERY

3 1 0 4

TURBINES: Energy transfer between fluid and rotor, Euler's energy transfer equation, components of energy transfer, degree of reaction, effect of blade angle on degree of reaction and energy transfer; Types of turbines: Pelton, Francis, Kaplan and Propeller -principles of operation, velocity triangles, turbine design, regulation and performance; Cavitation, types of draft tubes, specific speed and its significance. **(9 + 3)**

PUMPS: Types of pumps, differences between positive displacement pump and roto-dynamic pump, performance calculation, determination of main dimensions, minimum starting speed, cavitation in pumps, NPSH (net positive suction head), efficiency and slip, selection of pumps. **(9 +3)**

TURBO-COMPRESSORS: Classification, radial flow type, work done by the impeller, isentropic efficiency, pressure and flow coefficients, characteristic curves, surging and choking; Axial flow type, air foil analysis, stalling, calculation of delivery pressure, isentropic and polytropic efficiencies, number of stages, selection of fans and compressors. **(9 +3)**

STEAM NOZZLES AND TURBINES: Types of steam nozzle, maximum mass flow rate and velocity of steam at exit, critical pressure ratio, meta stable flow in nozzle; Types of steam turbines, compounding of steam turbines, degree of reaction, estimation of efficiency. **(9 +3)**

GAS TURBINES: Brayton cycle, open cycle, closed cycle, methods of improving the efficiency of a simple cycle, inter-cooling, reheating and regeneration, multistage compression; Effect of operating variables on thermal efficiency, work ratio; Open cycle gas turbine and calculations. **(9 +3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Dixon S. L., *'Fluid Mechanics and Thermodynamics of Turbomachinery'*. Butterworth-Heinemann, 2010.
2. Yahya S. M., *'Turbines, Compressors and Fans'*. Tata McGraw-Hill Education, 2017.

REFERENCES:

1. Valan Arasu A., *'Turbo Machines'*. Vikas Publishing House, 2013.
2. Korpela S. A., *'Principles of Turbomachinery'*. John Wiley & Sons, 2011.
3. Venkanna B. K., *'Fundamentals of Turbomachinery'*. PHI Learning, 2009.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of operation and energy transfer in turbomachines.	**K2**
CO2	Calculate the performance of turbines, pumps, and compressors under different operating conditions.	**K3**
CO3	Analyze and compare the performance of turbines, pumps, and compressors based on key performance characteristics.	**K4**
CO4	Use a model drafting tool to perform velocity triangle calculations graphically and to find performance metrics.	**--**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25ME505 METROLOGY AND INSTRUMENTATION

3 0 0 3

BASICS OF MEASUREMENT SYSTEM AND DEVICES: Definition of metrology, accuracy, precision and sensitivity, Abbe‘s principle; Three stages of generalized measurement system, mechanical loading, factors considered in selection of instruments, commonly used terms, uncertainty, traceability, error analysis and classification, sources of error; Principle of interferometry, Michelson interferometer, NPL flatness interferometer, laser interferometer. **(8)**

CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS: Calibration of measuring instruments, principles of calibration, calibration of vernier caliper, micrometer, feeler gauges, dial indicator, surface plate, slip gauges; Care of gauge blocks-general rules in measurement and preservation methods; ISO 9000 quality standards and ISO 14000 environmental management standards. **(9)**

COMPARATORS AND GEOMETRICAL MEASUREMENT: Comparators - mechanical, electrical, optical and pneumatic; Angular measurement: Bevel protractors, sine bar, tool maker’s microscope; Roundness measurement, limit gauge, design of plug gauge, Taylor‘s principle, three basic types of limit gauges; Components of surface texture: Roughness, lay, waviness, Ra and Rz, surface roughness measuring instrument; Computer controlled CMM. **(9)**

MEASUREMENT OF SCREW THREAD AND SPUR GEARTERMINOLOGY: ISO metric thread, measurement of major, minor and effective diameters; Gear terminology, spur gear measurement, checking of composite errors, base pitch measurement. **(9)**

INDUSTRIAL MEASUREMENTS : Position sensors: Potentiometer, LVDT; Proximity sensors- types; Vibration sensors - seismic instrument; Torque sensors; Strain gauges; Temperature sensors: Resistance temperature detector, thermistor, thermocouples, J&K type and thermopiles, optical pyrometer; Pressure sensor: Elastic transducers, pressure cell, bulk modulus pressure gauge; Low pressure measurement; Thermal conductivity gauge; Flow measurement: Turbine type meter, hotwire anemometer, magnetic flowmeter. **(10)**

Total L: 45 periods

TEXT BOOKS:

1. Raghavendra N. V., Krishnamurthy L., *'Engineering Metrology and Measurements'*. Oxford University Press, 2021.
2. Beckwith T. G., Roy D., Marangoni, Lienhard J. H., *'Mechanical Measurements'*. Pearson, 2019.

REFERENCES:

1. Morris A. S., Langari R., *'Measurement and Instrumentation: Theory and Application'*. Elsevier, 2013.
2. Jain R. K., *'Engineering Metrology'*. Khanna Publishers, 2015.
3. Dotson C. L., *'Fundamentals of Dimensional Metrology'*. Cengage Learning, 2019.
4. Mukherjee B. Y., *'Quality Management System ISO 9000 & ISO 14000'*. Manas Publications, 2003.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom’s Level**
CO1	Explain the concepts of measurement systems, instrumentation, and metrological parameters.	**K2**
CO2	Apply appropriate methods and instruments for calibration, dimensional and geometrical measurements, and assess compliance with ISO standards.	**K3**
CO3	Analyze industrial measurement systems and techniques for assessing physical properties.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25ME511 FLUID MECHANICS AND MACHINERY LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Determination of the Coefficient of discharge of given Orifice meter and compare the accuracy with rotameter
2. Determination of the Coefficient of discharge of given Venturi meter and compare with other flow measuring instruments
3. Determination of friction factor for a given set of pipes.
4. Measurement of force on given vanes due to impact of jet
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, *'Fluid Mechanics and Machinery Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.
2. Kumar D. S., *'Fluid Mechanics and Fluid Power Engineering'*. Kataria S. K. and Sons, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the working principles of flow meters, pumps, turbines, and the impact of jet on surfaces.	**K2**
CO2	Perform experiments to determine discharge coefficients, friction factors, pump and turbine performance, and jet impact forces.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	1
CO2	3											2	1
	3											**2**	**1**

1-low, 2-medium, 3-high

Fourth ACM

25ME512 MACHINE DRAWING

0 0 4 2

INTRODUCTION AND CONVENTIONS : Introduction to machine drawing; Types of sections, sectional views of engineering components; Code of practice for engineering drawing; Conventional representation of features: Drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways; Conventional representation of standard parts: Bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges. **(15)**

ASSEMBLY CONCEPTS: Assembly requirements, bill of materials; Methods of assembly-bolts, nuts, studs, screws and pins; Methods of axial and radial retention of parts of an assembly; Assembly of parts with emphasis on assembly sequence and appropriate fits. **(10)**

FITS AND TOLERANCES: Limits, fits and tolerances; Need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances; Geometric tolerance: uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings; Surface finish symbols - methods of indicating the surface roughness; Blue print reading exercises; Preparation of production drawing. **(15)**

ASSEMBLY DRAWING PRACTICE: Drawing practice of typical sub-assemblies: Sleeve and cotter joint, flange coupling, plummer block, stuffing box, gear box, foot step bearing, screw jack **(8)**

ASSEMBLY USING SOLID MODELING Modeling and assembly using a modeling software-extracting views and sections; Drawing of assemblies: Machine vice, stop valve, drill jig, tail stock; Creation of bill of materials, calculation of mass and section properties, interference check between solids. **(6)**

CNC PROGRAMMING : CNC turning center – Introduction to part programming; development of turning programs using G and M codes for operations such as facing, turning, threading, and contouring. CNC machining center – Creation of part programs for milling operations including contour milling, drilling, and pocketing using G and M codes and canned cycles. **(6)**

Total P: 60 periods

REFERENCES:

1. BIS, *'SP:46-2003 – Engineering Drawing Practice for Schools and Colleges'*. New Delhi, 2003.
2. John K. C., *'Text Book of Machine Drawing'*. PHI Learning Pvt. Ltd, 2009.
3. Gopalakrishna K. R., *'Machine Drawing'*. Subhas Stores, 22nd edition, 2013.
4. Narayana K. L., Kannaiah P., Venkata Reddy K., *'Machine Drawing'*. New Age International Publishers, 3rd edition, 2006.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Identify and interpret engineering drawing conventions, fits, tolerances, and assembly requirements based on industrial drafting standards.	**K2**
CO2	Apply manual and CAD-based modeling techniques, including CNC programming, to create assembly drawings and part programs for manufacturing applications.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												3	2
CO2	3				3				1			3	2
	3				**3**				**1**			**3**	**2**

1-low, 2-medium, 3-high

25MEE02 /25MEE03 INTERNSHIP I /COMMUNITY PROJECT

0 0 0 1

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problems or issues.

25EEC04 APTITUDE SKILLS

0 0 2 1

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

Total P: 30 Periods

REFERENCES:

1. R.S. Aggarwal, ‘*Quantitative Aptitude for Competitive Examination*’. S Chand Publishing, New Delhi, 2017.

SEMESTER VI
25ME601 MECHANICAL SYSTEM DESIGN

3 1 0 4

IC ENGINE: Systems concept, Overview of mechanical systems that include power generation and power transmission systems; Review of design considerations for system components subjected to static and dynamic loads; Design of IC engine comprising cylinder, piston, connecting rod, crankshaft, flywheel, valves and valve springs. **(9+3)**

SPUR/HELICAL GEAR REDUCERS AND GEARBOX DESIGN: Design of spur and helical gears: Materials, modes of failure, non-metallic gears; Speed reducers: Design of single stage spur/helical gear reducers for various applications – force analysis, shaft design and bearing selection; Gear box design for automotive transmission. **(9+3)**

BEVEL/WORM GEAR REDUCERS: Overview of bevel gear design; Design of worm gears: Materials, thermal considerations; Design of bevel gear reducer and worm gear reducer for various applications – force analysis, shaft design and bearing selection; Applications like speedometer, steering gear box, etc. **(8+3)**

FRICTION DRIVES/BRAKES: Design of belt drives using basic equations, Design of flat and V- belt drives based on manufacturer's data, Design of chain drive; Overview of timing belt and silent chain; Design of automobile clutch - design of friction plate assembly, declutching linkage; Design of power screws – force analysis and design for various applications; Design of automotive braking systems. **(10+3)**

MATERIAL HANDLING SYSTEMS: Material handling systems: Design principles, power requirement, wire ropes, sheaves, point hooks, wheels and rails for trolley; Design of EOT crane – Lifting mechanism, trolley and cross-beam sub-systems involving frame, electric motor, reduction gearbox, band brake and other elements; Design of belt conveyor system – capacity of conveyor, rubber covered and fabric ply belts, pulleys, idlers, tension-take up systems. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Patil S. P., *'Mechanical System Design'*. Jaico Publishing House, 2nd edition, 2008.
2. Goel A., *'Mechanical System Design'*. Technical Publications, 1st edition, 2020.

REFERENCES:

1. Bandari V. B., *'Design of Machine Elements'*. Tata McGraw Hill Publishers Co. Ltd, 5th edition, 2020.
2. Budynas R. G., Nisbett J. K., *'Shigley's Mechanical Engineering Design'*. McGraw Hill Publishers Co. Ltd, 11th edition, 2020.
3. Norton R. L., *'Machine Design – An Integrated Approach'*. Pearson Education, 6th edition, 2020.
4. Faculty of Mechanical Engineering, PSG College of Technology, *'PSG Design Data Book'*. Kalaikathir Achagam, 2020.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Apply design principles to size and select mechanical subsystems for automotive and industrial applications, considering performance and safety.	**K3**
CO2	Analyze the interaction between multiple mechanical subsystems to develop a complete functional design based on the given design constraints.	**K4**
CO3	Assess mechanical system performance using simulation tools under defined loading and boundary conditions.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25ME602 HEAT AND MASS TRANSFER

3 1 0 4

STEADY STATE HEAT CONDUCTION: Concepts of heat and mass transfer, three-dimensional heat conduction equations in various co-ordinate systems, steady state one dimensional heat conduction equation, thermal analogy for complex system analysis, variable thermal conductivity, heat transfer with heat generation in different shapes. **(9+3)**

UNSTEADY STATE HEAT CONDUCTION: Lumped parameter systems, infinite solids, and semi- infinite solids, numerical and graphical methods. **(9+3)**

CONVECTION HEAT TRANSFER: Differential analysis of hydrodynamic and thermal boundary layers; Forced and free convection, external and internal flow, laminar and turbulent flow, convective mass transfer, non-dimensional analysis. **(9+3)**

RADIATION AND PHASE CHANGE HEAT TRANSFER: Emissive power, grey body, irradiation, radiosity, Radiation heat transfer between surfaces, shape factor, radiation shield, gas radiation; Boiling heat transfer: bubble growth, freezing and melting; Condensation: Film wise condensation and drop wise condensation. **(9+3)**

APPLICATIONS OF HEAT TRANSFER: Heat transfer enhancement techniques in various applications; Fins: Types of fins, effectiveness and efficiency of fins; Heat exchangers: Types, tube and shell arrangements, single and multi-pass types, parallel flow, counter flow, cross flow and compact heat exchangers, LMTD and effectiveness method (NTU). **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Bergman T. L., Lavine A. S., Incropera F. P., DeWitt D. P., *'Fundamentals of Heat and Mass Transfer'*. Wiley India Private Limited, 2017.
2. Cengel Y. A., *'Heat Transfer: A Practical Approach'*. Tata McGraw Hill Inc., 2017.

REFERENCES:

1. Lienhard J. H., Lienhard J. H., *'Heat Transfer Text Book'*. Phlogiston Press, 2017.
2. Kothandaraman C. P., *'Fundamentals of Heat and Mass Transfer'*. New Age International (P) Limited, 2014.
3. Nag P. K., *'Heat and Mass Transfer'*. McGraw Hill Education, 2011.
4. Shah R. K., Sekulic D. P., *'Fundamentals of Heat Exchanger Design'*. John Wiley & Sons, 2003.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the physical mechanisms of conduction, convection and radiation heat transfer and their analogy with mass transfer	**K2**
CO2	Apply the relevant heat transfer mechanism(s) along with its governing equations to a given system and study its characteristics	**K3**
CO3	Design and fabricate a system demonstrating simple heat transfer concept as a team, with budgeting and to present the design aspect orally	**--**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME603 DESIGN FOR MANUFACTURE AND ASSEMBLY

3 0 0 3

PROCESS CAPABILITY ANALYSIS AND GEOMETRIC TOLERANCES: DFM approach: DFM/DFA guidelines, DFA index; Process capability metrics: Cp, Cpk. feature tolerances, surface finish, review of relationship between attainable tolerance grades and different machining processes; Geometric tolerances: form, orientation, runout, and profile tolerances. **(9)**

TOLERANCE ANALYSIS AND SELECTIVE ASSEMBLY: Cumulative effect of tolerances: Sure fit law, normal law, and truncated normal law; Interchangeable and selective assembly: Deciding the number of groups, Model-I where group tolerances of mating parts are equal, Model-II where total and group tolerances of shaft are equal, number of shafts/holes in each group, control of axial play - secondary machining operations, laminated shims. **(9)**

DATUM SYSTEMS: Degrees of freedom, grouped datum systems, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, tongue and slot pairs, computation of translational and rotational accuracy, geometric analysis and applications; Datum features - functional and manufacturing; Component design - machining considerations, redesign for manufacture, examples. **(9)**

TRUE POSITION TOLERANCING THEORY: Comparison between co-ordinate tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, composite tolerancing, examples. **(9)**

FORM DESIGN OF CASTINGS, WELDMENTS AND TOLERANCE CHARTING: Redesign of castings based on parting line considerations, minimizing core requirements; Redesign of cast members using weldments, use of welding symbols – case studies; Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. ASME, *'Y14.5M-2018 Dimensioning and Tolerancing – Engineering Product Definition and Related Documentation Practices'*. The American Society of Mechanical Engineers, 2019.
2. Henzold G., *'Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection: A Handbook for Geometrical Product Specification Using ISO and ASME Standards'*. Butterworth-Heinemann, 2nd edition, 2006.

REFERENCES:

1. Fischer B. R., *'Mechanical Tolerance Stack Up and Analysis'*. Taylor & Francis, 2004.
2. Wade O. R., *'Tolerance Control in Design and Manufacturing'*. Industrial Press Inc., 1st edition, 2008.

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COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamental principles of designing for manufacturability and assembly, including tolerance and process considerations.	**K2**
CO2	Apply established manufacturing and assembly guidelines to solve practical engineering design challenges.	**K3**
CO3	Analyze various factors affecting manufacturing precision, design efficiency, and component integration.	**K4**
CO4	Design optimized mechanical components and systems by integrating advanced tolerancing and manufacturing design practices.	**--**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25ME611 HEAT TRANSFER LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.
3. Determination of heat transfer coefficient of air under natural convection and forced convection.
4. Heat transfer from pin-fin under natural and forced convection.
5. Determination of heat flux under pool boiling and flow boiling in various regimes.
6. Determination of heat transfer coefficient in film-wise and drop-wise condensation.
7. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Calibration of thermocouples / RTDs at standard reference temperatures.

Total P: 60 Periods

REFERENCES:

1. Department of Mechanical Engineering, *'Heat Transfer Laboratory Manual'.* PSG Institute of Technology and Applied Research, 2025.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the basics of thermophysical property measurements and the different types of sensors used for thermal and flow measurements.	**K2**
CO2	Apply the heat transfer and fluid flow fundamental concepts to conduct experiments and evaluate the thermophysical properties of materials and other characteristic properties relevant to various modes of heat transfer	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25ME612 DYNAMICS AND METROLOGY LABORATORY

0 0 4 2

DYNAMICS LABORATORY:

1. Study of Gear parameters
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom spring-mass system.
6. Torsional Vibration (Undamped) of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment on Watt Governor.
9. Experiment on Porter Governor.
10. Experiment on Proell Governor.
11. Experiment on motorized gyroscope.
12. Determination of critical speed of shafts.

METROLOGY LABORATORY:

1. Measurement of gear tooth thickness using gear tooth gear tooth vernier.
2. Measurement of screw thread and single point cutting tool parameters using optical profile projector.
3. Measurement of mean effective diameter of external parallel screw threads using floating carriage micrometer.
4. Angular measurement using sine bar and Calibration of Vernier, Micrometer and Height Gauge
5. Measurement of Surface finish in components using stylus-based instruments.
6. Checking the dimensions of the components using Comparators.

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, *'Dynamics and Metrology Laboratory Manual'.* PSG Institute of Technology and Applied Research, 2025.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Demonstrate fundamental understanding of dynamic systems and metrological principles, including vibrations, balancing, pressure distribution, measurement techniques, and surface characteristics.	**K2**
CO2	Apply standard experimental procedures to conduct dynamic tests and dimensional measurements using appropriate equipment such as dynamic balancing machines, CMMs, sine bars, and profile projectors	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	1
CO2	3					1						2	2
	3					**1**						**2**	**2**

1-low, 2-medium, 3-high

SEMESTER VII
25ME701 FINITE ELEMENT ANALYSIS

3 0 0 3

STATIC ANALYSIS USING ONE DIMENSIONAL SPAR ELEMENTS: Basic concepts of FEM, general procedure of FEM, discretization of domain, basic types of elements; Formulation of element stiffness matrices and load vectors: 1D linear spar and quadratic spar elements, plane truss element, treatment of boundary conditions and temperature effects; Solution of problems. **(9)**

STATIC ANALYSIS USING ONE DIMENSIONAL BEAM ELEMENTS: Beam element: Hermite shape functions, formulation of element stiffness matrix and load vectors; Beam son elastic foundation; Problems using one dimensional beam element. **(10)**

STATIC ANALYSIS USING TWO DIMENSIONAL ELEMENTS: Isoparametric formulation, 2D triangular and quadrilateral elements, element stiffness matrices and load vectors, problems using two dimensional elements; Introduction to higher order elements. **(10)**

DYNAMIC ANALYSIS: Equations of motion for dynamic problems using one dimensional spar, truss and beam elements, formulation of consistent and lumped mass matrices, solving free vibration problems using one dimensional element. **(8)**

HEAT TRANSFER ANALYSIS: Basic equations of heat transfer and fluid flow, finite element formulation and solution of one-dimensional heat transfer problems involving steady state heat conduction and convection. **(8)**

Total L: 45 periods

TEXT BOOKS:

1. Chandrupatla T. R., Belegundu A. D., *'Introduction to Finite Elements in Engineering'*. Pearson, 4th edition, 2011.
2. Logan D., *'A First Course in Finite Element Method'*. Cengage Learning, 6th edition, 2016.

REFERENCES:

1. Cook R. D., Malkus D. S., Plesha M. E., Witt R. J., *'Concepts and Applications of Finite Element Analysis'*. Wiley India Pvt. Ltd, 4th edition, 2007.
2. Bhavikatti S. S., *'Finite Element Analysis'*. New Age International, 1st edition, 2015.
3. Dixit U. S., *'Finite Element Methods for Engineers'*. Cengage Learning India Pvt. Ltd, 1st edition, 2009.
4. Seshu P., *'Finite Element Analysis'*. PHI Learning Private Limited, 10th Edition, 2012.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Demonstrate the concepts of finite element analysis and formulation of element matrices for structural and heat transfer problems.	**K2**
CO2	Apply finite element procedures to formulate and solve problems involving 1D & 2D structural, and non-structural problems.	**K3**
CO3	Analyze structural and thermal systems by interpreting FEM results to assess the behaviour of elements under static, dynamic, and thermal loads.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												3	3
CO2	3											3	3
CO3		1			1							3	3
	3	**1**			**1**							**3**	**3**

1-low, 2-medium, 3-high

25ME702 INDUSTRIAL AUTOMATION

3 0 0 3

PNEUMATICS: symbols, compressors, types of actuators, pressure, flow and direction control valves, time delay valves and counters, design of sequential circuits using intuitive and cascade methods. **(9)**

COMPUTER NUMERICAL CONTROL MACHINES: Numerical Control-basic theory, advantages of numerical control. Open and closed loop systems. Classification of CNC machine tools. Special design features of CNC machines. Drive system for CNC machine tools. Manual and computer aided part programming-G and M functions, canned cycles for turning and machining centers. **(9)**

INDUSTRIAL ROBOTICS: Anatomy of a robot and robot end effectors. Classification of robots based on physical configuration. Transducers and sensors: position, velocity and force sensors, vision system. Methods of Robot programming. Concepts of forward and inverse kinematics. **(9)**

REAL TIME INTERFACING: Data acquisition systems, Virtual Instrumentation, interfacing of sensors/actuators with PC, Condition monitoring, Adaptive control, HMI and SCADA systems. **(9)**

INDUSTRIAL IoT: IoT Architecture, M2M Architecture, Cloud: Types, edge analytics, fog computing; Augmented reality and virtual reality, big data analytics, predictive analytics. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Groover M. P., *'Automation, Production Systems and Computer-Integrated Manufacturing'*. Pearson, 2016.
2. Shetty D., Kolk R. A., *'Mechatronics System Design'*. PWS Publishing Company, 2010.
3. Gilchrist A., *'Industry 4.0: The Industrial Internet of Things'*. Apress, 1st edition, 2017.

REFERENCES:

1. Groover M. P., Weiss M., Nagel R. N., Odrey N. G., *'Industrial Robotics'*. Tata McGraw-Hill, 2008.
2. Esposito A., *'Fluid Power with Application'*. Pearson Education India, 2013.
3. Bolton W., *'Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering'*. Pearson India, 2010.
4. Gupta S., John J., *'Virtual Instrumentation using LabVIEW'*. Tata McGraw Hill Publications Co. Ltd, 2017.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the architecture and functioning of pneumatic, electro-pneumatic, robotic, and computer-controlled systems used in automation.	**K2**
CO2	Apply control logic and sequencing techniques to design and interpret pneumatic, robotic, and PLC-based circuits.	**K3**
CO3	Analyze the role of IoT-based sensors and actuators in monitoring and controlling industrial automation systems.	**K4**
CO4	Evaluate the performance of automation systems using simulation tools under varying control strategies.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25ME711 FINITE ELEMENT ANALYSIS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS

1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates.
4. Stress analysis of axi–symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Analysis of non-linear systems

Total P: 30 periods

REFERENCES:

1. Gokhale N. S., Deshpande S. S., Bedekar S. V., Thite A. N., *'Practical Finite Element Analysis'*. Finite to Infinite, 1st edition, 2008.
2. Chandrupatla T. R., Belegundu A. D., *'Introduction to Finite Elements in Engineering'*. Pearson, 4th edition, 2012.
3. Logan D. L., *'A First Course in Finite Element Method'*. Cengage Learning, 6th edition, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the principles and applications of finite element methods in analyzing structural, thermal, and dynamic behavior of mechanical systems.	**K2**
CO2	Apply engineering concepts and computational tools to simulate and analyze mechanical systems using finite element methods.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	3
CO2	3				3							2	3
	3				**3**							**2**	**3**

1-low, 2-medium, 3-high

25ME712 MANUFACTURING AUTOMATION LABORATORY

0 0 2 1

Pneumatics & PLC Automation

Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Intuitive method.
Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method.
Co-ordinated motion of multiple actuators (electro-pneumatic systems) in a desired sequence using PLC.
Modeling and simulation of pneumatic and hydraulic circuits using industrial automation software. **(10)**

Sensor Interfacing & Measurement

LVDT interfacing with PC/DAQ to monitor displacement and trigger an alarm if limits are exceeded.
Thermocouple interfacing to monitor temperature and control fan/heater within specified tolerance.
Hot wire anemometer calibration using a data acquisition system to measure airflow rate. **(10)**

IoT-Based Automation

IoT-based temperature monitoring using a microcontroller with sensor-to-cloud interface.
Remote control of solenoid valve using IoT-based sensor input over the internet. **(8)**

Case Study

Development of an automation system integrating sensors, actuators, and control logic for a practical application. **(2)**

Total P: 30 periods

REFERENCES:

1. Department of Mechanical Engineering, '*Manufacturing Automation Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Simulate pneumatic, hydraulic, and IoT-based automation systems by integrating sensors, actuators, and controllers using industrial software tools and microcontrollers.	**K3**
CO2	Analyze the behavior of automation systems by interpreting sensor signals, control logic, and data acquisition flow in IoT-enabled industrial applications.	**K4**

COs-POs & PSOs MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3		3		3					3		3	2
CO2				2	2					2	2	3	2
	3		**3**	**2**	**3**					**3**	**2**	**3**	**2**

1-low, 2-medium, 3-high

25MEE05 PROJECT WORK I

0 0 4 2

1. Identification of a real-life problem in thrust areas
2. Review of literature and identification of gaps
3. Framing of objectives and methodology of work considering available resources
4. Preparation of time line of activities
5. Execution of preliminary work
6. Preparation of consolidated report

Total P: 60 periods

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Accomplish a detailed literature survey, identify research gaps, formulate a well posed research problem benefitting scientific community/society	**K2**
CO2	Apply the subject knowledge and establish an experimental/computation model based on the available codes and standards to carry out the investigations.	**K3**
CO3	Conduct investigation as individual or team to bring out new findings benefitting scientific community.	**K4**
CO4	Disseminate the findings ethically and professionally in the form of project reports, patents, conference/journal publications and also present it orally.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEE06 INTERNSHIP II

0 0 0 1

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problems or issues.

SEMESTER VIII

25MEE07 PROJECT WORK II

0 0 8 4

Execution of work for the problem identified taking into consideration the following aspects:

1. Development of appropriate analytical/numerical/empirical models
2. Development of prototype wherever applicable
3. Testing and validation of model
4. Analysis and interpretation of results
5. Cost-benefit analysis wherever applicable
6. Preparation of consolidated report

Total P: 120 periods

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Accomplish a detailed literature survey, identify research gaps, formulate a well posed research problem benefitting scientific community/society	**K2**
CO2	Apply the subject knowledge and establish an experimental/computation model based on the available codes and standards to carry out the investigations	**K3**
CO3	Conduct investigation as individual or team to bring out new findings benefitting scientific community	**K4**
CO4	Disseminate the findings ethically and professionally in the form of project reports, patents, conference/journal publications and also present it orally	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

PROFESSIONAL ELECTIVES
25MEP01 PRODUCTION DESIGN

3 0 0 3

INTRODUCTION: General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards. **(9)**

FACTORS INFLUENCING FORM DESIGN: Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings. **(9)**

COMPONENT DESIGN - MACHINING CONSIDERATION: Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly. **(9)**

COMPONENT DESIGN – CASTING CONSIDERATION: Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA. **(9)**

DESIGN FOR ADDITIVE MANUFACTURING: Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. James G. Bralla, *‘Design for Manufacturability Handbook’*. McGraw Hill Professional, 1998.
2. Tempelman E, Shercliff H, Ninaber Van Eyben B, 'Manufacturing and Design: Understanding the Principles of How Things Are Made'. Elsevier, 2014.

REFERENCES:

1. Poli C, *'Design for Manufacturing: A Structured Approach'*. Elsevier, 2001.
2. Anderson D M, *'Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production'*. CIM Press, 2004.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom’s Level**
CO1	Explain general design principles related to manufacturability and assembly.	**K2**
CO2	Apply design strategies to modify components for improved manufacturability through casting, forging, welding, machining, or additive manufacturing techniques.	**K3**
CO3	Analyze component designs to evaluate form, material choice, and process constraints for manufacturability, disassembly, and assembly efficiency	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												3	2
CO2	3											3	2
CO3		3				3						3	2
	3	**3**				**3**						**3**	**2**

1-low, 2-medium, 3-high

25MEP02 CAD/CAM

3 0 0 3

BASICS OF DESIGNS: Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading. **(9)**

2D DRAFTING: Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting. **(9)**

3D MODELING: Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc. **(9)**

ASSEMBLY MODELING: Basics of Assembly modeling, Purpose of Assembly modeling & amp; its advantages – Top to Down & BottomUp modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis –Cumulative effect of Tolerances in after assembly conditions.- motion analysis. **(9)**

CAM: Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programming 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation – Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Goel A, Moses A J, Bright R J, Agarwal R, 'Computer Aided Design & Manufacturing'. Technical Publications, 2020.
2. Srinivas J, *'CAD / CAM Principles and Application'*. Oxford Higher Education Publication, 2016.

REFERENCES:

1. Grewal C, *'CAD / CAM'*. Khanna Publishers, 2009.
2. Haideri F, *'CAD/CAM & Automation'*. Nirali Prakashan, 2010.
3. Goel A, *'Computer Aided Design and Manufacturing'*. Laxmi Publications, 2010.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamental concepts of design principles, part modeling, and part programming in CAD/CAM systems.	**K2**
CO2	Apply design principles to develop technical drawings, assembly components, and 3D models.	**K3**
CO3	Analyze CNC programming techniques and use them to perform specific machining operations.	**K4**
CO4	Use modern tools for part programming, tool path simulation, and machining process validation.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP03 PRODUCT LIFE CYCLE MANAGEMENT

3 0 0 3

HISTORY, CONCEPTS AND TERMINOLOGY OF PRODUCT LIFECYCLE MANAGEMENT: Introduction and evolution of Product Lifecycle Management (PLM). Need for PLM, historical progression from Engineering Data Management (EDM) and Product Data Management (PDM) to Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), and PLM. Overview of PLM infrastructure, introduction to Digital Twin, Model-Based Systems Engineering (MBSE), and the role of PLM in Industry 4.0 ecosystems. Timeline-based understanding of PLM's evolution. **(9)**

PLM/PDM FUNCTIONS AND FEATURES: Functional modules in PLM and PDM systems, user-oriented functions - data vault, document management, workflow control, product structure management, and classification systems for product families, utility services - communication and notification mechanisms, data transport, data format translation, image management, system administration, and software application integration, role-based functionalities relevant to design engineers, project managers, and administrators. **(9)**

MODULES IN PLM/PDM SOFTWARE: Functional and architectural modules in PLM/PDM software platforms, study of software design including client-server models, web-based deployment, and Software-as-a-Service (SaaS) architectures. Case studies based on the functional capabilities of platforms - commercial and open-source, criteria for selecting suitable PLM tools for specific industrial applications, open standards and extensibility through application programming interfaces (APIs). **(9)**

ROLE OF PLM IN INDUSTRIES: Application of PLM systems in industrial sectors (automotive, aerospace, electronics, and consumer goods), small and medium enterprises (SMEs) and startup environments, formulation of PLM vision and strategy, feasibility studies, change management, and stakeholder engagement. Financial modeling for return on investment (ROI) and cost-benefit analysis in PLM projects, process barriers to PLM adoption, ten-Step approach to PLM implementation, role of PLM in enabling sustainable practices, compliance with environmental regulations, and adoption of circular economy principles. **(9)**

CUSTOMIZATION AND INTEGRATION OF PLM SYSTEMS: Introduction to customization approaches in PLM software, study of middleware solutions and Enterprise Application Integration (EAI) technologies for linking PLM with legacy databases, Computer-Aided Design (CAD), Computer-Aided Engineering (CAE), Enterprise Resource Planning (ERP), and Service Lifecycle Management (SLM) systems, emerging low-code and no-code technologies for rapid PLM configuration and adaptation to evolving business workflows. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Stark J, *'Product Lifecycle Management for a Global Market'*. Springer, 2014.

REFERENCES:

1. Saaksvuori A, Immonen A, *'Product Lifecycle Management'*. Springer, 3rd Edition, 2008.
2. Stark J, *'Product Lifecycle Management: 21st Century Paradigm for Product Realisation'*. Springer, 2nd Edition, 2011.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamental concepts, terminology and evolution of Product Lifecycle Management (PLM), in industrial ecosystems.	**K2**
CO2	Apply PLM features and modules to the needs of various stakeholders across product development stages in different industrial contexts.	**K3**
CO3	Analyse PLM software architectures and deployment strategies to evaluate their suitability, scalability and integration within enterprise systems.	**K4**
CO4	Design strategic plans for PLM implementation, including feasibility studies, ROI modeling, and stakeholder engagement.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP04 ERGONOMICS IN DESIGN

3 0 0 3

INTRODUCTION: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound. **(9)**

ERGONOMICS AND PRODUCTION: Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form. **(9)**

DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS: Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles. **(9)**

ENVIRONMENTAL FACTORS: Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style. **(9)**

AESTHETIC CONCEPTS: Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Bridger R C, *'Introduction to Ergonomics'*. McGraw Hill Publications, 2nd Edition, 2003.
2. Helander M, *'A Guide to Human Factors and Ergonomics'*. Taylor & Francis, 2006.

REFERENCES:

1. Niebel B W, *'Motion and Time Study'*. Richard D Irwin Inc., 7th dition, 2002.
2. Mukhopadhyay P, *'Ergonomics Principles in Design: An Illustrated Fundamental Approach'*. CRC Press, Taylor & Francis, 2024.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand ergonomic principles related to human interaction, environment, and aesthetics in industrial design.	**K2**
CO2	Apply ergonomic and engineering principles to workspaces, control systems, and aesthetic products considering human and environmental factors.	**K3**
CO3	Design ergonomic products to meet specified requirements.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	2
CO2	3											2	2
CO3			2		2							2	2
	3		**2**		**2**							**2**	**2**

1-low, 2-medium, 3-high

25MEP05 AUTOMOBILE ENGINEERING

3 0 0 3

VEHICLE STRUCTURE AND ENGINES: Types of automobiles, vehicle construction and layouts; chassis, frame and body; vehicle aerodynamics – resistances and moments; IC engines – components, functions and materials; variable valve timing (VVT). **(9)**

ENGINE AUXILIARY SYSTEMS: Electronically controlled gasoline injection (SI engines); electronically controlled diesel injection – unit injector, rotary distributor and common rail systems; electronic ignition – transistorized coil and capacitive discharge systems; turbochargers (WGT, VGT); three-way catalytic converter; emission norms (Euro and BS). **(9)**

TRANSMISSION SYSTEMS: Clutch – types and construction; gearboxes – manual and automatic; gear shift mechanisms; overdrive; transfer box; fluid flywheel; torque converter; propeller shaft; slip joints; universal joints; differential and rear axle; Hotchkiss drive and torque tube drive. **(9)**

STEERING, BRAKES AND SUSPENSION SYSTEMS: Steering geometry and steering gearboxes; power steering; front axle types; suspension systems; pneumatic and hydraulic braking systems; ABS, EBD and traction control. **(9)**

ALTERNATIVE ENERGY SOURCES: Natural gas, LPG, biodiesel, bioethanol, gasohol and hydrogen in automobiles; engine modifications; performance, combustion and emission characteristics of SI and CI engines; electric and hybrid vehicles; fuel cell; practical training in dismantling and assembling of engine and transmission systems. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Jain K K, Asthana R B, *'Automobile Engineering'*. Tata McGraw Hill Publishers, New Delhi, 2002.
2. Singh K, *'Automobile Engineering (Vol. 1 & 2)'*. Standard Publishers, New Delhi, 13th Edition, 2014.

REFERENCES:

1. Ganesan V, *'Internal Combustion Engines'*. Tata McGraw-Hill, 3rd Edition, 2012.
2. Rajput R K, *'A Textbook of Automobile Engineering'*. Laxmi Publications Pvt Ltd, 2nd Edition, 2007.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand vehicle construction, layouts, aerodynamics, IC engine components and explain the working principles of engine auxiliary systems including fuel injection, ignition, turbocharging and emission control systems.	**K2**
CO2	Apply the concepts of transmission systems such as clutch, gearbox, differential and torque converter in vehicle operation.	**K3**
CO3	Analyze steering, braking and suspension systems for vehicle stability, control and safety performance.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP06 STATISTICAL QUALITY CONTROL

3 0 0 3

BASIC STATISTICS FOR QUALITY CONTROL: Introduction to quality - definition of quality - basic and modern - seven quality tools, measures of location and dispersion, statistics and parameters, causes of variation and their characteristics, constant and variable system of chance causes, patterns of variation. **(9)**

CONTROL CHART FUNDAMENTALS AND APPLICATIONS: Variables and attributes - defects and defectives - statistical basis of the control chart - purpose of control charting, anatomy of a control chart, two types of errors, rational sub grouping, sensitizing rules, guidelines for implementing control charts, types of control chart. **(9)**

ACCEPTANCE SAMPLING: Single sampling - double sampling - multiple sampling - sequential sampling - use of Dodge-Romig tables in sampling inspection. **(9)**

REGRESSION: Definition - need for regression- simple linear probabilistic model for regression, assumptions, method of least squares, estimation of constants - ANOVA for linear regression - testing the usefulness of the model, coefficient of determination, checking the assumptions - multiple regression - general linear model and assumptions, ANOVA for multiple regression, interpretation of results - polynomial regression - limitations of regression. **(9)**

DESIGN AND ANALYSIS OF EXPERIMENTS: Classical design of experiments - single factor experiment - multiple factor experiment - randomized block design, latin square design, analysis of experimental results - Taguchi design of experiments - planning, analysis and conducting phases, analysis and interpretation of experimental results. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Grant E M, Leavenworth R L, *'Statistical Quality Control'*. Tata McGraw Hill, New Delhi, 2017.
2. Montgomery D C, *'Design and Analysis of Experiments'*. Wiley India, New Delhi, 2012.

REFERENCES:

1. Krishnaiah K, *'Applied Statistical Quality Control and Improvement'*. PHI Learning Pvt Ltd, New Delhi, 2014.
2. Mahajan M, *'Statistical Quality Control'*. Dhanpat Rai & Co Pvt Ltd, New Delhi, 2018.
3. Montgomery D C, *'Statistical Quality Control: A Modern Introduction'*. Wiley India, New Delhi, 2012.
4. Ross P J, *'Taguchi Techniques for Quality Engineering'*. Tata McGraw Hill, New Delhi, 2005.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the basic concepts of quality, statistical variation, and fundamental tools used in quality control.	**K2**
CO2	Construct and interpret various control charts for both attributes and variables in manufacturing and service processes.	**K3**
CO3	Analyze product quality using acceptance sampling plans and evaluate their effectiveness using statistical principles.	**K4**
CO4	Design Quality improvement experiments using modern statistical software tools	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP07 DYNAMICS OF GROUND VEHICLES

3 0 0 3

CONCEPT OF VIBRATION: Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed. **(9)**

TYRES: Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre. **(9)**

VERTICAL DYNAMICS: Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. Design and analysis of Passive, semi active and Active suspension using Quarter car, Bicycle Model, half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties. **(9)**

LONGITUDINAL DYNAMICS AND CONTROL: Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Estimation of CG location. Stability of vehicles resting on slope. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control. **(9)**

LATERAL DYNAMICS: Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Wong J Y, *'Theory of Ground Vehicles'*. Wiley-Interscience, 4th Edition, 2008.
2. Rao Singiresu S, *'Mechanical Vibrations'*. Prentice Hall, 5th Edition, 2010.
3. Gillespie Thomas D, *'Fundamentals of Vehicle Dynamics'*. Society of Automotive Engineers Inc, 2014.

REFERENCES:

1. Karnopp Dean, *'Vehicle Dynamics, Stability, and Control'*. CRC Press, 2nd Edition, 2013.
2. Jazar Reza N, *'Vehicle Dynamics: Theory and Application'*. Springer, 2nd Edition, 2013.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of vibration, tyre mechanics, and dynamic forces essential for modelling and controlling ground vehicles.	**K2**
CO2	Apply dynamic models for vertical, longitudinal, and lateral motions of ground vehicles considering suspension, driveline, and aerodynamic influences.	**K3**
CO3	Examine the ride, handling, and performance characteristics of ground vehicles under various driving and road conditions.	**K4**
CO4	Assess simulation models developed using MATLAB/Simulink for their ability to represent the dynamic behaviour of ground vehicles under various operating conditions.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP08 MECHANICAL VIBRATION

3 0 0 3

SINGLE DEGREE OF FREEDOM SYSTEMS: Review of concepts of vibration; Mathematical modeling of single degree of freedom systems: Discrete and continuous systems - Free vibration and forced vibration of longitudinal, transverse and torsional vibratory systems, various damping models. **(9)**

TWO DEGREES OF FREEDOM SYSTEMS: Generalized co-ordinates, principal co-ordinates, equations of motion for two degrees of freedom systems, co-ordinate coupling, Lagrange's equation. **(9)**

MULTI DEGREES OF FREEDOM SYSTEMS: Equations of motion, influence coefficients, orthogonality principle; Natural frequencies by Rayleigh, Stodala, Dunkerley, Holzer and matrix iteration methods; Branched systems and geared systems. **(9)**

TRANSIENT VIBRATION: Impulse and arbitrary excitation – periodic and non-periodic forces, base excitation, convolution integral, Laplace transform formulation, response spectrum. **(9)**

VIBRATION AND NOISE - MEASUREMENTS AND CONTROL: Free and forced vibration tests; Vibration control: Excitation reduction at source, balancing of masses, material damping, vibration absorbers, viscous dampers, vibration isolation; Noise: Measurement of sound, sound level meter, sound isolation–machine enclosures, silencers and mufflers. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Rao Singiresu S, *'Mechanical Vibrations'*. Pearson Education, 6th Edition, 2018.
2. Thomson William T, *'Theory of Vibration with Applications'*. Pearson Education, New Delhi, 5th Edition, 2017.

REFERENCES:

1. Tse F S, Morse I E, Hinkle R T, *'Mechanical Vibrations – Theory and Applications'*. CBS Publishers & Distributors, 2018.
2. Grover G K, *'Mechanical Vibrations'*. New Chand and Brothers, Roorkee, 8th Edition, 2009.
3. Kelly S Graham, *'Mechanical Vibrations – Theory and Applications'*. Cengage Learning, 2012.
4. Ambekar A G, *'Mechanical Vibrations and Noise Engineering'*. PHI Learning Private Limited, 2nd Edition, 2013.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the fundamental concepts of mechanical vibrations, single and multi-degree of freedom systems.	**K2**
CO2	Apply mathematical modelling techniques to formulate and solve equations of motion for mechanical systems with single and multiple degrees of freedom.	**K3**
CO3	Analyse vibratory behaviour of mechanical systems under transient excitations and interpret their dynamic response.	**K4**
CO4	Evaluate the effectiveness of vibration and noise control techniques using simulation-based systems.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP09 ARTIFICIAL INTELLIGENCE FOR MECHANICAL ENGINEERS

3 0 0 3

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM FORMULATION: Overview and relevance of Artificial Intelligence to mechanical engineering, differences between AI and traditional programming approaches, types of AI techniques – knowledge based, learning based, and optimization-based methods, problem formulation in mechanical systems such as diagnostics and design automation, case study on predictive maintenance. **(7)**

SEARCH AND OPTIMIZATION IN MECHANICAL DESIGN: Introduction to classical search strategies - breadth-first and depth-first search, metaheuristic algorithms - Genetic Algorithms, Simulated Annealing, and Particle Swarm Optimization, application of these methods in mechanical design optimization, thermal systems, and manufacturing processes, case study of optimizing fin heat exchanger geometry. **(9)**

MACHINE LEARNING TECHNIQUES AND APPLICATIONS: Introduction to supervised learning techniques - regression (linear and polynomial) for wear and heat loss prediction, classification methods for fault diagnosis in mechanical systems, unsupervised learning techniques - K-Means clustering for analyzing material behavior, evaluation of model performance using metrics, case study on surface defect classification. **10)**

SENSOR DATA ANALYSIS AND PREDICTIVE MODELING: Collection and preprocessing of sensor data from mechanical systems - vibration, temperature, and force sensors, feature engineering from time-series signals, predictive modeling using machine learning techniques, application of time-series forecasting for maintenance and performance monitoring, case study of bearing fault prediction using vibration datasets. **(9)**

DEEP LEARNING AND VISION-BASED INSPECTION IN MECHANICAL SYSTEMS: Basics of neural networks - perceptrons, activation functions, and training processes, introduction to deep learning architectures - Convolutional Neural Networks (CNNs), application of deep learning to image-based inspection and defect detection, transfer learning techniques for mechanical datasets, case study on surface crack detection using CNNs. **(10)**

Total L: 45 periods

TEXT BOOKS:

1. Esfandiari Ramin S, *'Artificial Intelligence for Mechanical Engineers'*. CRC Press, 1st Edition, 2021.
2. Brunton Steven L, Kutz J Nathan, *'Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control'*. Cambridge University Press, 1st Edition, 2019.

REFERENCES:

1. Krishnamoorthy C S, Rajeev S, *'Artificial Intelligence and Expert Systems for Engineers'*. CRC Press, 1st Edition, 1996.
2. Drymonas Emmanouil, 'Practical Machine Learning for Engineering and Sciences'. Wiley, 1st Edition, 2023.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the foundational concepts of Artificial Intelligence and their relevance in mechanical engineering applications.	**K2**
CO2	Apply appropriate AI techniques to solve domain-specific mechanical engineering problems.	**K3**
CO3	Analyse mechanical sensor and performance data to extract meaningful features and insights using machine learning and data-driven techniques.	**K4**
CO4	Create AI-based models for predictive maintenance, fault diagnosis, and vision-based inspection in mechanical systems.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25MEP10 ADDITIVE MANUFACTURING

3 0 0 3

CONCEPTS AND CLASSIFICATION OF AM: Definition, terminology, generic AM process chain, difference between AM and subtractive processes; Application levels: Direct and indirect processes; New AM classification scheme, Applications and Case studies: Automobile, Aerospace, Healthcare. **(9)**

AM PROCESSES FOR POLYMERS: Stereolithography Apparatus (SLA), Digital Light Processing (DLP), Continuous Liquid Interface Production (CLIP) Technology, Laminated Object Manufacture (LOM), Fused Deposition Modeling (FDM), Material Jetting – Materials, Process, Advantages, Limitations. **(9)**

METAL ADDITIVE MANUFACTURING: Laser Engineered Net Shaping (LENS), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Electron Beam Melting (EBM), Binder Jetting for metals – Materials, Process, Advantages, Limitations. **(9)**

DESIGN FOR ADDITIVE MANUFACTURING: Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM. **(9)**

CAD TO 3D PRINTING: Modelling and converting CAD models into STL file, Manipulation and error fixing of STL file, Design and fabrication of parts by varying part orientation and support structures, Fabrication of parts with material extrusion AM process, Design and fabrication of topology optimized parts. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Gibson Ian, Rosen David, Stucker Brent, Khorasani Mahyar, *'Additive Manufacturing Technologies'*. Springer Cham, Switzerland, 3rd Edition, 2021.
2. Gebhardt Andreas, Hötter Jan-Steffen, *'Additive Manufacturing: 3D Printing for Prototyping and Manufacturing'*. Hanser Publications, 2015.

REFERENCES:

1. Milewski John O, *'Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewellery'*. Springer, 2017.
2. Chua Chee Kai, Leong Kah Fai, *'3D Printing and Additive Manufacturing: Principles and Applications'*. World Scientific, 2016.
3. Brandt Milan, *'Laser Additive Manufacturing: Materials, Design Technologies, and Applications'*. Woodhead Publishing, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the classifications, processes, and applications of AM for polymers and metals	**K2**
CO2	Apply DFAM principles to optimize designs and improve part quality with effective post-processing	**K3**
CO3	Design AM components to enhance functionality and performance.	**K6**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	3
CO2	3											2	3
CO3			3		3							2	3
	3		**3**		**3**							**2**	**3**

1-low, 2-medium, 3-high

25MEP11 NON-TRADITIONAL MACHINING PROCESSES

3 0 0 3

INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES: Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations. **(9)**

CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES: Principles, equipment's, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring. **(9)**

THERMAL AND ELECTRIC ENERGY BASED PROCESSES: Principles, equipment's, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining. **(9)**

ADVANCED NANO FINISHING PROCESSES: Principles, equipment's, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing. **(9)**

RECENT TRENDS AND HYBRID NON-TRADITIONAL MACHINING PROCESSES: Recent developments in non-traditional machining processes - Introduction - Various hybrid non-traditional machining processes, their working principles, equipment's, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Jain Vijay K, *'Advanced Machining Processes'*. Allied Publishers Pvt Ltd, New Delhi, 2007.
2. Pandey P C, Shan H S, *'Modern Machining Processes'*. Tata McGraw-Hill, New Delhi, 2007.

REFERENCES:

1. Sommer Carl, *'Non-Traditional Machining Handbook'*. Advance Publishing, United States, 2000.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles, classifications, and characteristics of various non-traditional machining processes.	**K2**
CO2	Select and apply suitable non-traditional machining processes for specific industrial applications based on material and geometry considerations.	**K3**
CO3	Compare and analyse different non-traditional machining processes with respect to their process parameters, advantages, limitations, and performance.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP12 PROCESS PLANNING AND COST ESTIMATION

3 0 0 3

INTRODUCTION TO PROCESS PLANNING: Introduction; methods of process planning; drawing interpretation; material evaluation; steps in process selection; production equipment and tooling selection. **(9)**

PROCESS PLANNING ACTIVITIES: Process parameter calculation for various production processes; selection of jigs and fixtures; selection of quality assurance methods; set of documents for process planning; economics of process planning; case studies. **(9)**

INTRODUCTION TO COST ESTIMATION: Importance of costing and estimation; methods of costing; elements of cost estimation; types of estimates; estimating procedure; estimation of labour cost and material cost; allocation of overhead charges; calculation of depreciation cost. **(9)**

PRODUCTION COST ESTIMATION: Estimation of different types of jobs; estimation of forging shop; estimation of welding shop; estimation of foundry shop. **(9)**

MACHINING TIME CALCULATION: Estimation of machining time; importance of machine time calculation; calculation of machining time for different lathe operations, drilling and boring; machining time calculation for milling, shaping and planning; machining time calculation for grinding. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Scalon P R, *'Process Planning, Design/Manufacture Interface'*. Elsevier Science Technology Books, 2002.
2. Groover M P, *'Automation, Production Systems and Computer Integrated Manufacturing'*. Pearson Education, 2001.

REFERENCES:

1. Chitale A V, Gupta R C, *'Product Design and Manufacturing'*. PHI, 2nd Edition, 2002.
2. Russell R S, Taylor B W, *'Operations Management'*. PHI, 4th Edition, 2003.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the concepts of process planning, cost estimation, and machining time calculation in manufacturing systems.	**K2**
CO2	Interpret engineering drawings and plan suitable manufacturing processes by selecting materials, equipment, tooling, and process parameters for various production systems.	**K3**
CO3	Estimate manufacturing costs by applying costing methods, evaluating labour, material and overhead costs, and preparing process planning documents.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												3	1
CO2	3											3	1
CO3		3										3	1
	3	**3**										**3**	**1**

1-low, 2-medium, 3-high

25MEP13 INDUSTRIAL MANAGEMENT

3 0 0 3

INTRODUCTION TO MANAGEMENT: Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits. **(9)**

FUNCTIONS OF MANAGEMENT – I: Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design. **(9)**

FUNCTIONS OF MANAGEMENT – II: Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications. **(9)**

ORGANIZATION THEORY: Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict. **(9)**

PRODUCTIVITY AND MODERN TOPICS: Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS), Industry 4.0. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Koontz Harold, Weihrich Heinz, *'Essentials of Management: An International Perspective'*. Tata McGraw Hill, New Delhi, 8th Edition, 2010.
2. Robbins Stephen P, DeCenzo David A, *'Essentials of Management'*. Pearson India, 6th Edition, 2010.

REFERENCES:

1. Saxena P K, *'Principles of Management: A Modern Approach'*. Global India Publications, 2009.
2. Daft Richard L, *'Organization Theory and Design'*. South Western College Publishing, 11th Edition, 2012.
3. Certo S Trevis, *'Modern Management: Concepts and Skills'*. Pearson Education, 2018.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the core concepts of management, classical theories, organizational forms, and managerial functions	**K2**
CO2	Apply core managerial functions to address organizational challenges and improve business operations.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												3	
CO2	3							3	3			3	
	3							**3**	**3**			**3**	

1-low, 2-medium, 3-high

25MEP14 COMPUTER INTEGRATED MANUFACTURING

3 0 0 3

INTRODUCTION TO CAD/CAM AND CIM: Introduction to CAD, CAM, CAD/CAM and CIM; evolution of CIM; CIM wheel and cycle; production concepts and mathematical models; CIM hardware and software; major elements of CIM system; implementation of CIM; computers and computer networks in manufacturing; automated factory; management, safety aspects and advances in CIM. **(9)**

AUTOMATED MANUFACTURING SYSTEMS: Automated production lines and assembly systems; system configurations and part transfer mechanisms; design for automated assembly; material handling systems and principles; conveyor systems; automated guided vehicles (AGVs) – types, applications and guidance systems; storage systems including AS/RS and carousel systems; deadlocks and Petri net models; smart manufacturing, Industry 4.0, digital and virtual manufacturing. **(9)**

GROUP TECHNOLOGY AND FMS: Part families and classification; coding and production flow analysis; rank order clustering; benefits of group technology; flexible manufacturing systems (FMS) – components, layouts and control; FMS planning and implementation; machine cell design; quantitative analysis including bottleneck models; FMS applications and benefits. **(9)**

PROCESS PLANNING: Process planning activities and required information; selection and sequencing of manufacturing processes; matrix of anteriorities; manual process planning and process sheets; computer-aided process planning (CAPP); variant and generative process planning; comparison of manual and computer-aided approaches. **(9)**

PROCESS CONTROL AND DATA ANALYSIS: Process model formulation; linear feedback, optimal and adaptive control; sequence control, PLC and SCADA; computer process control and interfaces; process monitoring and control strategies; automatic identification and data capture methods; barcode technology; statistical process control (SPC) and automated inspection. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Shivanand H K, Benal M M, Koti V, *'Flexible Manufacturing System'*. New Age, 2016.
2. Alavudeen, Venkateshwaran, *'Computer Integrated Manufacturing'*. PHI Learning Pvt Ltd, New Delhi, 2013.

REFERENCES:

1. Rehg James A, Kraebber Henry W, *'Computer Integrated Manufacturing'*. Pearson Education Asia, 3rd Edition, 2004.
2. Groover Mikell P, *'Automation, Production Systems and Computer Integrated Manufacturing'*. Prentice Hall of India Pvt Ltd, 4th Edition, 2014.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the concepts of CAD/CAM, CIM architecture, automated manufacturing systems and modern digital manufacturing approaches.	**K2**
CO2	Apply principles of material handling, automated systems and group technology for efficient manufacturing system design.	**K3**
CO3	Analyze flexible manufacturing systems (FMS), process planning methods and their implementation in production environments.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3							3	3			3	3
CO3		3										3	3
	3	**3**						**3**	**3**			**3**	**3**

1-low, 2-medium, 3-high

25MEP15 INDUSTRIAL ROBOTICS

3 0 0 3

INTRODUCTION: Classification of Industrial Robots, Structures of Robots – Cartesian, SCARA, Articulated, Parallel, Cylindrical, Gantry Robots, Delta and Polar Robots - Introduction to Cobots. **(9)**

COMPONENTS OF ROBOTS: Links, Joints, Motion Control Systems – Servo Motors, Belt and Pulley Mechanism, Harmonic Gears, Cycloidal Gears, End Effectors – Grippers: Mechanical Grippers, Hydraulic and Pneumatic Grippers, Magnetic Grippers, Vacuum Grippers, RCC Grippers – Two and Three Fingered Grippers – Internal and External Grippers – Selection Considerations, Gripper Force Analysis and Design of Drive System for Grippers. **(9)**

APPLICATIONS OF ROBOTS: Implementation of Robots in Industries – Use of Simulation Tools, Machine Loading/Unloading - Processing Operation, Assembly and Inspection, Application of Robots in Continuous Arc Welding, Spot Welding, Spray Painting - Selection of Robot - Factors Influencing the Choice of a Robot, Robot Performance Testing, Economics of Robotization - Impact of Robot on Industry and Society. **(9)**

ROBOT PROGRAMMING AND LANGUAGES: Methods of Robot Programming - Lead through Programming- Joint Linear Circular Motion Instructions – Program Instructions Capabilities and Limitations of Lead through Methods - Robot Languages - the Textual Robot Languages - Generations of Robot Programming Languages - Robot Language Structure - Motion Commands - End Effector and Sensor Commands - Computations and Operations - Program Control and Subroutines - Communications and Data Processing - Monitor Mode Commands. **(9)**

APPLICATIONS OF ROBOTS Industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Groover Mikell P, Nagel Roger N, *'Industrial Robotics: Technology, Programming, and Applications'*. McGraw Hill Education, 2012.
2. Groover Mikell P, *'Automation, Production Systems and Computer Integrated Manufacturing'*. John Wiley & Sons Inc, 2007.

REFERENCES:

1. Niku Saeed B, *'Introduction to Robotics: Analysis, Control and Application'*. Wiley, 2017.
2. Siciliano Bruno, Khatib Oussama, *'Springer Handbook of Robotics'*. Springer, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the fundamental concepts, classifications, components, programming methods, and applications of industrial and service robots.	**K2**
CO2	Apply principles of robot structures, motion control systems, end effectors, and programming techniques to develop industrial robotic operations.	**K3**
CO3	Analyze the deployment, performance, societal influence, and economic impact of robots across diverse applications using simulation and evaluation tools.	**K4**
CO4	Design robotic systems and task solutions using modeling and simulation tools, considering operational requirements.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25MEP16 INDUSTRY 4.0

3 0 0 3

INTRODUCTION TO INDUSTRY 4.0 AND SMART MANUFACTURING: Evolution of industrial revolutions: Industry 1.0 to 4.0, Pillars and design principles of Industry 4.0, Cyber-Physical Systems (CPS), Smart Factories, and Digital Manufacturing, Benefits and challenges of Industry 4.0 adoption, Role of standards, case studies of Industry 4.0 implementation in India and abroad. **(9)**

INTERNET OF THINGS AND INDUSTRIAL INTERNET OF THINGS: IoT architecture and protocols (MQTT, CoAP), Edge, fog, and cloud computing, Smart sensors, RFID, actuators, and controllers, M2M communication and cyber-physical communication protocols, IIoT platforms and data interoperability, Applications of IIoT in predictive maintenance, supply chain, and automation, Role of data in smart factories. **(9)**

DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE IN INDUSTRY 4.0: Role of data in smart factories, Basics of data acquisition, storage, and processing, Big data and its 5 Vs: Volume, Variety, Velocity, Veracity, Value, Introduction to Machine Learning and AI in manufacturing Predictive analytics, anomaly detection, and process optimization, Data visualization dashboards and KPI monitoring. **(9)**

AUTOMATION, ROBOTICS, AND HUMAN-MACHINE INTERACTION: PLC, SCADA, HMI: Architectures and applications, Advanced automation: robotics, cobots, and AGVs, Human-Machine Interaction (HMI) and digital twin concepts, Augmented Reality (AR) / Virtual Reality (VR) in operations, Safety, ethics, and legal considerations in automation, Integration of robotics with IIoT platforms. **(9)**

ADDITIVE MANUFACTURING AND DIGITAL TRANSFORMATION: Additive manufacturing (3D printing): Principles and types, Integration of AM with smart manufacturing, Digital twins and simulation for product life cycle, Block chain and cyber security in smart factories, sustainability, circular economy and green manufacturing. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Gilchrist Alasdair, *'Industry 4.0: The Industrial Internet of Things'*. Apress, 1st Edition, 2017.
2. Bansal Vikram, Deepthi B, *'Industry 4.0: Sustainable Industrial Approach'*. Sultan Chand and Sons, 2025.

REFERENCES:

1. Sabherwal Rajiv, Becerra-Fernandez Irma, *'Business Intelligence: Practices, Technologies, and Management'*. Wiley, 1st Edition, 2013.
2. Lee Jay et al., 'Industrial AI: Applications with Sustainable Performance'. Springer, 2020.
3. Bahga Arshdeep, Madisetti Vijay, *'Internet of Things: A Hands-On Approach'*. Vijay Madisetti Publication, 2014.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamental concepts, architecture, and key technologies of Industry 4.0 and smart manufacturing systems.	**K2**
CO2	Apply Industry 4.0 tools and technologies for real-time monitoring, data acquisition, and control in automated systems.	**K3**
CO3	Analyze various components and technologies of Industry 4.0 to evaluate their suitability for specific industrial automation needs.	**K4**
CO4	Design basic automation and smart manufacturing systems using integrated Industry 4.0 solutions such as robotics, AI, and digital twins.	

COS-POS & PSOS MAPPING

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

1-low, 2-medium, 3-high

25MEP17 DRONE STRUCTURES AND DYNAMICS

3 0 0 3

INTRODUCTION TO DRONES: Classification of drones – applications of UAVs – basic components of drones – fixed wing, rotary wing and hybrid drones – aerodynamic forces acting on drones – stability and control concepts – payload systems – materials used in drone structures. **(9)**

DRONE STRUCTURES AND MATERIALS: Structural configuration of drones – lightweight structural design – properties and selection of materials – aluminium alloys, titanium alloys and composite materials – sandwich structures – vibration and fatigue considerations – joining methods – structural failure modes in drones. **(9)**

DRONE DYNAMICS AND FLIGHT MECHANICS: Introduction to flight dynamics – translational and rotational motion – degrees of freedom – equations of motion – forces and moments acting on drones – stability analysis – gyroscopic effects – maneuverability and control response. **(9)**

PROPULSION AND CONTROL SYSTEMS: Drone propulsion systems – electric motors, propellers and ESC – battery systems and power management – sensors and actuators – flight controllers – GPS and navigation systems – communication systems – autonomous flight concepts. **(9)**

DESIGN, ANALYSIS AND APPLICATIONS: Structural analysis of drone components – CAD and simulation tools – finite element analysis of drone structures – aerodynamic analysis – crashworthiness and safety – drone regulations and standards – industrial and defence applications – recent trends in drone technology. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Sadraey M.H., Fahlstrom P.G., '*Introduction to UAV Systems (Aerospace Series)*'. John Wiley & Sons Inc., 2022.
2. DeFrangesco R., DeFrangesco S., *'The Big Book of Drones'*. Routledge, 1st Edition, 2022.
3. András Sobester, Alexander Forrester, *'Aircraft Aerodynamic Design: Geometry and Optimization'*. Wiley, 2014.

REFERENCES:

1. Beard R. W., McLain T. W., '*Small Unmanned Aircraft: Theory and Practice'*. Princeton University Press, 2012.
2. Tripathi A., *'NSQF (Level 3) Drone Technician Theory (I Year)'*. Arihant Publication India, 2024.
3. Gonzalez L. F., *'Drone Technology and Applications'*. MDPI, 2020.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamentals of drone structures, aerodynamics and flight mechanics.	**K2**
CO2	Apply the principles of materials selection, propulsion and control systems for drone design.	**K3**
CO3	Analyze the structural and dynamic behaviour of drones using engineering analysis techniques.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												3	2
CO2	3											3	2
CO3		3										3	2
	3	**3**										**3**	**2**

1-low, 2-medium, 3-high

25MEP18 ELECTRIC VEHICLE TECHNOLOGY

3 0 0 3

ROTATING POWER CONVERTERS: Magnetic circuits – Overview of DC and AC machines – Working principles of motors and generators (DC and AC) – Voltage and torque equations – Characteristics and typical applications. Special electric machines: Brushless DC motor (BLDC), Switched Reluctance Motor (SRM), and Permanent Magnet Synchronous Motor (PMSM) – Construction, working, and applications. **(9)**

STATIC POWER CONVERTERS: Power semiconductor devices: Characteristics and operation of Power Diodes, MOSFETs, and IGBTs. Power converter circuits: Uncontrolled and controlled rectifiers (single-phase and three-phase), DC-DC choppers, single-phase and three-phase inverters, multilevel inverters, and matrix converters – Working principles and applications. **(9)**

CONTROL OF DC AND AC MOTOR DRIVES: Speed control methods for electric motors: Constant torque and constant power regions. DC motor control using chopper-based four-quadrant operation. Induction motor control: V/f control (motoring and regenerative braking), vector control, transformation theory. Control of special machines: PMSM vector control, BLDC motor control, and SRM drive control. **(9)**

HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWERTRAIN COMPONENTS: History and evolution of electric vehicles – Comparison between EVs and conventional IC engine vehicles. Architectures: Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV). Overview of powertrain components: Motors, batteries, gears, clutches, transmissions, and braking systems – Sizing considerations. **(9)**

MECHANICS OF HYBRID ELECTRIC VEHICLES AND VEHICLE CONTROL: Basics of vehicle mechanics – Tractive effort and power requirement – Energy analysis based on standard drive cycles. Selection of motor power rating and battery capacity. Supervisory control strategies in HEVs – Mode selection: power split mode, parallel mode, engine braking mode, regenerative braking, and series-parallel mode. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Umans Stephen D, *'Fitzgerald & Kingsley's Electric Machinery'*. Tata McGraw Hill, 7th Edition, 2020.
2. Wilamowski Bogdan M, Irwin J David, *'The Industrial Electronics Handbook: Power Electronics and Motor Drives'*. CRC Press, 2nd Edition, 2011.

REFERENCES:

1. Krause Paul C, Wasynczuk Oleg, Sudhoff Scott D, Pekarek Steven D, *'Analysis of Electric Machinery and Drive Systems'*. Wiley-IEEE Press, 3rd Edition, 2013.
2. Rashid Muhammad H, *'Power Electronics: Circuits, Devices and Applications'*. Pearson, 4th Edition, 2021.
3. Husain Iqbal, *'Electric and Hybrid Electric Vehicles'*. CRC Press, 2021.
4. Liu Wei, *'Hybrid Electric Vehicle System Modelling and Control'*. Wiley, 2nd Edition, 2017.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the fundamentals of electric machines, power converters, motor control methods, and electric vehicle architectures.	**K2**
CO2	Apply knowledge of power electronics, motor drive control, and vehicle mechanics to develop electric and hybrid vehicle subsystems.	**K3**
CO3	Analyze the performance and energy management of electric and hybrid electric vehicles under various driving conditions using model-based design approaches.	**K4**
CO4	Design suitable powertrain configurations and control strategies for electric and hybrid vehicles based on performance requirements and energy optimization.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP19 POWER PLANT ENGINEERING

3 0 0 3

COAL BASED THERMAL POWER PLANTS: Rankine cycle-improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants–Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems. **(9)**

DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**:** Otto, Diesel, Dual & Brayton Cycle-Analysis & Optimization. Components of Diesel and Gas turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems. **(9)**

NUCLEAR POWER PLANTS: Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium - Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled reactors. Safety measures for Nuclear Power plants. **(9)**

POWER FROM RENEWABLE ENERGY: Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems. **(9)**

ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS: Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Nag P K, *'Power Plant Engineering'*. Tata McGraw Hill, New Delhi, 2017.
2. Hedge R K, *'Power Plant Engineering'*. Pearson India Education Services Pvt Ltd, 2016.
3. Desai Ashok V, *'Non-Conventional Energy'*. Wiley Eastern Limited, New Delhi, 2022.

REFERENCES:

1. Rajput R K, *'Power Plant Engineering'*. Laxmi Publications Pvt Ltd, 2016.
2. Rudramoorthy R, *'Thermal Engineering'*. Tata McGraw Hill, 2003.
3. Arora S C, Domkundwar S, *'Power Plant Engineering'*. Dhanpat Rai and Sons, New Delhi, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Describe the layout, working principles, and major components of conventional and renewable power plants.	**K2**
CO2	Apply thermodynamic cycles and performance parameters to assess the operation and efficiency of power plant systems	**K3**
CO3	Analyze power plants for efficiency, emissions, and cost to recommend strategies for performance improvement and energy conservation.	**K4**
CO4	Analyze and communicate, recent power sector trends using critical thinking and effective technical presentation skills.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP20 RENEWABLE ENERGY

3 0 0 3

SOLAR ENERGY: Basic concepts on solar radiation, potential of solar energy; Solar collectors: Flat plate collectors, evacuated tubes, concentrators; Solar plant configurations, photovoltaic systems, environmental aspects of solar energy. **(9)**

WIND ENERGY: Principles of wind power, wind turbine operation, site characteristics, horizontal and vertical axis types, aerodynamics of wind turbine, performance analysis, design principles of wind turbine blades, tower design, small and large machines, storage systems. **(9)**

BIO-ENERGY: Concepts and systems, biomass production, energy plantations, biomass resources and processing, environmental factors; Pyrolysis, gasification and liquefaction, types of gasifiers; Bioconversion: Biogas, fermentation and wet processes; Bio fuels: Manufacturing methods and properties. **(9)**

OCEAN ENERGY: Wave energy: Offshore and shoreline energy systems, tidal energy, types of OTEC power plants, design and performance evaluation. **(9)**

OTHER ENERGY SOURCES: Geothermal energy, magneto hydrodynamic system (MHD), thermionic and thermos- electric generator, micro-hydel systems, hybrid systems and applications; Fuel cells: Classification, reactions and performance; Hydrogen production and storage methods. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Rai G D, *'Non-Conventional Sources of Energy'*. Khanna Publishers, 2022.
2. Rosa Aldo Vieira da, *'Fundamentals of Renewable Energy Processes'*. Elsevier Academic Press, 2013.

REFERENCES:

1. Kothari P, Singal K C, Ranjan Rakesh, *'Renewable Energy Sources and Emerging Technologies'*. PHI Pvt Ltd, New Delhi, 2022.
2. Sukhatme S P, Nayak J K, *'Solar Energy: Principles of Thermal Collection and Storage'*. Tata McGraw Hill, 2008.
3. Sorensen Bent, *'Renewable Energy'*. Academic Press, 2017.
4. Goswami Yogi, *'Energy Efficiency and Renewable Energy'*. CRC Press, 2015.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Summarize the fundamentals and components of solar, wind, bio, ocean, and alternative energy systems.	**K2**
CO2	Apply theoretical concepts to evaluate the performance of renewable energy systems for sustainable energy generation	**K3**
CO3	Review and present the recent trends in renewable and alternative energy technologies.	**K2**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP21 FUEL CELL TECHNOLOGIES

3 0 0 3

INTRODUCTION: Principle of working and components, various types of fuel cells- PEMFC, DMFC, AFC, PAFC, SOFC, MCFC, potential applications. **(9)**

THERMODYNAMICS OF FUEL CELL: Basic reactions, reaction heat, higher and lower heating value of hydrogen, ideal cell voltage-effect of pressure and temperature, fuel cell efficiency and Carnot efficiency myth **(9)**

ELECTROCHEMISTRY OF FUEL CELL: Electrode kinetics, Over potential and cell polarization curve, current density and power density, parallel and series connections, sensitivity of parameters in polarization curve, effect of by-products, overall fuel cell efficiency. **(9)**

MEMBRANE ELECTRODE ASSEMBLY: Anode/cathode catalysts, membrane-physiochemical and geometrical requirements, effect of assembly pressure, high temperature fuel cells- opportunities and challenges **(9)**

FUEL CELL STACK DESIGN: Stack design and size configuration, heat removal from stack, hydrogen and air supply system with humidification, fuel processor, application of fuel cell in stationary, transportation and portable power applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Frano Babir, '*PEM Fuel Cells: Theory and Practice'*. Elsevier Academic Press, USA, 2012.
2. Shigenori Mitsushima and Viktor Hacker, '*Fuel Cells and Hydrogen from Fundamentals to Applied Research'*. Elsevier Science, 2018.

REFERENCES:

1. Paul Breeze, *'Fuel Cells'*. Elsevier Science, 2017
2. Viswanathan B. and Scibioh Aulice M, '*Fuel Cells: Principles and Applications*'. University Press, 2006.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, '*Modem Electric, Hybrid Electric and Fuel cell Vehicles, Fundamental, Theory and design'*. CRS Press, 2004.
4. Jiujun Zhang, '*PEM Fuel Cells Electro catalysts and Catalyst Layers'*. Springer, 2008

COURSE OUTCOMES

At the end of this course, the student will be able to		**Bloom's Level**
CO1	Understand the importance of Hydrogen energy and fuel cell technology with respect to sustainability.	**K2**
CO2	Apply the fundamental equations and find the system performance.	**K3**
CO3	Investigate the effect of design and operating parameters on the performance of single fuel cell and stack	**K4**
CO4	Present Orally as individual and team the latest research developments in the field of fuel cells	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25MEP22 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

INTRODUCTION: Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors **(9)**

FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION: Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes. **(9)**

FINITE VOLUME METHOD FOR CONVECTION DIFFUSION: Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis. **(9)**

FLOW FIELD ANALYSIS: Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer. **(9)**

TURBULENCE MODELLING: Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Versteeg, H. K., and Malalasekera, W., '*An Introduction to Computational Fluid Dynamics*: *The finite volume Method*'. Pearson Education, 2014.
2. Ghoshdastidar, P. S., '*Computational Fluid Dynamics and Heat Transfer'*. Cengage Learning, 2017.

REFERENCES:

1. John. F. Wendt, '*Computational Fluid Dynamics – An Introduction'*. Springer, 2013
2. Suhas V, Patankar, '*Numerical Heat transfer and Fluid flow*'. Taylor & Francis, 2009.
3. Yogesh Jaluria & Kenneth E. Torrance, '*Computational Heat Transfer'*. CRC press, 2002.

COURSE OUTCOMES

At the end of this course, the student will be able to		Bloom's Level
CO1	Understand the need of CFD in solving engineering problems.	**K2**
CO2	Apply the fundamentals of CFD and develop case specific governing equations, use appropriate numerical scheme to solve the governing equations.	**K3**
CO3	Use computational tools to Investigate the performance of various fluid flow/thermal systems.	**K4**
CO4	Present Orally as individual and team the findings of the computational study.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP23 HYDRAULICS AND PNEUMATICS

3 0 0 3

FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS: Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory–– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed &Variable displacement pumps – Problems. **(9)**

HYDRAULIC ACTUATORS AND CONTROL COMPONENTS: Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems **(9)**

HYDRAULIC CIRCUITS AND SYSTEMS: Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems. **(9)**

PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS: Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits. **(9)**

TROUBLE SHOOTING AND APPLICATIONS: Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics Note: (Use of standard Design Data Book is permitted in the University examination) **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Esposito Anthony, *'Fluid Power with Applications'*. Prentice Hall, 2009.
2. Sullivan James A, *'Fluid Power: Theory and Applications'*. Prentice Hall, 4th Edition, 1997.

REFERENCES:

1. Jagadeesha T, *'Pneumatics: Concepts, Design and Applications'*. Universities Press, 2015.
2. Srinivasan R, *'Hydraulic and Pneumatic Controls'*. Vijay Nicole Imprints, 3rd Edition, 2019.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Describe and explain the fundamental concepts of hydraulics and pneumatics systems	**K2**
CO2	Construct hydraulic and pneumatic circuits using standard symbols and appropriate component selection to meet operational requirements.	**K3**
CO3	Analyze the performance, troubleshooting aspects, and integration of hydraulic and pneumatic systems under various industrial operating conditions.	**K4**
CO4	Simulate hydraulic and pneumatic circuits to assess system behaviour and validate circuit performance under different operational scenarios.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP24 HEAT EXCHANGER DESIGN

3 0 0 3

FUNDAMENTALS OF HEAT EXCHANGERS: Introduction, classification according to transfer processes, number of fluids, surface compactness, construction features, flow arrangements and heat transfer mechanisms, LMTD, NTU and other methods, effectiveness. **(9)**

DESIGN ASPECTS: Heat exchanger variables and thermal circuit, Heat exchanger design methodology, interactions among design considerations, number of transfer unit relationships, solution methods for determining exchanger effectiveness. **(9)**

HEAT TRANSFER ANALYSIS: Thermal stresses, Longitudinal wall heat conduction effects, non-uniform overall heat transfer coefficients, pressure and carryover leakages and matrix material, fouling and corrosion considerations, type of failures. **(9)**

PRESSURE DROP ANALYSIS: Pressure drop calculation in extended surface heat exchanger regenerator, tubular heat exchanger, plate heat exchanger and surface geometrical characteristics, network and pinch analysis of heat exchangers. **(9)**

CHALLENGES IN HEAT EXCHANGER DESIGN: Role of numerical simulation in heat exchanger design, challenges in heat exchange between solid phase change materials and fluid, effect of geometry on performance in multi-phase change heat exchangers, Influence of Heat transfer enhancement techniques in heat exchangers, next generation heat exchangers. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Shah Ramesh K, Sekulic Dusan P, *'Fundamentals of Heat Exchanger Design'*. Wiley Publications, 2013.
2. Kakac Sadik, Liu Hongtan, *'Heat Exchangers: Selection, Rating and Thermal Design'*. CRC Press, 2002.

REFERENCES:

1. Martin Holger, *'Heat Exchangers'*. Hemisphere Publications, 2012.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the types and applications of Heat Exchangers.	**K2**
CO2	Apply the fluid mechanics and heat transfer fundamentals for performance evaluation of heat exchangers.	**K3**
CO3	Investigate the effect of design parameters on the effectiveness of heat exchanger using computational tools.	**K4**
CO4	Present Orally as individual and team the findings of the computational study.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP25 ALTERNATE FUELS

3 0 0 3

INTRODUCTION TO ALTERNATE FUELS: Global energy demand – depletion of fossil fuels – environmental impacts of conventional fuels – need for alternate fuels – classification of alternate fuels – properties of fuels – calorific value, flash point, cetane number and octane number – fuel standards and emission norms. **(9)**

BIOFUELS AND SYNTHETIC FUELS: Biomass energy – production and properties of biofuels – biodiesel, bioethanol and biogas – transesterification process – synthetic fuels – Fischer–Tropsch fuels – alcohol fuels and blended fuels – performance and emission characteristics. **(9)**

GASEOUS AND HYDROGEN FUELS: Compressed natural gas (CNG) – liquefied petroleum gas (LPG) – liquefied natural gas (LNG) – producer gas and syngas – hydrogen as a fuel – hydrogen production, storage and transportation – combustion characteristics and safety aspects of gaseous fuels. **(9)**

ALTERNATE FUELS FOR IC ENGINES: Fuel modification techniques for SI and CI engines – combustion characteristics of alternate fuels – engine performance and emission analysis – dual fuel engines – fuel injection systems – corrosion and material compatibility – engine durability issues. **(9)**

FUTURE FUELS AND SUSTAINABILITY: Fuel cells and hybrid energy systems – ammonia as fuel – e-fuels and renewable fuels – waste-to-energy technologies – carbon capture and emission reduction strategies – sustainability and life cycle assessment of fuels – recent trends in alternate fuel technologies. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Thipse S.S., *'Alternative Fuel'*. Jaico Publishing House, 2015.
2. Rai G.D., *'Non-Conventional Energy Sources'*. Khanna Publishing, New Delhi, 2010.

REFERENCES:

1. Gupta R.B., Demirbas A., '*Gasoline, Diesel and Ethanol Biofuels from Grasses and Plants'*. Cambridge University Press, 2010.
2. Bechtold R., *'Alternative Fuels Guide'*. SAE, 2005.
3. Veziroglu T.N., *'Alternative Energy Sources'*. McGraw Hill, 2001.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the properties, production methods and applications of alternate fuels.	**K2**
CO2	Apply combustion and thermodynamic principles to evaluate engine performance and emission characteristics using alternate fuels.	**K3**
CO3	Analyze the performance, emissions and sustainability aspects of alternate fuels.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
CO3		3										2	2
	3	**3**										**2**	**2**

1-low, 2-medium, 3-high

Fourth ACM

25MEP26 CRYOGENIC ENGINEERING

3 0 0 3

INTRODUCTION TO CRYOGENICS: Definition and scope of cryogenic engineering – properties of materials at low temperatures – liquefaction of gases – applications of cryogenics – cryogenic fluids – hydrogen, helium, nitrogen and oxygen – thermodynamic principles – Joule Thomson effect – Claude and Linde liquefaction systems. **(9)**

CRYOGENIC REFRIGERATION SYSTEMS: Principles of cryogenic refrigeration – gas refrigeration cycles – Stirling cycle, Gifford McMahon cycle and pulse tube refrigeration – cascade refrigeration systems – cryocoolers – performance parameters – efficiency and COP of cryogenic systems. **(9)**

CRYOGENIC INSULATION AND STORAGE SYSTEMS: Heat transfer at cryogenic temperatures – vacuum insulation – multilayer insulation – cryogenic vessels and storage tanks – transfer lines and valves – boil off losses – instrumentation and measurement techniques in cryogenic systems – safety precautions in handling cryogenic fluids. **(9)**

MATERIALS AND APPLICATIONS OF CRYOGENICS: Mechanical and thermal properties of materials at cryogenic temperatures – material selection – superconducting materials – cryogenic treatment of materials – applications in aerospace, medical, energy and food industries – LNG systems and space applications. **(9)**

ADVANCED CRYOGENIC SYSTEMS: Cryogenic propulsion systems – liquid hydrogen and liquid oxygen systems – cryogenic applications in superconductivity and fusion reactors – cryogenic machining – environmental and safety aspects – recent trends and developments in cryogenic engineering. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Flynn T.M., *'Cryogenic Engineering'*. Taylor & Francis, 2nd edition, 2004.

REFERENCES:

1. Mukhopadhyay M., *'Fundamental of Cryogenic Engineering'*. PHI Learning Private Limited, 2015.
2. Zhao Z., Wang C., *'Cryogenic Engineering and Technologies: Principles and Applications of Cryogen-Free Systems'*. CRC Press, 1st edition, 2019.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Explain the principles of cryogenic engineering, refrigeration systems and cryogenic fluids.	**K2**
CO2	Apply cryogenic concepts for storage, insulation and engineering applications.	**K3**
CO3	Analyze the performance, material behaviour and safety aspects of cryogenic systems.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											2	2
CO3		2										2	2
	3	**2**										**2**	**2**

1-low, 2-medium, 3-high

25MEP27 ENERGY STORAGE TECHNOLOGIES

3 0 0 3

INTRODUCTION: Necessity of energy storage–types of energy storage–comparison of energy storage technologies– Applications. **(9)**

THERMAL STORAGE SYSTEM: Thermal storage–Types–Modelling of thermal storage units–Simple water and rock bed storage system–pressurized water storage system–Modelling of phase change storage system –Simple units, packed bed storage units – Modelling using porous medium approach, Use of TRNSYS. **(9)**

ELECTRICAL ENERGY STORAGE: Fundamental concept of batteries–measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel Cadmium, Zinc Manganese dioxide and modern batteries. **(9)**

HYDROGEN AND BIOGAS STORAGE: Hydrogen storage options–compressed gas–liquid hydrogen–Metal Hydrides, chemical Storage, Biogas storage-comparisons. Safety and management of hydrogen and Biogas storage - Applications. **(9)**

ALTERNATE ENERGY STORAGE TECHNOLOGIES: Flywheel, Super capacitors, Principles & Methods–Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Dincer Ibrahim, Rosen Mark A, *'Thermal Energy Storage Systems and Applications'*. John Wiley & Sons, 2010.
2. Viswanathan, *'Fuel Cell: Principles and Applications'*. Universities Press, 2006.

REFERENCES:

1. Cabeza Luisa F, *'Advances in Thermal Energy Storage Systems: Methods and Applications'*. Elsevier Woodhead Publishing, 2015.
2. Huggins Robert A, *'Energy Storage: Fundamentals, Materials and Applications'*. Springer, 2nd Edition, 2015.
3. Liu Ru-shi, Zhang Lei, Sun Xueliang, *'Electrochemical Technologies for Energy Storage and Conversion'*. Wiley Publications, 2012.
4. National Energy Technology Laboratory, *'Fuel Cell Handbook'*. U.S. Department of Energy, 7th Edition.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamental concepts, types, and applications of energy storage technologies, including thermal, electrical, hydrogen, biogas, and alternate systems.	**K2**
CO2	Apply appropriate methods to evaluate the working principles and performance parameters of thermal, electrical, and alternate energy storage systems in practical scenarios.	**K3**
CO3	Analyze and compare various energy storage technologies in terms of efficiency, storage characteristics, safety, and suitability for different applications.	**K4**
CO4	Design and present a practical scenario by selecting and applying an appropriate energy storage system, including a rough layout, specifications, and performance evaluation, through collaborative teamwork and technical reporting.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25MEP28 CASTING AND WELDING METALLURGY

3 0 0 3

FERROUS CAST ALLOYS: Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size- Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass-Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family & microstructures-alloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels-Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels-low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization dephosphorization, specifications for carbon steels- low alloy steels and stainless steels. **(9)**

NON-FERROUS CAST ALLOYS: Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys-problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings. **(9)**

PHYSICAL METALLURGY OF WELDING: Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat-affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld-metal toughness. **(9)**

WELDING OF ALLOY STEELS AND NON-FERROUS METALS: Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions. **(9)**

DEFECTS, WELDABILITY AND STANDARDS: Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Heine R W, Loper C R, Rosenthal P C, *'Principles of Metal Castings'*. Tata McGraw Hill, 2017.
2. Chakrabarthi A K, *'Casting Technology and Cast Alloys'*. Prentice Hall, 2005.
3. Radhakrishnan V. M, ‘Welding Technology and Design’. New Age International Publications, 2nd Edition, 2011.

REFERENCES:

1. ASM International, *'ASM Handbook: Casting (Volume 15)'*. ASM International, 2008.
2. Beeley P, *'Foundry Technology'*. Butterworth-Heinemann, 2001.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom’s Level**
CO1	Explain the fundamental physical metallurgical principles governing casting and welding processes.	**K2**
CO2	Apply solidification concepts to predict the microstructure of casted and welded products made from ferrous and non-ferrous alloys.	**K3**
CO3	Examine the casting and welding microstructures to identify defects and assess their impact on the mechanical properties of ferrous and non-ferrous alloys.	**K4**
CO4	Evaluate microstructural features of a given microstructure using an appropriate software.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP29 PRINCIPLES OF MATERIALS SELECTION

3 0 0 3

ENGINEERING MATERIALS: Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials, non-metallic materials- smart materials - physical, metrical properties of metals. **(9)**

MATERIAL PROPERTIES: Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties – Magnetic Properties - Fabrication Properties –electrical, optical properties - Environmental Properties, Corrosion properties –shape and size - Material Cost and Availability– failure analysis. **(9)**

MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS: Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials. **(9)**

MATERIALS SELECTION CHARTS AND TESTING: Ashby material selection charts-Testing of Metallic Materials - Plastics Testing – Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Nondestructive Inspection. **(9)**

APPLICATIONS AND USES: Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Ashby M F, *'Materials Selection in Mechanical Design'*. Elsevier, 6th Edition, 2024.
2. Ashby M F, Johnson K, *'Materials and Design: The Art and Science of Material Selection in Product Design'*. Elsevier, 2002.

REFERENCES:

1. Charles J A, Crane F A A, Furness J A G, *'Selection and Use of Engineering Materials'*. Butterworth-Heinemann, 3rd Edition, 1997.
2. Kutz Myer (Ed.), *'Handbook of Materials Selection'*. John Wiley & Sons Inc., New York, 2002.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand engineering materials, properties, and their impact on manufacturing	**K2**
CO2	Select suitable materials for appropriate engineering applications.	**K3**
CO3	Analyze the Ashby charts to select a suitable material for engineering requirements	**K4**
CO4	Present material selection techniques for real-world applications	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP30 COMPOSITE MATERIALS

3 0 0 3

INTRODUCTION TO COMPOSITE MATERIALS: Definition, characteristics, and classification of composite materials – Distinction between matrix and reinforcement – Types of composites: polymer matrix, metal matrix, ceramic matrix, hybrid composites – Advantages and limitations of composites over conventional materials – Applications. **(9)**

CONSTITUENTS OF COMPOSITES: Fibers: Types – glass, carbon, aramid, and natural fibers – their structure and properties – Matrix materials: thermoset and thermoplastic polymers, metals, and ceramics – Fillers and additives, Interface bonding and interphase behavior – Micromechanics of failure in composites – Fiber-matrix interaction and wetting. **(9)**

MANUFACTURING OF POLYMER COMPOSITES: Overview of manufacturing methods – Hand lay-up, spray lay-up, resin transfer molding (RTM), pultrusion, filament winding, autoclave molding – Manufacturing of short fiber and particulate composites – Defects in processing and quality control**.** **(9)**

MANUFACTURING OF METAL AND CERAMIC COMPOSITES: Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs)– hot pressing reaction bonding process-infiltration technique, direct oxidation-interfaces challenges, and thermal applications. **(9)**

MECHANICAL BEHAVIOR AND LAMINATED COMPOSITES: Mechanical behavior of unidirectional and short-fiber composites – Stress-strain response – Mechanics of lamina: stress-strain relationships, stiffness matrix – Orthotropic behavior and engineering constants – Laminate theory: stacking sequence, symmetric and asymmetric laminates – In-plane loading analysis of laminates. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Agarwal Bhagwan D, Broutman Lawrence J, Chandrashekhara K, *'Analysis and Performance of Fiber Composites'*. John Wiley & Sons, United States, 2017.
2. Kaw Autar K, *'Mechanics of Composite Materials'*. CRC Press, United States, 2007.

REFERENCES:

1. Vasiliev Valery V, Morozov Evgeny V, *'Advanced Mechanics of Composite Materials and Structural Elements'*. Elsevier Ltd, 2018.
2. Mallick P K, *'Fiber-Reinforced Composites: Materials, Manufacturing, and Design'*. CRC Press, United States, 2007.
3. Voyiadjis George Z, Kattan Peter I, *'Mechanics of Composite Materials with MATLAB'*. Springer, 2014.
4. Jones Robert M, *'Mechanics of Composite Materials'*. CRC Press, United States, 2018.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the fundamentals of composite materials, such as constituents, processing methods, mechanical behavior, and applications.	**K2**
CO2	Apply engineering knowledge to select, process, and design composite materials for structural and functional applications.	**K3**
CO3	Analyze composite materials to assess their suitability for applications.	**K4**
CO4	Use modern tools to analyze composite material behavior.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP31 MECHANICAL BEHAVIOUR OF MATERIALS

3 0 0 3

INTRODUCTION TO MATERIAL BEHAVIOR: Role of materials in engineering design – Mechanical properties: strength, hardness, toughness, ductility – Stress-strain behavior of ductile and brittle materials – Elastic and plastic deformation – Introduction to strengthening mechanisms: grain size refinement, work hardening, solid solution strengthening – Effect of temperature and strain rate. **(9)**

MATERIAL BEHAVIOR UNDER LOADING AND FAILURE: Tensile, compressive, and shear behavior – Fatigue: definition, S-N curve, stages of fatigue failure – Creep: time-temperature dependence– Introduction to fracture: ductile and brittle fracture – Real-world examples of failure in engineering components. **(9)**

MATERIAL SELECTION AND APPLICATION DESIGN: Factors influencing material selection: strength, cost, corrosion, thermal properties – Introduction to performance indices – Basics of material selection charts – Processing-structure-property relationship – Case studies. **(9)**

COMMON ENGINEERING METALS: Ferrous materials: plain carbon steels, cast iron, alloy steel, wrought iron, pig iron – Non-ferrous materials: Aluminum, Copper, Zinc, Nickel, Titanium, Magnesium – Application of ferrous and non-ferrous materials. **(9)**

NON-METALLIC AND COMPOSITE MATERIALS: Polymers: types, properties, and engineering applications – Ceramics: classification– Composites: basic classification, advantages over conventional materials – Comparison of metals, ceramics, and polymers – Functional application-based selection. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Hosford William F, *'Mechanical Behaviour of Materials'*. Cambridge University Press, New York, USA, 2005.
2. Meyers Marc A, Chawla Krishan Kumar, *'Mechanical Behaviour of Materials'*. Cambridge University Press, New York, USA, 2nd Edition, 2008.
3. Dieter George E, *'Mechanical Metallurgy'*. McGraw Hill, 3rd Edition, 2017.
4. Callister William D Jr, Rethwisch David G, *'Callister's Materials Science and Engineering'*. Wiley Editorial, 2nd Edition, 2018.

REFERENCES:

1. Courtney Thomas H, *'Mechanical Behavior of Materials'*. McGraw Hill, 2nd Edition, 2000.
2. Ashby M F, *'Materials Selection in Mechanical Design'*. Butterworth-Heinemann, 2nd Edition, 1999.
3. Askeland Donald R, Phule Pradeep P, *'The Science and Engineering of Materials'*. Thomson, Singapore, 4th Edition, 2003.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand material responses to loading and environments, and their role in engineering design and selection.	K2
CO2	Apply mechanics and material science principles to solve problems in material behavior and selection.	K3
CO3	Analyze the mechanical behavior of materials to interpret their properties, performance, and suitability for various applications.	K4

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEP32 NON-DESTRUCTIVE TESTING OF MATERIALS

3 0 0 3

INTRODUCTION TO NDT AND VISUAL TESTING: Concepts of non-destructive testing; merits and limitations; NDT versus mechanical testing; fundamentals of visual testing – vision, lighting, material attributes and environmental factors; visual perception; direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes; light sources and special lighting. **(9)**

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTING: Liquid penetrant inspection – principles, applications, dyes, developers and cleaners; methods, advantages, limitations and interpretation; magnetic particle inspection – principles, magnetization methods, testing procedures, demagnetization, advantages, limitations and evaluation of indications. **(9)**

EDDY CURRENT TESTING AND THERMOGRAPHY: Eddy current testing – generation, properties, probes and instrumentation; arrangements, applications, advantages and limitations; factors affecting sensing elements, calibration and evaluation; thermography – principles, contact and non-contact methods, active and passive techniques; infrared thermography, detectors, instrumentation and applications. **(9)**

ULTRASONIC TESTING AND ACOUSTIC EMISSION TECHNIQUE: Ultrasonic testing – wave types, characteristics, attenuation, couplants and probes; inspection methods – pulse echo, transmission and phased array; scanning methods and displays; weld inspection, TOFD technique and thickness measurement; acoustic emission technique – principles, signal types, wave propagation, source location, instrumentation, advantages, limitations and applications. **(9)**

RADIOGRAPHY TESTING: X-ray and gamma ray sources and characteristics; absorption and scattering; filters and screens; imaging techniques – film and digital radiography; exposure factors, inverse square law, exposure charts; penetrameters; safety in radiography. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Raj Baldev, Jayakumar T, Thavasimuthu M, *'Practical Non-Destructive Testing'*. Alpha Science International Limited, 3rd Edition, 2002.
2. Prasad J, Nair C G K, *'Non-Destructive Test and Evaluation of Materials'*. Tata McGraw Hill Education, 2nd Edition, 2011.

REFERENCES:

1. ASM International, *'ASM Metals Handbook: Non-destructive Evaluation and Quality Control (Vol. 17)'*. American Society of Metals, USA, 2001.
2. Prakash Ravi, *'Non-Destructive Testing Techniques'*. New Age International Publishers, 1st Revised Edition, 2010.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Understand the principles, instrumentation, advantages and limitations of major non-destructive testing methods.	**K2**
CO2	Apply appropriate non-destructive testing techniques and procedures for defect detection, evaluation and quality inspection in engineering materials and components.	**K3**
CO3	Analyze and interpret test results obtained from various NDT methods to assess defects, structural integrity and safety of components.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
CO3		3										2	2
	3	**3**										**2**	**2**

1-low, 2-medium, 3-high

25MEP33 MATERIALS CHARACTERIZATION TECHNIQUES

3 0 0 3

INTRODUCTION TO MATERIALS CHARACTERIZATION: Classification of characterization techniques – Structural, Microstructural, Compositional, and Surface characterization – Resolution, magnification, accuracy, and sensitivity – Sampling and specimen preparation – Calibration and standards. **(5)**

STRUCTURAL CHARACTERIZATION: X-ray Diffraction (XRD): Bragg's law, diffraction geometry, powder method – Phase identification, lattice parameter measurement – Structure factor – Crystallite size effect and Scherrer formula – Full Width at Half Maximum (FWHM) and line broadening – Effect of strain: tensile vs. compressive, uniform vs. non-uniform – Electron Diffraction: SAED and Kikuchi patterns – Fundamentals of Neutron and synchrotron diffraction. **(10)**

MICROSTRUCTURAL CHARACTERIZATION: Optical Microscopy – Etching, grain size, phase estimation – Scanning Electron Microscopy (SEM): secondary and backscattered imaging – Transmission Electron Microscopy (TEM): bright field, dark field, HRTEM – Atomic Force Microscopy (AFM): contact and non-contact modes – Focused Ion Beam (FIB) – Atom Probe Tomography (APT): working principle and applications – Aberrations in Microscopes. **(12)**

COMPOSITIONAL AND MOLECULAR CHARACTERIZATION: Energy Dispersive and Wavelength Dispersive X-ray Spectroscopy (EDS/WDS) – X-ray Photoelectron Spectroscopy (XPS) – Auger Electron Spectroscopy (AES) – Secondary Ion Mass Spectrometry (SIMS) – Electron Energy Loss Spectroscopy (EELS) – Raman Spectroscopy – Fourier Transform Infrared Spectroscopy (FTIR) – Fluorescence Spectroscopy. **(9)**

THERMAL AND SURFACE CHARACTERIZATION: Thermal Analysis: Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA), Thermogravimetric Analysis (TGA), Dynamic Mechanical Analysis (DMA) – Dilatometry – Surface Profilometry – Nanoindentation. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Leng Yang, *'Materials Characterization: Introduction to Microscopic and Spectroscopic Methods'*. John Wiley & Sons, 2013.
2. Angelo P C, *'Materials Characterization'*. Cengage Learning India Private Limited, 2016.

REFERENCES:

1. Cullity B D, Stock S R, *'Elements of X-ray Diffraction'*. Pearson Education Ltd, 2013.
2. Whan R E, *'ASM Handbook: Materials Characterization (Volume 10)'*. ASM International, USA, 1992.
3. Goldstein Joseph et al., *'Scanning Electron Microscopy and X-ray Microanalysis'*. Springer, 2018.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamentals of diffraction, microscopy, thermal, and spectroscopic techniques used for materials characterization.	**K2**
CO2	Apply characterization techniques to determine phase composition, thermal behaviour, and microstructural features of materials.	**K3**
CO3	Analyze the data from diffraction patterns, micrographs, and thermal curves to correlate processing history with structural and phase evolution in metallic and non-metallic materials.	**K4**
CO4	Plot and interpret experimental data obtained from various characterization techniques using appropriate software.	

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

Fourth ACM

25MEP34 NANOMATERIALS AND APPLICATIONS

3 0 0 3

NANOMATERIALS: Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials. **(9)**

THERMODYNAMICS & KINETICS OF NANO STRUCTURED MATERIALS: Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials. **(9)**

PROCESSING: Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique. **(9)**

STRUCTURAL CHARACTERISTICS: Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis. **(9)**

APPLICATIONS: Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Bhusan B. (Ed.), ‘Springer Handbook of Nanotechnology’. Springer, 2nd edition, 2007.
2. Koch C. C. (Ed.), ‘Nanostructured Materials: Processing, Properties and Potential Applications’. Noyes Publications, 2000.

REFERENCES:

1. Poole C. P. and Owens F. J., *‘Introduction to Nanotechnology’*. John Wiley, 2003.
2. Nalwa H. S., *‘Encyclopedia of Nanoscience and Nanotechnology’*. American Scientific Publishers, 2004.
3. Zehetbauer M. J. and Zhu Y. T., *‘Bulk Nanostructured Materials’*. Wiley, 2008.
4. Wang Z. L., *‘Characterization of Nanophase Materials’*. Wiley, 2000.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom’s Level**
CO1	Explain and describe the classification, thermodynamic stability, synthesis methods, and applications of nanomaterials and nanocomposites.	**K2**
CO2	Apply the principles of dimensionality, thermodynamics and kinetics to analyze the processing techniques, structural characteristics, and practical uses of various nanomaterials.	**K3**
CO3	Analyze the properties of nanomaterials and bulk materials, evaluate their synthesis methods, and characterize structures for advanced technological applications.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	3											2	2
CO3		2										2	2
	3	**2**										**2**	**2**

1-low, 2-medium, 3-high

25MEP35 MATERIALS FOR ENERGY STORAGE AND CONVERSION

3 0 0 3

INTRODUCTION: Global energy scenario – renewable energy sources – need for energy storage and conversion – classification of energy materials – fundamentals of electrochemistry – ionic conductivity and charge transfer – structure–property relationship of energy materials – nanomaterials for energy applications. **(9)**

BATTERY MATERIALS AND TECHNOLOGIES: Principles of batteries – primary and secondary batteries – materials for anodes, cathodes, separators and electrolytes – lithium-ion, sodium-ion and solid-state batteries – battery management systems – safety aspects – recycling of battery materials. **(9)**

SUPERCAPACITORS AND HYDROGEN ENERGY MATERIALS: Fundamentals of supercapacitors – electric double layer capacitors and pseudocapacitors – electrode materials – graphene, CNTs and conducting polymers – hydrogen production and storage – metal hydrides and carbon-based storage materials – hydrogen embrittlement. **(9)**

FUEL CELLS AND ENERGY CONVERSION MATERIALS: Principles of fuel cells – PEM fuel cells and SOFC – electrode and electrolyte materials – catalysts and bipolar plate materials – corrosion and degradation – thermoelectric and photovoltaic materials – energy harvesting materials. **(9)**

ADVANCED MATERIALS AND SUSTAINABILITY IN ENERGY SYSTEMS: Advanced nanomaterials for energy applications – phase change materials for thermal energy storage – sustainable energy materials – additive manufacturing of energy materials – AI approaches in material development – recycling and environmental impact of energy materials. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Linden D., Reddy T. B., *'Handbook of Batteries'*. McGraw Hill Education, 4th edition, 2011.
2. Viswanathan B., *'Energy Sources: Fundamentals of Chemical Conversion Processes and Applications'*. Springer, 2017.

REFERENCES:

1. O'Hayre R., Cha S.W., Colella W., Prinz F.B., *'Fuel Cell Fundamentals'*. Wiley, 3rd edition, 2016.
2. Luque A., Hegedus S., *'Handbook of Photovoltaic Science and Engineering'*. Wiley, 2nd edition, 2011.
3. Kalaiselvam S., Parameshwaran R., *'Thermal Energy Storage Technologies for Sustainability'*. Elsevier, 2014.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of energy storage and conversion systems and energy materials.	**K2**
CO2	Apply the knowledge of batteries, supercapacitors, fuel cells and hydrogen storage materials for energy applications.	**K3**
CO3	Analyze the performance and sustainability aspects of materials used in energy storage and conversion systems.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1													
CO2	3											2	2
CO3		3										2	2
	3	**2**										**2**	**2**

1-low, 2-medium, 3-high

Fourth ACM

25MEP36 NON-METALLIC MATERIALS

3 0 0 3

POLYMERIC MATERIALS: Classification of polymers; thermoplastics and thermosets; polymerization mechanisms; structure–property relationships; mechanical, thermal and electrical properties; additives and fillers; degradation and recycling of polymers; engineering applications. **(9)**

CERAMIC MATERIALS: Structure and classification of ceramics; traditional and advanced ceramics; processing techniques – powder preparation, forming and sintering; properties – mechanical, thermal and electrical; defects in ceramics; applications in engineering. **(9)**

COMPOSITE MATERIALS: Classification of composites; matrix and reinforcement materials; fiber-reinforced composites; particulate and laminated composites; manufacturing techniques – hand lay-up, filament winding, pultrusion; properties and applications of composites. **(9)**

GLASS AND BIOMATERIALS: Structure and properties of glass; types of glass; glass manufacturing processes; applications; introduction to biomaterials; types – bioinert, bioactive and biodegradable materials; properties and applications in medical field. **(9)**

ADVANCED NON-METALLIC MATERIALS: Nanomaterials – types, synthesis and properties; smart materials; polymer nanocomposites; carbon-based materials (graphene, CNTs); materials for energy storage and conversion; environmental aspects and sustainability. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Charles E. Carraher Jr. *'Introduction to Polymer Chemistry'*. Taylor & Francis Inc, CRC Press Inc, 2017.
2. Chandan Das, *'Introduction to Ceramics: Fabrication, Characterizations, and Applications'.* Taylor & Francis Inc, CRC Press Inc, 2024.
3. A.K. Bhargava, *'Engineering Materials: Polymers, Ceramics and Composites'*. PHI publication 2nd Edition, 2012.

REFERENCES:

1. James E Shelby *'Introduction to Glass Science and Technology'*. Royal Society of Chemistry, 3rd Edition, 2020
2. Mauli Agrawal C, Mark R. Appleford, Gopinath Mani, Joo L. Ong, *'Introduction to Biomaterials: Basic Theory with Engineering Applications'.* Cambridge University Press, 2013.

COURSE OUTCOMES:

At the end of this course students will be able to		Bloom's Level
CO1	Understand the classification, structure, properties and processing of various non-metallic materials including polymers, ceramics, composites, glass and advanced materials.	**K2**
CO2	Apply the knowledge of material selection and processing techniques of non-metallic materials for engineering applications.	**K3**
CO3	Analyze the structure–property relationships and performance of non-metallic materials for specific industrial and advanced applications.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEM01 FUNDAMENTALS OF THERMAL ENGINEERING

3 0 0 3

BASIC CONCEPTS AND PROPERTIES: System, control volume; properties, state and equilibrium; processes and cycles; intensive and extensive properties; Zeroth law of thermodynamics; pure substances; phase diagram; property tables; energy forms; heat and work interactions. **(9)**

FIRST LAW OF THERMODYNAMICS: First law for closed systems; energy balance; work and heat transfer; steady flow energy equation; applications to turbines, compressors, pumps and nozzles; limitations of first law. **(9)**

SECOND LAW OF THERMODYNAMICS: Kelvin-Planck and Clausius statements; heat engines, refrigerators and heat pumps; Carnot cycle; efficiency; entropy; irreversibility; availability and exergy. **(9)**

HEAT TRANSFER FUNDAMENTALS: Modes of heat transfer; conduction, convection and radiation; Fourier law; Newton's law of cooling; Stefan-Boltzmann law; basic heat transfer applications. **(9)**

THERMAL SYSTEM APPLICATIONS: Rankine cycle; basics of steam power plants; internal combustion engines; SI and CI engines; refrigeration and air conditioning; vapour compression cycle; overview of renewable energy systems. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Nag P K, *'Engineering Thermodynamics'*. Tata McGraw Hill, 2017.
2. Çengel Yunus A, Boles Michael A, *'Thermodynamics: An Engineering Approach'*. McGraw Hill, 2015.

REFERENCES:

1. Holman J P, *'Heat Transfer'*. McGraw Hill, 2010.
2. Ganesan V, *'Internal Combustion Engines'*. Tata McGraw Hill, 2012.
3. Çengel Yunus A, Ghajar Afshin J, *'Heat and Mass Transfer: Fundamentals and Applications'*. McGraw Hill, 2015.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamental principles of thermodynamics and heat transfer in thermal systems.	**K2**
CO2	Apply thermodynamic and heat transfer concepts to analyze basic thermal engineering systems and processes.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM02 BASIC PRODUCTION TECHNIQUES

3 0 0 3

METAL CASTING PROCESSES: Introduction to manufacturing processes; pattern materials and allowances; moulding sand properties and testing; moulding processes; core making; melting and pouring; casting defects and remedies; inspection of castings. **(9)**

FORMING PROCESSES: Hot and cold working; rolling, forging, extrusion and drawing; sheet metal operations; blanking, piercing, bending and deep drawing; defects in forming processes; applications. (**9)**

WELDING PROCESSES: Principles of welding; fusion welding and solid-state welding; gas welding, arc welding; resistance welding; welding defects and inspection; safety precautions; applications. **(9)**

MACHINING PROCESSES: Fundamentals of machining; cutting tool materials; single point and multi-point cutting tools; turning, milling, drilling and grinding; cutting parameters; tool wear and tool life. **(9)**

NON-TRADITIONAL AND ADVANCED PROCESSES: Introduction to non-traditional machining; EDM, ECM, USM and laser beam machining; basics of additive manufacturing; advantages and limitations; applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Hajra Choudhury S K, Hajra Choudhury A K, Nirjhar Roy S K, *'Elements of Workshop Technology (Vol. I & II)'*. Media Promoters & Publishers Pvt Ltd, 2010.
2. Kalpakjian Serope, Schmid Steven R, *'Manufacturing Engineering and Technology'*. Pearson, 2014.

REFERENCES:

1. Groover Mikell P, *'Fundamentals of Modern Manufacturing: Materials, Processes and Systems'*. John Wiley & Sons Inc, 2010.
2. Jain Vijay K, *'Advanced Machining Processes'*. Allied Publishers Pvt Ltd, New Delhi, 2007.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the basic production processes including casting, forming, welding and machining.	**K2**
CO2	Apply appropriate production techniques to manufacture components considering process capabilities and limitations.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM03 ROBOTICS AND MECHANISM DESIGN

3 0 0 3

BASICS OF MECHANISMS: Kinematic links; pairs; chains and mechanisms; types of constrained motion; Grashof's law; inversions of four bar and slider crank mechanisms; degrees of freedom; mobility criteria; planar mechanisms. **(9)**

MECHANISM ANALYSIS: Velocity and acceleration analysis; graphical methods; relative velocity and acceleration; instantaneous centre method; kinematic analysis of simple mechanisms; cams and followers; types of cams; follower motion. **(9)**

MECHANISM SYNTHESIS: Function generation; path generation; motion generation; graphical synthesis of four bar mechanisms; analytical methods; dimensional synthesis; applications. **(9)**

INTRODUCTION TO ROBOTICS: Robot anatomy; classification of robots; coordinate systems; work envelope; end effectors; sensors and actuators; robot specifications; applications in manufacturing. **(9)**

ROBOT KINEMATICS AND APPLICATIONS: Forward and inverse kinematics; basic robot motions; robot programming methods; automation in manufacturing; robotic assembly; safety and industrial applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Groover Mikell P, *'Industrial Robotics: Technology, Programming, and Applications'*. McGraw Hill Education, 2012.
2. Uicker John J, Pennock Gordon R, Shigley Joseph E, *'Theory of Machines and Mechanisms'*. Oxford University Press, 2017.

REFERENCES:

1. Norton Robert L, *'Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines'*. McGraw Hill, 2011.
2. Niku Saeed B, *'Introduction to Robotics: Analysis, Control and Applications'*. Wiley, 2017.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of mechanisms and fundamentals of robotics systems.	**K2**
CO2	Apply kinematic analysis and robotic concepts to solve engineering problems in mechanism design and automation.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM04 INTERNAL COMBUSTION ENGINES

3 0 0 3

BASICS OF I.C. ENGINES: Classification of engines; components and working principles of SI and CI engines; two stroke and four stroke engines; engine terminology; valve timing diagram; fuels and combustion basics. **(9)**

THERMODYNAMIC CYCLES AND COMBUSTION: Air standard cycles; Otto cycle; Diesel cycle; Dual cycle; fuel-air cycle; combustion in SI and CI engines; abnormal combustion; knocking and its effects; combustion chambers. **(9)**

FUEL SUPPLY AND IGNITION SYSTEMS: Carburetion; fuel injection systems; MPFI and CRDI systems; ignition systems; battery ignition and magneto ignition; electronic ignition systems; air intake and exhaust systems. **(9)**

ENGINE PERFORMANCE AND TESTING: Performance parameters; indicated power; brake power; thermal efficiencies; specific fuel consumption; engine testing methods; heat balance; emission measurement techniques. **(9)**

EMISSIONS AND CONTROL: Exhaust emissions; sources of pollutants; emission standards; emission control techniques; catalytic converters; alternative fuels; electric and hybrid vehicle overview. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Ganesan V, *'Internal Combustion Engines'*. Tata McGraw Hill, 3rd Edition, 2012.
2. Heywood John B, *'Internal Combustion Engine Fundamentals'*. McGraw Hill, 2018.

REFERENCES:

1. Heisler Heinz, *'Advanced Engine Technology'*. SAE International Publications, 1998.
2. Ferguson Colin R, Kirkpatrick Allan T, *'Internal Combustion Engines: Applied Thermosciences'*. Wiley, 2015.
3. Pulkrabek Willard W, *'Engineering Fundamentals of the Internal Combustion Engine'*. Pearson, 2013.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the working principles and performance characteristics of internal combustion engines.	**K2**
CO2	Apply thermodynamic and combustion concepts to assess engine performance and emission control methods.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM05 ENGINEERING MATERIALS

3 0 0 3

STRUCTURE OF MATERIALS: Atomic structure; bonding in solids; crystal structures; unit cells; crystal defects; dislocations; grain boundaries; phase diagrams; iron-carbon equilibrium diagram. **(9)**

MECHANICAL PROPERTIES: Stress-strain behaviour; elastic and plastic deformation; hardness; toughness; creep and fatigue; factors affecting mechanical properties; testing methods. **(9)**

FERROUS AND NON-FERROUS MATERIALS: Steels and cast irons; classification and applications; alloy steels; heat treatment of steels; aluminium and copper; properties and applications. **(9)**

POLYMERS AND COMPOSITES: Types of polymers; thermoplastics and thermosets; properties and applications; fibre reinforced composites; manufacturing methods; applications. **(9)**

ADVANCED MATERIALS: Ceramics; smart materials; nanomaterials; biomaterials; selection of materials; corrosion and prevention methods. (**9)**

Total L: 45 periods

TEXT BOOKS:

1. Callister William D Jr, Rethwisch David G, *'Materials Science and Engineering: An Introduction'*. Wiley, 2018.
2. Smith William F, Hashemi Javad, *'Foundations of Materials Science and Engineering'*. McGraw Hill, 2010.

REFERENCES:

1. Dieter George E, *'Mechanical Metallurgy'*. McGraw Hill, 2017.
2. Ashby M F, *'Materials Selection in Mechanical Design'*. Elsevier, 2011.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the structure, properties and classification of engineering materials.	**K2**
CO2	Apply material selection and property relationships for engineering applications.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

Fourth ACM

25MEM06 PRODUCT MODELLING AND VISUALIZATION TECHNIQUES

3 0 0 3

BASICS OF DESIGN: Understanding of projections; scales; units; geometric dimensioning and tolerancing (GD&T); its 14 symbols; special characteristics; title block reading; revision / ECN status of drawings; customer specific requirements; drawing grid reading. **(9)**

2D DRAFTING: Projection views; orthographic view; auxiliary view; full and half section views; broken section view; offset section view; title block creation; BOM creation; notes creation; ballooning of 2D drawings; inspection reporting features. **(9)**

3D MODELING: Conversion of views; 2D to 3D and 3D to 2D; parametric and non-parametric modeling; feature tree and its advantages; surface modeling; solid modeling; Boolean operations such as union; subtraction and intersection. **(9)**

ASSEMBLY MODELING AND VISUALIZATION: Assembly constraints; mating conditions; exploded views; rendering techniques; material and texture assignment; lighting; animation; interference and clearance checking. **(9)**

CAD APPLICATIONS AND DATA MANAGEMENT: Product data management; file formats; CAD standards; drawing release process; design revision control; introduction to PLM; collaboration tools; industrial applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Srinivas J, *'CAD / CAM Principles and Application'*. Oxford Higher Education Publication, 2016.
2. Groover Mikell P, *'Automation, Production Systems and Computer Integrated Manufacturing'*. John Wiley & Sons Inc, 2007.

REFERENCES:

1. Rao P N, *'CAD / CAM: Principles and Applications'*. Tata McGraw Hill, 2010.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamentals of product modelling, drafting and visualization techniques.	**K2**
CO2	Apply CAD tools to create 2D drawings, 3D models and assemblies for engineering applications.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM07 MECHANICS OF RIGID AND DEFORMABLE BODIES

3 0 0 3

STATICS OF RIGID BODIES: Force systems; resolution and composition of forces; equilibrium of particles and rigid bodies; free body diagrams; moments and couples; friction; applications. **(9)**

PROPERTIES OF AREAS AND MASS: Centroid and centre of gravity; area moments of inertia; polar moment of inertia; parallel axis theorem; mass moment of inertia; applications. **(9)**

KINEMATICS OF PARTICLES AND RIGID BODIES: Rectilinear and curvilinear motion; velocity and acceleration; relative motion; kinematics of rigid bodies; translation and rotation; applications. **(9)**

KINETICS OF PARTICLES AND RIGID BODIES: Newton's laws of motion; work-energy principle; impulse and momentum; impact; dynamics of rigid bodies; applications. **(9)**

MECHANICS OF DEFORMABLE BODIES: Stress and strain; Hooke's law; elastic constants; axial loading; shear force and bending moment; torsion; deflection of beams; failure theories. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Hibbeler Russell C, *'Engineering Mechanics: Statics and Dynamics'*. Pearson, 2016.
2. Bansal R K, *'Strength of Materials'*. Laxmi Publications Pvt Ltd, 2010.

REFERENCES:

1. Beer Ferdinand P, Johnston E Russell, Mazurek David F, *'Vector Mechanics for Engineers: Statics and Dynamics'*. McGraw Hill, 2015.
2. Gere James M, Timoshenko Stephen P, *'Mechanics of Materials'*. Cengage Learning, 2012.
3. Meriam J L, Kraige L G, *'Engineering Mechanics: Dynamics'*. Wiley, 2013.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of statics, dynamics and mechanics of deformable bodies.	**K2**
CO2	Apply mechanics concepts to analyse forces, motion and deformation in engineering systems.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM08 FUNDAMENTALS OF HEAT TRANSFER

3 0 0 3

INTRODUCTION TO HEAT TRANSFER: Modes of heat transfer; conduction; convection; radiation; thermal properties; thermal conductivity; specific heat; heat transfer mechanisms; applications. **(9)**

HEAT CONDUCTION: Fourier law; one dimensional steady state conduction; heat conduction through plane wall; cylinder and sphere; composite walls; thermal resistance concept; critical radius of insulation; unsteady state conduction basics. **(9)**

CONVECTION HEAT TRANSFER: Newton's law of cooling; free and forced convection; boundary layer concepts; dimensionless numbers; Nusselt; Reynolds and Prandtl numbers; heat transfer correlations; applications. **(9)**

RADIATION HEAT TRANSFER: Thermal radiation; black body and grey body; emissivity; absorptivity; Stefan-Boltzmann law; Wien's displacement law; view factors; radiation exchange between surfaces. **(9)**

HEAT EXCHANGERS AND APPLICATIONS: Types of heat exchangers; parallel flow and counter flow; LMTD method; effectiveness-NTU method; fouling factor; applications in engineering systems. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Holman J P, *'Heat Transfer'*. McGraw Hill, 2010.
2. Çengel Yunus A, Ghajar Afshin J, *'Heat and Mass Transfer: Fundamentals and Applications'*. McGraw Hill, 2015.

REFERENCES:

1. Incropera Frank P, DeWitt David P, Bergman Theodore L, Lavine Adrienne S, *'Fundamentals of Heat and Mass Transfer'*. Wiley, 2017.
2. Kreith Frank, Manglik Raj M, Bohn Mark S, *'Principles of Heat Transfer'*. Cengage Learning, 2011.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the fundamental modes and principles of heat transfer.	**K2**
CO2	Apply heat transfer concepts to analyse conduction, convection and radiation problems in engineering systems.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

Fourth ACM

25MEM09 LEAN MANUFACTURING

3 0 0 3

INTRODUCTION TO LEAN: Evolution of manufacturing systems; mass production to lean production; principles of lean manufacturing; value and value stream; waste identification; types of waste; lean thinking; benefits and limitations. **(9)**

LEAN TOOLS AND TECHNIQUES: 5S methodology; Kaizen; Just In Time (JIT); Kanban system; Poka-Yoke; Total Productive Maintenance (TPM); Standard work; visual management. **(9)**

VALUE STREAM MAPPING: Current state mapping; future state mapping; process flow analysis; takt time; cycle time; lead time; bottleneck identification; continuous improvement strategies. **(9)**

LEAN IMPLEMENTATION: Lean layout; cellular manufacturing; line balancing; pull and push systems; supply chain integration; lean in service industries; case studies. **(9)**

QUALITY AND PERFORMANCE IMPROVEMENT: Six Sigma basics; DMAIC methodology; statistical tools; process capability; performance measurement; benchmarking; sustainability in lean systems. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Womack James P, Jones Daniel T, *'Lean Thinking: Banish Waste and Create Wealth in Your Corporation'*. Free Press, 2003.
2. Liker Jeffrey K, *'The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer'*. McGraw Hill, 2004.

REFERENCES:

1. Rother Mike, Shook John, *'Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA'*. Lean Enterprise Institute, 2003.
2. George Michael L, *'Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed'*. McGraw Hill, 2002.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles, tools and techniques of lean manufacturing.	**K2**
CO2	Apply lean concepts to improve productivity and eliminate waste in manufacturing systems.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

25MEM10 METROLOGY AND QUALITY CONTROL SYSTEMS

3 0 0 3

BASICS OF METROLOGY: Measurement and its importance; standards of measurement; linear and angular measurement; limits, fits and tolerances; interchangeability; gauges and gauge design; slip gauges; measurement errors and calibration. **(9)**

MEASURING INSTRUMENTS AND METHODS: Vernier caliper; micrometer; dial indicator; comparators; optical measurement methods; surface roughness measurement; measurement of form and geometry; CMM basics. **(9)**

STATISTICAL QUALITY CONTROL: Quality concepts; control charts for variables and attributes; process capability; acceptance sampling; OC curves; sampling plans; applications. **(9)**

QUALITY MANAGEMENT SYSTEMS: ISO standards; quality assurance and quality control; documentation; auditing; TQM principles; continuous improvement; benchmarking. **(9)**

ADVANCED QUALITY TECHNIQUES: Six Sigma basics; DMAIC methodology; reliability engineering; failure analysis; FMEA; quality tools and techniques; industrial applications. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Jain R K, *'Engineering Metrology'*. Khanna Publishers, 2014.
2. Montgomery Douglas C, *'Statistical Quality Control: A Modern Introduction'*. Wiley, 2012.

REFERENCES:

1. Grant Eugene L, Leavenworth Richard S, *'Statistical Quality Control'*. Tata McGraw Hill, 2017.
2. Krishnaiah K, *'Applied Statistical Quality Control and Improvement'*. PHI Learning Pvt Ltd, 2014.
3. Mahajan M, *'Statistical Quality Control'*. Dhanpat Rai & Co Pvt Ltd, 2018.

COURSE OUTCOMES:

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles of metrology and quality control systems.	**K2**
CO2	Apply measurement techniques and statistical tools to ensure quality in manufacturing processes.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	2
CO2	3											2	2
	3											**2**	**2**

1-low, 2-medium, 3-high

OPEN ELECTIVES

25MEO01 FUNDAMENTALS OF ROBOTICS

3 0 0 3

INTRODUCTION : Classification of Robots based on Geometry, Workspace, Actuation, Control and Application; Advantages and Disadvantages of Robots - Robot Components: Manipulator, Wrist, End-effectors, Actuator, Sensor, Controller; Processor, Software; Degrees of Freedom; Robot Joints; Coordinates; Reference frames; Robot Specifications: Number of Axes; Major, Minor, Redundant; Payload Capacity and Speed; Reach and Stroke; Tool Orientation (RPY); Repeatability, Precision and Accuracy; Workspace. **(9)**

HOMOGENEOUS TRANSFORMATIONS: Matrix Representation: Representation of a point and vector in space, Global and Local Coordinate axes - Homogeneous Transformation Matrices: Representation of Pure Translation, Pure Rotation and Combined Transformations - Inverse of Transformation Matrices - Forward and Inverse Kinematic Equation: Position and Orientation. **(9)**

FORWARD KINEMATICS: Denavit-Hartenberg Notation - Transformation between two Adjacent Coordinate Frames - Forward Kinematics of Two, Three, Four, Five and Six axis Robots. **(9)**

INVERSE KINEMATICS: Decoupling Technique; Inverse Transformation Technique; Inverse position: Geometric Approach; Inverse Orientation; Inverse Kinematics of 2-, 3-, 4-, 5- and 6-axis Robots. **(9)**

VELOCITY KINEMATICS: Angular Velocity; Linear Velocity; Jacobian representation of Linear and Angular Velocity; Calculation of Jacobian for Two, Three and Four axis Robots; Inverse Jacobian; Singularities: Wrist and Arm Singularities; Manipulability; Induced joint torques and forces. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Niku Saeed B, *'Introduction to Robotics: Analysis, Control and Applications'*. John Wiley & Sons Inc, 2011.
2. Schilling Robert J, *'Fundamentals of Robotics: Analysis and Control'*. PHI Learning, 2009.

REFERENCES:

1. Jazar Reza N, *'Theory of Applied Robotics'*. Springer, 2010.
2. Saha S K, *'Introduction to Robotics'*. Tata McGraw Hill Education Pvt Ltd, 2010.
3. Mittal R K, Nagrath I J, *'Robotics and Control'*. Tata McGraw Hill Publishing Company Ltd, 2003.
4. Spong Mark W, Hutchinson Seth, Vidyasagar M, *'Robot Modeling and Control'*. Wiley, 2012.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the principles of robotics including structure, specifications, kinematics, coordinate systems, and motion fundamentals.	**K2**
CO2	Apply appropriate mathematical and modeling techniques to represent and simulate robotic systems and their motion.	**K3**
CO3	Analyze the motion behavior and performance characteristics of robotic systems under various operating conditions.	**K4**
CO4	Design robotic solutions using modeling and simulation tools, considering workspace optimization, motion planning, precision, and task requirements.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEO02 3D PRINTING TECHNOLOGY

3 0 0 3

INTRODUCTION: Overview; need; development of additive manufacturing technology; principle; AM process chain; classification; rapid prototyping; rapid tooling; rapid manufacturing; applications; benefits; case studies. **(9)**

POLYMER BASED AM PROCESSES: Stereolithography apparatus (SLA); digital light processing (DLP); continuous liquid interface production (CLIP); laminated object manufacture (LOM); material jetting; materials; process; advantages; limitations. **(9)**

METAL BASED AM PROCESSES: Laser engineered net shaping (LENS); selective laser sintering (SLS); selective laser melting (SLM); electron beam melting (EBM); binder jetting for metals; materials; process; advantages; limitations. **(9)**

EXTRUSION BASED PROCESS: Fused deposition modeling (FDM); introduction; basic principle; materials; applications; limitations; bioextrusion; solidification; position control; bonding; support generation; plotting and path control. **(9)**

POST-PROCESSING: Support material removal; surface texture improvement; aesthetic improvement; property enhancement using thermal and non-thermal techniques. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Gibson Ian, Rosen David, Stucker Brent, Khorasani Mahyar, *'Additive Manufacturing Technologies'*. Springer Cham, Switzerland, 3rd Edition, 2021.
2. Gebhardt Andreas, Hötter Jan-Steffen, *'Additive Manufacturing: 3D Printing for Prototyping and Manufacturing'*. Hanser Publications, 2015.

REFERENCES:

1. Milewski John O, *'Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewellery'*. Springer, 2017.
2. Chua Chee Kai, Leong Kah Fai, *'3D Printing and Additive Manufacturing: Principles and Applications'*. World Scientific, 2016.
3. Brandt Milan, *'Laser Additive Manufacturing: Materials, Design Technologies, and Applications'*. Woodhead Publishing, 2016.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explore the classifications, processes, and applications of AM for polymers and metals	**K2**
CO2	Select suitable AM processes based on materials, methods, and application requirements	**K3**
CO3	Design AM components to enhance functionality and performance	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	3
CO2	3											2	3
CO3			2		2							2	3
	3		**2**		**2**							**2**	**3**

1-low, 2-medium, 3-high

Fourth ACM

25MEO03 NEW PRODUCT DEVELOPMENT

3 0 0 3

FUNDAMENTALS OF NPD: Introduction; reading of drawing; grid reading; revisions; ECN (Engineering Change Note); component material grade; specifications; customer specific requirements; basics of monitoring of NPD using Gantt chart and critical path analysis; fundamentals of BOM; engineering BOM and manufacturing BOM; basics of MIS software and applications such as SAP, MS Dynamics, Oracle ERP Cloud; QFD. **(9)**

MATERIAL SPECIFICATIONS; ANALYSIS & PROCESS: Material specification standards such as ISO, DIN, JIS, ASTM, EN; awareness on manufacturing processes like metal casting and forming; machining (conventional; 3 axis; 4 axis; 5 axis); fabrication; welding processes; qualification of parts based on mechanical; physical and chemical properties; test report preparation and submission; fundamentals of DFMEA and PFMEA; fundamentals of FEA; bend analysis; hot distortion; metal and material flow; fill and solidification analysis. **(9)**

ESSENTIALS OF NPD: RFQ processing; feasibility studies and reporting; CFT discussion and reporting; concept design; machine selection for tool making and machining; manufacturing process selection; machining planning; cutting tool selection; inspection methods such as manual measurement; CMM; GOM; layout marking and cut section analysis; tool design and detailed drawing preparation; release to machine shop and CAM programming; tool assembly and shop floor trials; initial sample submission with PPAP documents. **(9)**

CRITERIONS OF NPD: New product qualification for dimensions; mechanical and physical properties; internal soundness testing using X-ray; radiography; ultrasonic testing; MPT; agreement with customer on testing frequency; market survey; risk analysis; validation with simulation results; lessons learned and horizontal deployment in NPD. **(9)**

REPORTING & FORWARD-THINKING OF NPD: Detailed study of PPAP with 18 elements; APQP and its five sections; APQP vs PPAP; importance of SOP; purpose and documentation; deployment in shop floor; prototyping and RPT concepts; applications and advantages; 3D printing such as resin models and sand cores; reverse engineering; cloud point generation; conversion to 3D model; advantages and limitations of RE; concurrent engineering; basics; applications and advantages in reducing development lead time; time to market; improving productivity and cost. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Jonsson Sten, *'Product Development'*. Butterworth-Heinemann, 2003.
2. Ulrich Karl T, Young Maria C, Eppinger Steven D, *'Product Design and Development'*. McGraw Hill, 2016.

REFERENCES:

1. Brown Tim, *'Change by Design'*. HarperCollins, 2009.
2. Morgan James M, Liker Jeffrey K, *'The Toyota Product Development System'*. Productivity Press, 2006.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Demonstrate the fundamental concepts of NPD	**K2**
CO2	Apply NPD fundamentals to plan, develop, and validate products using design tools, process selection, BOM, ERP systems, and quality techniques.	**K3**
CO3	Demonstrate the ability to develop and validate new products using design interpretation, material and process selection, digital tools, and quality documentation	**K3**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEO04 MODEL-BASED SYSTEMS ENGINEERING

3 0 0 3

INTRODUCTION TO MODEL-BASED SYSTEMS ENGINEERING: Overview of Systems Engineering and MBSE – Significance of MBSE in the automotive industry – Lifecycle of automotive systems from concept to production within an MBSE framework (V-Model) – Introduction to the RFLP (Requirement, Functional, Logical, and Physical) framework – System requirements and their role in guiding development – Conceptual modeling and abstraction of automotive systems for simulation – Personas and roles of engineering teams in the development cycle. **(9)**

ARCHITECTING AUTOMOTIVE SYSTEMS: Definition and importance of system architecture – Decomposition of complex systems into manageable subsystems – Architecting and managing requirements – Requirements traceability – Trade space exploration – Concept selection methodologies and decision-making frameworks. **(9)**

SYSTEM SIMULATION AND ANALYSIS: Development of dynamic models for automotive subsystems – Introduction to Body Control Module (BCM) – Use case development: Windshield wiper control system – Simulation-based verification and validation – Conformance checking of models against requirements – Functional behavior analysis. **(9)**

CONTROL SYSTEMS AND SOFTWARE INTEGRATION: Fundamentals of control system design for automotive applications – Plant modeling and control algorithm design – Controller performance evaluation – Software-in-the-loop (SIL) and Processor-in-the-loop (PIL) concepts – Introduction to Hardware-in-the-loop (HIL) testing – Integration of software and embedded controllers in system models. **(9)**

MBSE EMERGING TRENDS AND CASE STUDIES: INCOSE MBSE standards and frameworks – Systems-of-systems concepts – Safety analysis and sensor integration – Regulatory compliance in the automotive domain – Case study presentations from automotive and aerospace applications – Tools and technologies supporting modern MBSE workflows. **(9)**

Total L: 45 periods

TEXTBOOK:

1. Johnson Robert, *'Model-Based Systems Engineering with AI and Machine Learning'*.

REFERENCES:

1. International Council on Systems Engineering (INCOSE), *'Case Studies in Model-Based Systems Engineering'*.
2. MATLAB® & Simulink® Documentation.

COURSE OUTCOMES

At the end of this course students will be able to		Bloom's Level
CO1	Understand the principles of model-based systems engineering, system lifecycle management, system architecture, and simulation-based development across engineering domains.	**K2**
CO2	Apply model-based frameworks, modeling tools, system decomposition, and control development techniques for managing complex engineering systems.	**K3**
CO3	Analyze system models through simulation, verification, validation, and performance evaluation against defined requirements.	**K4**
CO4	Design integrated system solutions by synthesizing control algorithms, embedded software, and hardware components using model-based engineering workflows.	**K5**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEO05 ENERGY TECHNOLOGIES

3 0 0 3

ENERGY: Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives. **(8)**

CONVENTIONAL ENERGY: Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion. **(8)**

NON-CONVENTIONAL ENERGY: Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy. **(10)**

BIOMASS ENERGY: Biomass origin - Resources – Biomass estimation. Thermochemical conversion –Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification. **(10)**

ENERGY CONSERVATION: Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Bench marking and energy performance, material and energy balance, thermal energy management. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Rao S, Parulekar B B, *'Energy Technology'*. Khanna Publishers, 2005.
2. Nagpal G R, *'Power Plant Engineering'*. Khanna Publishers, 2008.

REFERENCES:

1. Nejat Vezirog, *‘Alternate Energy Sources’*. IT, McGraw Hill, New York.
2. El. Wakil, *‘Power Plant Technology’*. Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., *‘Solar Enery - Thermal Collection and Storage’*. Tata McGraw hill, New Delhi, 1981.
4. Thumann Albert, Younger William J, *'Handbook of Energy Audit'*. Fairmont Press, 7th Edition, 2008.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom’s Level**
CO1	Explain the types, sources, and importance of conventional and non-conventional energy resources, including global and Indian energy scenarios, units, and conversion factors.	**K2**
CO2	Apply the principles of solar, wind, ocean, geothermal, and biomass energy technologies to evaluate their potential and suitability for practical applications.	**K3**
CO3	Analyze the performance, efficiency, and sustainability of various energy systems, including power plants and energy conservation methods, through audits and energy management practices.	**K4**
CO4	Demonstrate the application of energy systems in a real-world case study (such as a power or process plant) by preparing a team report that includes system layout, energy consumption data, and assessment of environmental impacts.	**-**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

25MEO06 SMART MATERIALS

3 0 0 3

FUNDAMENTALS OF SMART MATERIALS: Introduction to smart materials; definition; significance and need; classification such as active; passive and hybrid materials; overview of stimuli responsive behaviour including mechanical; thermal; electrical; magnetic and optical; basic synthesis and processing techniques such as thin films; composites and functional coatings. **(9)**

SHAPE MEMORY ALLOYS AND PIEZOELECTRIC MATERIALS: Shape memory alloys; types; working mechanism of shape memory effect and superelasticity; thermomechanical behaviour; applications in biomedical; aerospace and robotics; piezoelectric materials; principle of piezoelectricity; common materials such as PZT and PVDF; applications in sensors; actuators and energy harvesting. **(9)**

MAGNETOSTRICTIVE; ELECTROACTIVE AND CHROMIC MATERIALS: Magnetostrictive materials; fundamentals and applications; magnetorheological and electrorheological fluids; principles and applications; electrochromic and thermochromic materials; working mechanisms and applications in smart windows; displays and thermal regulation systems. **(9)**

SMART COMPOSITES AND EMERGING SMART MATERIALS: Smart composites; fibre reinforced composites with embedded sensors and actuators; applications in structural health monitoring; nanostructured smart materials; smart coatings; thin films and nanoscale composites; self-healing and smart polymers. **(9)**

APPLICATIONS AND CASE STUDIES: Applications of smart materials; shape memory alloys in biomedical stents; piezoelectric sensors in structural health monitoring; magnetorheological dampers in automotive systems; electrochromic glass in building technologies; smart composites in aerospace structures; emerging industrial trends and future directions. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Kumar Upendra, Sonkar Piyush Kumar, *'Smart Materials for Science and Engineering'*. Wiley-Scrivener, 2024.
2. Shahinpoor Mohsen, *'Fundamentals of Smart Materials'*. Royal Society of Chemistry, 1st Edition, 2020.

REFERENCES:

1. Motzki P, Seelecke S, *'Encyclopedia of Smart Materials'*. Elsevier, Amsterdam, 2022.
2. Kharb Sandeep Singh, *'Introduction to Smart Materials'*. Abhishek Publications, 2024.

COURSE OUTCOMES

At the end of this course students will be able to		**Bloom's Level**
CO1	Explain the principles, classifications, fabrication techniques and applications of smart materials.	**K2**
CO2	Apply knowledge of smart material properties to select appropriate materials for specific engineering applications.	**K3**
CO3	Analyze the requirement and suggest the suitable smart materials for a given application.	**K4**

COs-POs & PSOs MAPPING

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

1-low, 2-medium, 3-high

LANGUAGE ELECTIVES

25HS211 COMMUNICATION SKILLS FOR ENGINEERS
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

COMMUNICATION CONCEPTS: Process of Communication – Inter and Interpersonal Communication – Essentials for effectiveness. **(9)**

ORAL COMMUNICATION: Oral presentations with visual aids and Group discussions. **(16)**

FOCUS ON SOFT SKILLS: Etiquette – Work Place etiquette – Telephone etiquette- Body Language – Critical Reasoning and Conflict Management based on Case Studies – Group Communication- Meetings -Interview Techniques. **(14)**

TECHNICAL WRITING: Technical Writing Principles - Style and Mechanics - Technical Definitions – Physical, Functional and Process Descriptions – Technical Report Writing – Preparing Instructions – Interpretation of Technical Data. **(14)**

BUSINESS CORRESPONDENCE: Writing Emails, Preparing Resumes. **(7)**

Total P: 60 periods

TEXT BOOKS

1. Course materials prepared by the Faculty, Department of English, PSG Institute of Technology and Applied Research, Neelambur, Coimbatore.

REFERENCES

1. Jeff Butterfield, '*Soft Skills for Everyone*'. Cengage Learning, New Delhi, 2020.
2. Sabina Pillai, and Agna Fernandez, '*Soft skills and Employability Skills*'. Cambridge University Press, New Delhi, 2019.
3. Prashant Sharma, '*Soft Skills Personality Development for Life Success*'. BPB Publications, New Delhi, 2021.
4. K. N. Shoba, and D. Praveen Sam, '*Technical English*'. Cambridge University Press, New York, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		Bloom's Level
CO1	Produce clear and concise technical reports, compose professional and effective emails and develop well-structured and impactful resumes	**K2**
CO2	Plan, organize, and deliver engaging and informative presentations using appropriate visual aids and participate positively in group discussions	**K3**
CO3	Resolve disagreements constructively, embody professional conduct and a strong work ethic and apply critical thinking to generate effective solutions	**-**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1										2			
CO2										3			
CO3									3	3			
									3	**3**			

1-low, 2-medium, 3-high

25HS212 BASIC GERMAN
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

Guten Tag! - Learning: To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages; **Vocabulary:** related to the topic; **Grammar:** W – Questions, Verbs & Personal pronouns I.

Freunde, Kollegen und ich - Learning: To speak about hobbies, jobs, learn numbers from 20; **Vocabulary:** related to the topic; **Grammar:** Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural.

In der Stadt – Learning: To know places, buildings, question, know transport systems, understand international words; **Vocabulary**: related to the topic; **Grammar:** Definite & indefinite articles, Negotiation, Imperative with Sie.

Guten Appetit! – Learning: To speak about food, shop, converse; **Vocabulary:** related to the topic; **Grammar:** Sentence position, Accusative, Accusative with verbs.

Tag für Tag and Zeit mit Freunden – Learning: To learn time related expressions, speak about family, ask excuse, fix appointments on phone, birthdays, understand & write invitations, converse in the restaurant; **Vocabulary:** related to the topic; **Grammar:** Preposition – am, im, um, von…bis, Possessive articles, Modal verbs.

Total P: 60 periods

TEXT BOOK:

1. Dengler, Stefanie et al., ‘*Netzwerk A1.1*’. Klett-Langenscheidt Gmbh, München, 2013.

REFERENCES:

1. Dengler, Stefanie et al., ‘*Netzwerk A1’.* Klett-Langenscheidt Gmbh München, 2013.
2. Sandra Evans, Angela Pude, and Franz Specht, ‘*Menschen A1*’. Hueber Verlag, 2012.
3. Hermann Funk, Christina Kuhn, and Silke Demme, ‘*Studio d A1*’. Goyal Publishers & Distributors Pvt. Ltd, 2009.
4. Rosa-Maria Dallapiazza, Eduard von Jan, ‘*Til Schönherr*’. Tangram Aktuell 1 (Deutsch als Fremdsprache), Max Hueber Verlag, 2004.

25HS213 BASIC JAPANESE
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses.

Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words.

Topic marker “wa”, Desu / dewa arimasen cupolas, Interrogative particle “ka”, Grammar particles “mo”, “no”, “Introducing someone: “Kochira wa ~“ and Self introductions: Hajimemashite”

Demonstratives “Kore”, “Sore”, “Are”, Demonstrative “Kono”, “Sono”, “Ano”, Possessive noun particle “no” and Japanese apartments: Greeting your neighbor.

Place markers “Koko”, “Soko”, “Asoko”, Direction markers “Kochira”, “Sochira”, “Achira” and Japanese department stores: Asking for and buying something.

Asking for and telling the time, Particle “ni (at)” for time, kara (from) ~ made (until), Particle “to (and)”, Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours.

Destination particle “e”, Particles “de (mode of transportation)” and “to (with) and Japanese train station: Asking for Fare and track no. / types of trains.

Direct object particle “o”, Particle “de (place of action)”, Verbs (“~masen ka”, “~mashou”) and “Ohanami” Cherry blossom viewing.

Particle “de (by means of)”, Particle “ni (to)”, Aaemasu (give) and Moraimasu (receive) and Visiting a Japanese house.

Adjectives (“i” and “na” type), Adjectives (Positive and negative usage), Particle “ga (however, but), “Dore which?)” and Leaving a room, thanking someone for hospitality.

Likes and dislikes, Potential verbs (wakarimasu and dekimasu), “Kara (~ because)”, Adverbs and Asking someone out over the phone.

Verbs denoting presence: “Imasu” and “arimasu”, Particle “ni (in)”, “Dare (who?)”, Adverbs (“Chikaku ni ~ “), Particle “dare mo (negative ~ no one)” , Dare ka (anyone), dare ga (who) , Nani ka (anything) , nani ga (what) - ~ya (and) ~ nado (etc.) and Asking for directions.

Counters and Counting suffixes.

Introduction to Adjectives (na and ii type), Different usages of adjectives, Comparison, Likes and dislikes and Going to a trip.

Need and desire (ga hoshii), Wanting to … (Tabeti desu), Going for a certain purpose (mi –ni ikimasu) and Choosing from a menu.
Verb groups, I, II and III and Exercises to group verbs.

Please do (te kudasai), Present continuous tenses (te imasu), Shall I? (~ mashou ka) and Describing a natural phenomenon (It is raining).
To grant permission (~te mo ii desu), Asking for permission (~ te mo ii desu ka) and Should not do (~ te waikemasen) Describing a continuing state and Describing a habitual action.
Roleplays in Japanese.
A demonstration on usage of chopsticks and Japanese tea party. **Total P: 60 periods**

TEXT BOOK

1. ‘*Minna no nohongo’.* – Romaji ban (first 10 lessons of this book).

REFERENCE

1. ‘*Minna no Nihongo I Honsatsu Roma – ji ban (Main Textbook Romanized Version)’.* International publisher – 3A Corporation,Tokyo, Indian distributor – Goyal Publishers & Distributors, New Delhi

MANDATORY COURSES
25MC001 ENVIRONMENTAL SCIENCE
(Common to B.E./B.Tech. Programmes)

3 0 0 3

INTRODUCTION TO ENVIRONMENT: Environment - Definition, scope and importance. Types and composition of atmosphere – particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats – India as a mega-diversity nation, hotspots of biodiversity, endangered and endemic species of India, conservation of biodiversity. **(9)**

ENERGY RESOURCES: Introduction – National and International status- exploitation - sustainable strategies- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal, geothermal, hydroelectric. **(9)**

ENVIRONMENTAL POLLUTION: Definition, Sources, causes, impacts and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, RF hazards, Role of an individual in prevention of pollution. Disaster Management: Floods, earthquake, cyclone and landslides – Case studies, consequences and rescue measures. **(9)**

WASTE MANAGEMENT: Waste water - Characteristics of domestic and industrial wastewater - COD and BOD, Various stages of treatment – primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management – Characteristics of municipal solid waste (MSW), biomedical, automobile and e-wastes and their management, landfills, incineration, pyrolysis, gasification and composting**.** **(9)**

SOCIAL ISSUES AND THE ENVIRONMENT: Environmentally Sustainable work practices- Rain water harvesting, Role of non-governmental organizations. Human ethics and rights- impact on environment and human health, role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Gilbert M. Masters, '*Introduction to Environmental Engineering and Science*'. Pearson Education, New Delhi, 2004.
2. Deswal S and Deswal A, '*A Basic Course in Environmental Studies*'. Dhanpat Rai and Co, New Delhi, 2004.

REFERENCES:

1. Benny Joseph, '*Environmental Science and Engineering*'. Tata McGraw - Hill, New Delhi, 2006.
2. Koteswara Rao M V R, '*Energy Resources: Conventional & Non – Conventional*'. BSP Publications, New Delhi, 2006.
3. Botkin and Keller, '*Environmental Science*'. Wiley India Private Limited, New Delhi, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basic concepts of environment, energy sources and waste management	**K2**
CO2	Use different renewable energy resources and environment protection measures for sustainable development	**K3**
CO3	Conduct a case study on real-time environmental issues and present findings as a team	**-**

COs-POs & PSOs MAPPING:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1													
CO2	1												
CO3						2	2	2			2		
	1					**2**	**2**	**2**			**2**		

1-low, 2-medium, 3-high

25MC002 INDIAN CONSTITUTION
(Common to B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION: Evolution of Indian Constitution; significance of constitution; Composition; Preamble and its Philosophy. **(4)**

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy. **(5)**

UNION GOVERNMENT: Union Government, President and Vice President, Houses of the Parliament and their functions; Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. **(6)**

STATE GOVERNMENT AND FEDERALISM: Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. **(8)**

JUDICIARY: Supreme Court, High Court; District Court and Lower Courts - Functions and Powers – Judges – Qualifications and Powers - Judicial Review. **(7)**

Total L: 30 periods

TEXT BOOKS:

1. Subash C Kashyap, '*Our Political System*'. National Book Trust, 2011.
2. Praveenkumar Mellalli E, '*Constitution of India, Professional Ethics and Human Rights*'. Sage Publications India Pvt. Ltd., 2015.

REFERENCES:

1. Briji Kishore Sharma, '*Introduction to the Constitution of India*'. Prentice Hall of India, 2010.
2. Basu D D, '*Introduction to the Constitution of India*'. Prentice Hall of India, 2016.
3. Jain. M C, '*The Constitution of India*'. Law House, New Delhi, 2001.
4. Shukla V N, '*Constitution of India*'. Eastern Book Company Ltd., New Delhi, 2011.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the evolution, significance, and philosophy of the Indian Constitution, including its Preamble, composition, and core principles.	**K2**
CO2	Analyze the structure, powers, and functions of the Union and State Governments, including the roles of the President, Parliament, Governor, and Council of Ministers, as well as the legislative process, types of bills, and constitutional amendments.	**K4**
CO3	Conduct a case study on the Indian Constitution, demonstrating understanding of its evolution, fundamental rights and duties, structure of Union and State governments, federal system, and the role of the judiciary in governance.	**-**

COs-POs & PSOs MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	2												
CO3								2	2		2		
	2							**2**	**2**		**2**		

1-low, 2-medium, 3-high

25MC003 INDUSTRIAL SAFETY

(Common to B.E./B.Tech. Programmes)

2 0 0 0

SAFETY TERMINOLOGIES: Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects - Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS. **(6)**

STANDARDS AND REGULATIONS: Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006. **(6)**

SAFETY ACTIVITIES: Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment. **(6)**

WORKPLACE HEALTH AND SAFETY: Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release. **(6)**

HAZARD IDENTIFICATION TECHNIQUES: Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment. **(6)**

Total L: 30 periods

TEXTBOOKS

1. Jain R. K. and Sunil S. Rao, '*Industrial Safety, Health and Environment Management Systems*'. Khanna Publisher, 4^{th} Edition, 2000.
2. Deshmukh L. M., *'Industrial Safety Management: Hazard Identification and Risk Control'*. McGraw-Hill Education, 2007.

REFERENCES

1. John Ridley, John Channing, '*Safety at Work*'. Routledge, 7^{th} Edition, 2008.
2. Dan Petersen, '*Techniques of Safety Management*: *A System Approach*'. Amer Society of Safety Engineers, 4^{th} Edition, 2003.

COURSE OUTCOMES

At the end of the course, students will be able to		**Bloom's Level**
CO1	Describe the safety protocols and standard operating procedures in industrial settings to ensure compliance with safety regulations and minimize hazards in the workplace.	**K2**
CO2	Implement and test emergency response plans tailored to the industrial environments, ensuring effective action during emergencies such as fires, chemical spills or equipment malfunctions.	**K3**
CO3	Review and present on risk assessments and hazards using industry-specific tools to identify potential safety risks and choose appropriate corrective actions to prevent accidents and injuries.	**-**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	2					2	2						
CO3						1	1	1	1		1		1
	2					**2**	**2**	**1**	**1**		**1**		**1**

1 - low, 2- medium, 3 – high

Fourth ACM

25MC004 DISASTER RISK REDUCTION AND MANAGEMENT
(Common to B.E./B.Tech. Programmes)

2 0 0 0

HAZARDS, VULNERABILITY AND DISASTER RISKS: Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced – Earthquake, Landslide, Flood, Drought, Fire, etc. – Technological disasters - Structural collapse, Industrial accidents, oil spills - Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals. **(6)**

DISASTER RISK REDUCTION (DRR): Sendai Framework for Disaster Risk Reduction, Disaster cycle - Community Based DRR, Structural – Non-structural measures, Roles and responsibilities of - community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders - Early Warning System – Relevance of indigenous Knowledge, appropriate technology and Local resources. **(6)**

DISASTER MANAGEMENT: Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction - Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Institutional Processes and Framework at State and Central Level - (NDMA – SDMA – DDMA – NRDF - Civic Volunteers). **(6)**

TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT: Early warning systems - Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness) – Role of GIS and Information Technology in Disaster Management – Disaster Damage Assessment - Elements of Climate Resilient Development – Standard operation Procedure for disaster response – Financial planning for disaster Management. **(6)**

DISASTER MANAGEMENT: CASE STUDIES: Case studies in the context of disasters - Landslide Hazard Zonation, Earthquake Vulnerability Assessment of Buildings and Infrastructure, Drought Assessment, Coastal Flooding, Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding, Forest Fire, Man Made disasters. **(6)**

Total L: 30 periods

TEXTBOOKS

1. Thomas D. Schneid, and Larry Collins, '*Disaster Management and Preparedness*'. CRC Publications, 2016.
2. R. Singh, '*Disaster Management Guidelines: Earthquakes, Landslides, Avalanches and Tsunami*'. Horizon Press Publications, 2017.
3. J. P. Singhal, '*Disaster Management*'. Laxmi Publications, 2024.
4. T. Bhattacharya, '*Disaster Science and Management*'. McGraw Hill India Education Pvt. Ltd., 2012.

REFERENCES

1. Government of India, '*Disaster Management Act*'. New Delhi, 2005.
2. Government of India, '*National Disaster Management Policy*'. New Delhi, 2009.
3. R. Shaw, '*Community based Disaster risk reduction*'. Natural Hazard Science, Oxford Research Encyclopedias, 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Summarize the concepts, tools, technologies and strategies for disaster risk reduction and management.	**K2**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1					1	1	1	1	1		1		
					1	**1**	**1**	**1**	**1**		**1**		

1-low, 2-medium, 3-high

25MC005 INDIAN KNOWLEDGE SYSTEMS FOR SUSTAINABLE HUMAN DEVELOPMENT

2 0 0 0

INTRODUCTION TO INDIAN KNOWLEDGE SYSTEMS & HUMAN DEVELOPMENT (6)

- Meaning, scope, and significance of Indian Knowledge Systems
- Indian view of life: Purusharthas (Dharma, Artha, Kama, Moksha)
- Relationship between individual, society, and nature
- Relevance of IKS in modern education and engineering

INDIAN PERSPECTIVES ON SUSTAINABILITY & ECOLOGY (6)

- Indian worldview on nature: Pancha Mahabhutas
- Traditional water management, agriculture, and resource conservation
- Sustainable lifestyles in Indian traditions
- Comparison with modern sustainable development goals (SDGs

HEALTH, WELL-BEING & HUMAN POTENTIAL IN IKS (6)

- Indian concept of health: Body–Mind–Spirit integration
- Introduction to Ayurveda & Yoga for sustainable health
- Mental health and emotional balance in Indian wisdom
- Food, nutrition, and lifestyle from IKS perspective
- Preventive healthcare through traditional knowledge

ETHICS, VALUES & SOCIAL SUSTAINABILITY (5)

- Work ethics and leadership in Indian tradition
- Gender dignity and social justice in Indian thought
- Professional ethics through IKS

IKS, TECHNOLOGY & SUSTAINABLE DEVELOPMENT (7)

- Science and technology in ancient India
- Sustainable engineering in traditional architecture and town planning
- Metallurgy, textiles, and indigenous manufacturing systems
- IKS and modern innovation ecosystems and ethical responsibility
- Role of engineers in sustainable human development **Total L: 30 periods**

TEXTBOOKS

1. Dharampal, '*Indian Science and Technology in the Eighteenth Century*'.
2. Kapil Kapoor, *'Indian Knowledge Systems'*.
3. S Radhakrishnan, *'Indian Philosophy'.*
4. B K Matilal, '*The Character of Logic in India'.*
5. '*UGC–IKS Documents and AICTE IKS Modules*'.
6. David Frawley, '*Ayurvedic Healing'.*
7. *'IIT-IKS Foundation Course Materials'.*
8. 'Ministry of Education – IKS Portal Resources'.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core concepts and evolution of Indian Knowledge Systems.	**K2**
CO2	Interpret Indian views on human development, ethics, and sustainability.	**K3**
CO3	Apply IKS principles to sustainable living and professional practices.	**K3**
CO4	Demonstrate social, ecological, and ethical responsibility in real-life situations.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						3	2				3
CO2						3	3				2
CO3			2			3	3		2	2	
CO4				2		3	3	2			
			2	**2**		**3**	**3**	**2**	**2**	**2**	**3**

1 - low, 2- medium, 3 - high

25MC006 STRATEGIC DATA MANAGEMENT AND GOVERNANCE
(Common to all B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION TO STRATEGIC DATA MANAGEMENT Data and Its strategic Value; Types of Data, Data as a Source of Competitive Advantage; The Data Lifecycle; Aligning Data Management with Business Goals; Data Management challenges in Contemporary Organizations; Overview of Data driven Decision making. **(6)**

DATA GOVERNANCE AND FRAMEWORK Introduction to Data Governance; Data Management Frameworks (DAMA-DMBOK, COBIT, ISO Data management Standards); Structuring Data Leadership Roles; Implementation of Data Policies and Standards. Master Data Management (MDM) and API Integration. **(6)**

DATA PRIVACY, ETHICS AND QUALITY MANAGEMENT Data Privacy and Protection Regulations (DPDP Act, GDPR); Principles and Importance of Ethical data management; Ethical decision-making models; Key data Quality Dimensions; Role of Data Quality in Effective Decision-Making; Tools and techniques for ensuring data quality. **(6)**

DATA LITERACY AND ORGANIZATIONAL TRANSFORMATION Role of Data Literacy in Modern Organisations; Strategies for implementing data-driven transformation; Communication and training for Overcoming Resistance to Change; Cross-Functional Collaboration across Organisational Departments; Fostering a Data-Driven Culture. **(6)**

DATA ARCHITECTURE AND RECENT TRENDS Business Intelligence (BI) Architecture; Big Data Ecosystem; AI/ML data pipelines in Business enterprises, Strategic Planning for Data Infrastructure; Build vs. Buy Decisions for Data Platforms; Generative AI in Data Management. **(6)**

Total L: 30 periods

TEXT BOOKS

1. Ladley, J. & Ladley, A. '*Data Governance: How to Design, Deploy, and Sustain an Effective Data Governance Program* (3rd ed.)'. Morgan Kaufmann (Elsevier).
2. Eryurek, E., Gilad, U., Kaye, B., Sicular, S., & Schur, E. (2021). '*Data Governance: The Definitive Guide: People, Processes, and Tools to Operationalize Data Trustworthiness*'. O'Reilly Media.

REFERENCE BOOKS

1. Plotkin, D. (2020). '*Data Stewardship: An Actionable Guide to Effective Data Management and Data Governance* (2nd ed.)'. Academic Press (Elsevier).2020.
2. DAMA International. (2024). '*DAMA-DMBOK: Data Management Body of Knowledge* (2nd ed. Revised)'. Technics Publications.2024.
3. Loukides, M., Mason, H., & Patil, D. J. (2018). '*Ethics and Data Science*'. O'Reilly Media.2018.

COURSE OUTCOMES:

At the end of the course, students will be able to:		Bloom's Level
CO1	Understanding the Management role in leveraging data for competitive advantage and strategic decision-making.	**K2**
CO2	Applying governance frameworks to design policies, roles, and standards.	**K3**
CO3	Analyzing ethical challenges in data management to improve data-literacy across organization departments.	**K4**
CO4	Evaluating enterprise data architecture and modern platforms for making strategic decisions on Data Management.	**K5**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2				3				3	3
CO2			2			2	3	2		3	
CO3						3	3		3		2
CO4	2		2	2	3	2				3	2
	2	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**

1 - low, 2- medium, 3 - high

Fourth ACM

25MC007 PROFESSIONAL ETHICS
(Common to all B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION TO THE CONCEPTS OF ETHICS: Introduction to ethics – meaning, definition, dimensions of ethics, determinants and consequences of ethics; ethical dilemmas – types of ethical dilemmas. Morality – definition, types of moral values, levels of moral development. Ethics Versus morality. Professional Ethics – definition, components, types and significance. **(6)**

PSYCHOLOGY OF ETHICAL BEHAVIOR: Attitude – components of attitude in promoting ethical behavior; Motivation – human drives as a trigger for ethical behavior; Role of Cognitive biases (self-serving bias, incrementalism and overconfidence bias) in shaping ethical behavior. **(6)**

WORKPLACE ETHICAL BEHAVIORS: Integrity, honesty, accountability, responsibility, fairness, civic virtue, conscientiousness, empathy, self-confidence, character, respect for others, transparency, loyalty. **(6)**

APPLICATION AREAS OF ETHICS: Application of Ethics in different fields - Engineering ethics, medical ethics, financial ethics, technological ethics, scientific ethics, legal ethics, business ethics, environmental ethics. **(6)**

INDICATORS OF PROFESSIONAL ETHICS IN ORGANIZATIONS: Corporate Governance – Definition, importance, Theories of Corporate Governance: Agency Theory, Stewardship theory, Stakeholder Theory, Resource Dependency Theory. Corporate Social Responsibility – Definition, Models of CSR. **(6)**

Total L: 30 periods

TEXT BOOKS

1. Govindarajan M, Natarajan S and Senthil Kumar VS, *'Engineering Ethics'*. Prentice Hall of India, New Delhi, 2013.
2. Stephen P. Robbins, *'Essentials of Organizational Behavior'.* Pearson Education, 2023.
3. Subramanian. R. '*Professional Ethics'*. Oxford Publication, 2013.
4. Nagarasan. R.S. *Professional Ethics and Human Values'.* New Age International Publications, 2006.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental concepts of ethics, morality and the psychological principles behind ethical behavior.	**K2**
CO2	Demonstrate the application of core ethical values in the different situations of the workplace.	**K3**
CO3	Analyze the ethical issues, challenges in different professional domains and the application of ethical principles to solve the issues	**K4**
CO4	Evaluate the relevance and effectiveness of corporate governance theories and CSR models in addressing ethical and managerial challenges in organizations.	**K5**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2	3				3
CO2						2	3	3	2		
CO3		2	2			3	3				
CO4						3	3	2		3	2
		2	**2**			**3**	**3**	**3**	**2**	**3**	**3**

1 - low, 2- medium, 3 - high

25HSO01 PHYSICAL EDUCATION
(Common to all B.E./B.Tech. Programmes)

0 0 2 0

INTRODUCTION TO PHYSICAL EDUCATION: Importance and scope of physical education, Physical fitness and exercise fundamentals, Conditioning and calisthenics exercises, Posture, flexibility, balance, and coordination, Warm-up, cool-down, and relaxation techniques, Basics of injury prevention and first aid practices, Importance of teamwork, discipline, and sportsmanship.

BASIC GYMNASTICS AND MOVEMENT EXERCISES: Warm-up exercises, conditioning drills, movement education, balance exercises, floor exercises, tumbling basics, swinging and grip exercises, simple apparatus activities, lead-up games, coordination drills, and safety practices.

SKILL DEVELOPMENT IN ANY ONE OF THE FOLLOWING OUTDOOR GAMES: Basketball, Volleyball, Ball Badminton, and Football.

SKILL DEVELOPMENT IN ANY ONE OF THE FOLLOWING INDOOR GAMES: Shuttle Badminton, Chess, Carrom, and Table Tennis.

Total P: 30 Periods

WEIGHTAGE

Continuous Assessment: 100%

ASSESSMENT

- Attendance and Participation – 70%
- Practical Assessment of Physical Fitness and Sports Skills – 30%

REFERENCES

1. Singh, A. ‘*Essentials of Physical Education’*. Kalyani Publishers.
2. Kamlesh, M.L. ‘*Psychology in Physical Education and Sport’*.
3. Mangal, S.K. ‘*Psychology of Sports Performance’*. Sports Publication.
4. Kandappan, K. ‘*Foundations of Physical Education’*. Friends Publications.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Demonstrate basic movement, balance, coordination, and fitness exercises with proper technique and safety awareness.	**K2**
CO2	Demonstrate physical fitness parameters such as endurance, agility, flexibility, speed, and strength through regular participation in physical activities.	**K2**
CO3	Develop teamwork, discipline, leadership qualities, and sportsmanship through participation in games and group activities.	**K3**
CO4	Adopt active lifestyle habits and participate regularly in physical and recreational activities for overall well-being.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3			2
CO2						2		3			3
CO3							3	3	2		2
CO4						2	2	3			3
						2	**3**	**3**	**2**		**3**

1 - low, 2- medium, 3 - high

25HSO02 YOGA AND HEALTH
(Common to all B.E./B.Tech. Programmes)

0 0 2 0

INTRODUCTION TO YOGA: Yoga as a tool for physical and mental wellness, Importance of posture, breathing, relaxation, and mindfulness, Role of yoga in stress management and lifestyle balance, Basic guidelines and safety precautions for yoga practice, Introduction to healthy habits including sleep hygiene, nutrition, and digital well-being

SURYA NAMASKAR – TYPES OF POSTURES: Pranamasana (Prayer Pose), Hastauttanasana (Raised Arms Pose), Padahastasana / Hastapadasana (Standing Forward Bend), Ashwa Sanchalanasana (Equestrian Pose), Dandasana (Plank Pose), Ashtanga Namaskara (Eight-Limbed Salutation), Bhujangasana (Cobra Pose), Adho Mukha Svanasana (Downward-Facing Dog), Ashwa Sanchalanasana (Equestrian Pose), Padahastasana (Standing Forward Bend), Hastauttanasana (Raised Arms Pose), and Pranamasana (Prayer Pose).

BASIC ASANAS:
1. Standing – Tadasana, Utkatasana, Trikonasana, Virabhadrasana, and Vrikshasana
2. Sitting – Sukhasana, Dandasana, Paschimottanasana, Vajrasana, and Gomukhasana
3. Prone Position – Bhujangasana, Salabhasana, Dhanurasana, Makarasana, and Urdhva Mukha Svanasana
4. Supine Position – Apanasana, Viparita Karani, Supta Baddha Konasana, Ardha Halasana, and Savasana

PRANAYAMA TECHNIQUES & MUDRAS: Ujjayi, Nadi Shodhana, Sheetali, Sitkari, Kapalabhati, Bhastrika, and Bhramari. Gyan Mudra (Chin Mudra), Prana Mudra, Apana Mudra, Vayu Mudra, Prithvi Mudra, Varun Mudra, Surya Mudra, Shunya Mudra, Linga Mudra, and Anjali Mudra.

Total P: 30 Periods

WEIGHTAGE: Continuous Assessment: 100%

ASSESSMENT METHODOLOGY: Attendance and Participation – 70%, Practical Demonstration (Surya Namaskar, Asanas, and Pranayama) – 30%

REFERENCES

1. *'The Heart of Yoga'.* – T.K.V. Desikachar
2. *'Yoga for Holistic Health'.* – Dr. H.R. Nagendra
3. *'Light on Yoga'.* – B.K.S. Iyengar
4. *'Asana Pranayama Mudra Bandha'.* – Swami Satyananda Saraswati

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate Surya Namaskar and basic asanas in standing, sitting, prone, and supine positions with correct alignment and breathing.	**K2**
CO2	Demonstrate pranayama techniques for stress management and respiratory health.	**K2**
CO3	Improve flexibility, balance, posture, breathing efficiency, and relaxation through regular yoga practice.	**K3**
CO4	Apply principles of healthy living such as nutrition, sleep hygiene, and digital well-being in daily life.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3			2
CO2						2	2				2
CO3						2	2	3			3
CO4						3	2	2			3
						3	**2**	**3**			**3**

1-low, 2-Medium, 3-High