PSG Institute of Technology and Applied Research, Coimbatore - 641 062

(Autonomous college affiliated to Anna University)

R2025

Courses of Study, Scheme of Assessment and Syllabi for All Semesters

for

M.E. Engineering Design

M.E. ENGINEERING DESIGN

(Minimum No. of credits to be earned: 70)

S. No.	Course Code	Course Title	Hours/ Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER I										
1	MA25101	Applied Numerical Methods	3	1	0	4	40	60	100	PC
2	ED25101	Theory of Elasticity and Plasticity	3	0	0	3	40	60	100	PC
3	ED25102	Machinery Vibration and Diagnostics	3	0	0	3	40	60	100	PC
4	ED25103	Mechanisms and Robot Kinematics	3	1	0	4	40	60	100	PC
5	ED25104	Mechatronics System Design	3	0	0	3	40	60	100	PC
6	SE25105	Research Methodology and IPR	2	0	0	2	40	60	100	RMC
7	ED25A_	Audit Course I	2	0	0	Grade	100	0	100	MC
8	ED25111	Vibration Engineering Laboratory	0	0	4	2	60	40	100	PC
9	ED25112	Automation and Sensor Interface Laboratory	0	0	4	2	60	40	100	PC
Total 29 periods			**19**	**2**	**8**	**23**	**460**	**440**	**900**	
SEMESTER II										
1	ED25201	Design for Manufacture and Assembly	3	1	0	4	40	60	100	PC
2	ED25202	Finite Element Analysis in Mechanical Design	3	1	0	4	40	60	100	PC
3	ED25203	Failure Analysis and Prevention	3	0	0	3	40	60	100	PC
4	ED25P__	Professional Elective I	3	0	0	3	40	60	100	PE
5	ED25P__	Professional Elective II	3	0	0	3	40	60	100	PE
6	ED25A__	Audit Course II	2	0	0	Grade	100	0	100	MC
7	ED25211	Computer Aided Engineering Laboratory	0	0	4	2	60	40	100	PC
8	ED25212	Data Analytics Laboratory	0	0	4	2	60	40	100	PC
9	ED25213	Industrial Visit and Technical Seminar	0	0	4	2	60	40	100	EEC
Total 31 periods			**17**	**2**	**12**	**23**	**480**	**420**	**900**	
SEMESTER III										
1	ED25P__	Professional Elective III	3	0	0	3	40	60	100	PE
2	ED25P__	Professional Elective IV	3	0	0	3	40	60	100	PE
3	ED25311	Project Work I	0	0	12	6	60	40	100	EEC
Total 18 periods			**6**	**0**	**12**	**12**	**140**	**160**	**300**	
SEMESTER IV										
1	ED25411	Project Work II	0	0	24	12	60	40	100	EEC
Total 24 periods			**0**	**0**	**24**	**12**	**60**	**40**	**100**	

CAT – Category; PC – Professional Core; PE - Professional Elective; RMC - Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not complete

Summary of Credit Distribution

M.E. Engineering Design						
Sl. No	**Course Category**	**Credits per Semester**				**Total Credits**
		1	**2**	**3**	**4**	
1	PC	21	15	0	0	36
2	PE	0	6	6	0	12
3	RMC	2	0	0	0	2
4	EEC	0	2	6	12	20
5	MC	-	-	-	-	-
Total		**23**	**23**	**12**	**12**	**70**

List of Professional Electives (Four to be Opted)

S. No.	Course Code	Course Title	Hours/ Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	ED25P01	Mechanics of Composites Materials	3	0	0	3	40	60	100	PE
2	ED25P02	Concepts of Engineering Design	3	0	0	3	40	60	100	PE
3	ED25P03	Applied Probability and Statistics for Design Engineers	3	0	0	3	40	60	100	PE
4	ED25P04	Surface Engineering	3	0	0	3	40	60	100	PE
5	ED25P05	Product Design and Development	3	0	0	3	40	60	100	PE
6	ED25P06	Topology Optimization and Generative Design	3	0	0	3	40	60	100	PE
7	ED25P07	Design and Analysis of Thermal Systems	3	0	0	3	40	60	100	PE
8	ED25P08	Fracture Mechanics	3	0	0	3	40	60	100	PE
9	ED25P09	Advanced Finite Element Analysis	3	0	0	3	40	60	100	PE
10	ED25P10	Micro Electro Mechanical Systems	3	0	0	3	40	60	100	PE
11	ED25P11	Optimization Techniques in Design	3	0	0	3	40	60	100	PE
12	ED25P12	Solid Freeform Manufacturing	3	0	0	3	40	60	100	PE
13	ED25P13	Material Handling Systems and Design	3	0	0	3	40	60	100	PE
14	ED25P14	Life cycle Assessment and Eco Design	3	0	0	3	40	60	100	PE
15	ED25P15	System Design for Sustainability	3	0	0	3	40	60	100	PE
16	ED25P16	Advanced Characterization of Materials	3	0	0	3	40	60	100	PE
17	ED25P17	Advanced Nanomaterials	3	0	0	3	40	60	100	PE
18	ED25P18	Macro and Nano Composite Materials	3	0	0	3	40	60	100	PE

List of Audit Courses

S. No.	Course Code	Course Title	Hours/ Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	SE25A01	Sustainable Development Goals	2	0	0	Grade	100	0	100	MC
2	SE25A02	English for Research Paper Writing	2	0	0	Grade	100	0	100	MC
3	SE25A03	Disaster Management	2	0	0	Grade	100	0	100	MC
4	SE25A04	Constitution of India	2	0	0	Grade	100	0	100	MC
5	SE25A05	Building Communication Skills	2	0	0	Grade	100	0	100	MC

MA25101 APPLIED NUMERICAL METHODS
(Common to ED and SE)

3 1 0 4

NUMERICAL SOLUTION OF SYSTEM OF EQUATIONS: System of linear equations – Thomas algorithm, Gauss Jacobi and Seidel methods, successive over relaxation method, system of non-linear equations - Newton Raphson method, eigenvalues - power method and inverse power method. Curve fitting - linear regression, multiple linear regression, cubic splines – Bezier curves**.** **(12+4)**

NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS: Runge-Kutta method of fourth order**.** Boundary value problem **-** Shooting method. Finite difference method, derivative boundary conditions. Finite Element Method - Rayleigh-Ritz method, Collocation and Galerkin methods. **(11+4)**

NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS: Elliptic Equations - Liebmann's method for Laplace and Poisson equations, alternating direct implicit method, irregular and non-rectangular grids. Parabolic equations - explicit method and Crank-Nicolson method, second order parabolic equations – explicit method. Hyperbolic equations - explicit method. **(12+4)**

MODELLING AND SIMULATION: System modelling, system studies, principles of mathematical modelling, technique of simulation, types and components of simulation study, Monte Carlo Method, random number generation, test for randomness, test for uniform distribution. Static simulation - model for profit on sales, probabilistic simulation - inventory model: consumer demand. **(10+3)**

Total L: 45 +T:15=60 periods

REFERENCES:

1. Curtis F.G and Patrick O.W, '*Applied Numerical Analysis'*. Pearson Education, New Delhi, 2019.
2. Richard L. B, J. Douglas F, '*Numerical Analysis*'. Cengage Learning, New Delhi, 2019.
3. Steven C. C and Raymond P. C, '*Numerical Methods for Engineers'.* Tata McGraw-Hill, New Delhi, 2021.
4. Geoffrey G, '*System Simulation'*. Pearson Education, New Delhi, 2017.
5. Frank R. G, William P. F and Steven B. H, '*First course in Mathematical Modeling'*. Cengage Learning, New Delhi, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the concepts related to numerical methods, modelling and simulation.	**K2**
CO2	Apply the techniques of numerical methods, modelling and simulation.to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing numerical methods, modelling and simulation.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1				1	1
CO2			1	2	2
CO3			3	3	3
			3	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25101 THEORY OF ELASTICITY AND PLASTICITY

3 0 0 3

ANALYSIS OF STRESS AND STRAIN: Introduction to general theory of elasticity, assumptions and applications of linear elasticity, stress tensor, Cauchy's stress principle, principal stresses, octahedral stresses, equations of equilibrium, strain tensor, principal strains, kinematic equations and compatibility conditions, generalized Hooke's law, plane stress and plane strain conditions, elasticity theorems, strain energy in elastic body. **(12)**

2D PROBLEMS, ENERGY THEOREMS AND VARIATIONAL PRINCIPLES OF ELASTICITY: Transformation of compatibility condition from strain components to stress components, Airy's stress function, two dimensional problems in cartesian and polar coordinate systems, axisymmetric problems, stress concentration, effect of circular holes on stress distribution in plates. Strain energy and complementary energy, Clapeyron's theorem, virtual work and potential energy principles, principle of complementary potential energy, Betti's reciprocal theorem, principle of linear superposition, uniqueness of elasticity solution. **(13)**

EXPERIMENTAL METHODS IN STRESS ANALYSIS AND CONTACT STRESSES: Fundamental concepts in measurements, grid method, brittle coating method, strain gages, rubber model method and Fischer's method for stress concentration, photo elasticity and Moiré fringes. Introduction, geometry of contact surfaces, notation and meaning of terms, expressions for principal stresses, methods of computing contact stresses: Hertzian, JKR, DMT models. **(10)**

INTRODUCTION TO PLASTICITY: One-dimensional elastic-plastic relations, Bauschinger effect, isotropic and kinematic hardening, yield function, yield criteria for metals, flow rule, hardening rule, incremental stress-strain relationship, Prandtl-Reuss and Levy-Mises relations, plastic instability, governing equations of elasto-plasticity. **(10)**

Total L: 45 periods

REFERENCES:

1. Timoshenko S P and Goodier J N '*Theory of Elasticity'*. Tata McGraw Hill Publications, 2017.
2. Chakrabarthy J '*Theory of Plasticity'*. Butterworth Heinemann Publications 2012.
3. George E Dieter. "Mechanical Metallurgy" McGraw Hill Education, Third edition 2017.
4. James F. Doyle, "Modern experimental stress analysis: Completing the solution of partially specified problems" Wiley Publications, 2012.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply the fundamental concepts of the theory of elasticity to solve problems under plane stress and plane strain conditions	K3
CO2	Solve two-dimensional elasticity problems using Airy's stress function in Cartesian and polar coordinate systems, and apply energy principles to determine the stress distribution.	K3
CO3	Analyze stress concentrations, elastic-plastic Behaviour and contact stress distributions in engineering components using analytical methods and evaluate their mechanical behaviour under different loading conditions	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	2	2
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25102 MACHINERY VIBRATION AND DIAGNOSTICS

3 0 0 3

FUNDAMENTALS OF VIBRATION: Introduction, sources and effects of vibration, types of vibration, harmonic analysis, transient time function, random time function, frequency spectrum; Single degrees of freedom system: free vibration, free damped vibration, forced vibration: nature of exciting forces, critical speeds, quality of balance, vibration isolation. **(12)**

TWO AND MULTIPLE DEGREES OF FREEDOM SYSTEMS: Normal mode vibration, co-ordinate coupling, Lagrange's equation, free harmonic vibration, tuned un-damped vibration absorbers; MDOF: influence coefficients, orthogonality, matrix iteration, Holzer method, Stodala method, branched system, geared system, Rayleigh's principle, Dunkerley's principle. **(12)**

TRANSIENT VIBRATION AND RANDOM VIBRATION: Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum; random vibration: frequency response function, spectral density, probability distribution, correlation, Fourier transform. **(10)**

VIBRATION AND NOISE-MEASUREMENT AND CONTROL: Overview of vibration analysis; Measuring instruments: Selection of sensors, acceleration mountings, vibration exciters; Experimental methods in vibration analysis: Free and forced vibration tests, FFT analyser, Nyquist criteria; Methods of vibration control, excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials - viscoelastic polymers; Noise sources and control: Noise in centrifugal fans and blowers, gears, chain drives and bearings, reduction measures, machine enclosures, silencers and mufflers. **(11)**

Total L: 45 periods

REFERENCES:

1. Thomson W T, '*Theory of Vibration with Applications'*. Prentice Hall of India, 2008.
2. Singiresu S Rao '*Mechanical Vibrations'*. Prentice Hall, 2018.
3. Ashok Kumar Mallik, '*Principles of Vibration Control'.* Affiliated East-West Press, 2014.
4. Lewis H Bell, '*Industrial Noise Control Fundamentals and Applications'.* Taylor and Francis Group, 2017.
5. Tse Hinkle and Morse, '*Mechanical Vibrations'.* OBS Publishers and Distributors, 2004.

COURSE OUTCOMES:

At the end of this course, students will be able to		**Bloom's Level**
CO1	Apply fundamental principles of vibration to solve problems involving single and multi-degree of freedom systems.	**K3**
CO2	Analyze the dynamic behavior of mechanical systems using single and multi-degree of freedom vibration models, and interpret measurement data to identify sources and recommend appropriate vibration and noise control strategies.	**K4**
CO3	Demonstrate the ability to interpret and communicate experimental vibration, and noise measurement & control techniques.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			1	1	1
CO2			3	3	3
CO3		1		2	2
		1	3	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25103 MECHANISMS AND ROBOT KINEMATICS

3 1 0 4

ANALYSIS OF PLANAR MECHANISMS: Kinematic analysis of planar mechanisms: Graphical and Analytical methods; Overview of complex mechanisms; Dynamics of mechanisms: Inertia force in linkages, kineto-static analysis by complex numbers, superposition and matrix methods. **(12+4)**

SYNTHESIS OF PLANAR MECHANISMS: Analytical synthesis of planar mechanisms: motion, path and function generation: two, three and four prescribed positions; Structural error, Chebyshev spacing; Freudenstein's equation, Bloch's method, complex number modelling, the dyad or standard form, three prescribed positions for motion, path and function generation, ground pivot specification; Cognate linkages, defects in synthesis. **(12+4)**

TRANSFORMATIONS AND SPATIAL MECHANISMS: Planar transformations, concatenation of finite displacements; Forward and inverse kinematic analysis of RR, RP, RPR and RRR planar manipulators; Spatial transformations - screw operations; Spatial mechanisms - kinematic analysis of closed loop spatial mechanisms. **(10+3)**

KINEMATIC ANALYSIS OF ROBOT MANIPULATORS: Topology arrangements of robotic arms, D-H parameters, forward kinematics, treatment of inverse position, velocity and acceleration analysis, Parallel kinematic manipulators, configurations and characteristics. **(11+4)**

Total L: 60 + T: 15 = 60 periods

REFERENCES:

1. Uicker G R, Pennock J and Shigley J E, '*Theory of Machines and Mechanisms'.* Oxford University Press, 2023.
2. Asok Kumar Mallik, Amitabha Ghosh and Günter Dittrich, '*Kinematic Analysis and Synthesis of Mechanisms'.* CRC Press, 2021.
3. Reza N Jazar '*Theory of Applied Robotics, Kinematics, Dynamics, and Control'*. Springer, 2022.
4. Dan B Marghitu, '*Mechanisms and Robots Analysis with MATLAB'.* Springer, 2010.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply kinematic and dynamic analysis methods to evaluate the motion and forces in planar and spatial mechanisms.	K3
CO2	Analyze the synthesis requirements for mechanisms and manipulators to achieve desired motion, path, and function.	K4
CO3	Design and present structured technical reports by synthesizing simulation results, failure case diagnostics, and mechanism performance evaluations	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			1	1	1
CO2			3	3	3
CO3		2	2	3	3
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25104 MECHATRONICS SYSTEM DESIGN

3 0 0 3

MECHATRONIC SYSTEMS: Mechatronic systems: Key elements, traditional and mechatronic system design approaches; Types of actuators and drives: Magnetostrictive, fluidic and electrical - PMDC, AC induction, stepper and servo motors; Control Valves. **(10)**

FLUIDIC SYSTEM DESIGN: Design of sequential circuits: Cascade, KV-map and step counter methods; Integration of fringe condition modules, sizing and selection of components in industrial hydraulic and pneumatic systems, analysis of industrial hydraulic circuits - high-low circuits and regenerative circuits. **(13)**

SENSORS AND CONTROLLERS: Sensors: proximity, displacement, velocity, acceleration, force, torque, temperature and flow measurements, selection of sensors for mechatronic systems; Types of controllers- Embedded, PLC and PC based; Embedded controllers: types and applications; PLCs: construction and working, programming using ladder logic diagram for mechatronic systems; Servo valves and Proportional valves. **(12)**

REAL TIME INTERFACING AND DESIGN OF MECHATRONIC SYSTEMS: Data acquisition systems, Virtual Instrumentation, interfacing of sensors/actuators with PC, Fault diagnosis - condition monitoring, adaptive control and SCADA systems, Introduction to modelling of systems using block diagram, design and development of Mechatronic systems- Automatic washing machine, hard drive control, auto-focusing in digital cameras, active suspension in vehicles, autonomous vehicles. **(10)**

Total L: 45 periods

REFERENCES:

1. Devdas Shetty and Richard A Kolk, *'Mechatronics System Design'.* Cengage Learning, Second edition, 2011.
2. W. Bolton, '*Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering'.* Pearson Education, Seventh edition, 2018.
3. Anthony Espisito, '*Fluid Power with Application'.* Dorling Kindersley, 2014.
4. Robert H. Bishop, '*LabVIEW Student Edition'.* Pearson, 2016.
5. Jovitha Jerome, '*Virtual Instrumentation Using LabVIEW'.* Prentice Hall, 2010.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Explain the structure and working of mechatronic systems, including actuators, sensors, controllers, and fluidic circuits.	K2
CO2	Apply the principles of sequential control, ladder logic, and component selection to design basic mechatronic and fluid power systems.	K3
CO3	Analyze the performance of mechatronic systems using modern tools such as PLCs, virtual instrumentation, and SCADA for fault diagnosis and real-time control.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	1	1
CO2			3	3	3
CO3	1		1	2	2
	1		**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

SE25105 RESEARCH METHODOLOGY AND IPR
(Common to ED and SE)

2 0 0 2

RESEARCH PROBLEM FORMULATION: Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap. **(4)**

RESEARCH DESIGN AND DATA COLLECTION: Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools. **(6)**

DATA ANALYSIS, INTERPRETATION AND REPORTING: Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research. **(10)**

INTELLECTUAL PROPERTY RIGHTS AND PATENTS: Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance. Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents. **(10)**

Total L: 30 periods

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma J. K., '*Business Research Methods'.* Tata McGraw Hill Education, 11th Edition, 2012.
2. Soumitro Banerjee, '*Research methodology for natural sciences'.* IISc Press, Kolkata, 2022,
3. Catherine J. Holland, '*Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets'.* Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, *'.Patent searching: tools & techniques'.* Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, *'Professional Programme Intellectual Property Rights, Law and practice'.* September 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Outline the principles of research problem formulation, research design, data collection, the basic features and significance of IPR.	K2
CO2	Utilize research methodology principles to develop a research plan, conduct literature reviews, analyze data using appropriate statistical methods, and prepare structured research reports or proposals following ethical guidelines.	K3

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	3	3	3	3	3
CO2	2	2	2	3	3
	3	**3**	**3**	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25111 VIBRATION ENGINEERING LABORATORY

0 0 4 2

In this course, students will be exposed to the various hardware/software needed for the list of topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topic of Orientation:

1. Undamped free vibrations of a single degree of freedom spring-mass system
2. Torsional Vibration (Undamped and damped) of single rotor shaft system
3. Torsional oscillation of trifilar suspension
4. Determination of natural frequency and mode shapes of specimens supported at its ends through modal analysis
5. Determination of the damping coefficient of specimens supported at their ends
6. Forced vibration of specimens supported under simply supported and cantilever boundary conditions – Determination of natural frequency.
7. Determination of critical speed of shafts.

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, *'Vibration Engineering Laboratory Manual'*. PSG Institute of Technology and Applied Research, 2025.
2. Virtual lab: https://mdmv-nitk.vlabs.ac.in/.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply vibration analysis techniques to identify critical operating conditions such as resonance and critical speed in rotating systems.	K3
CO2	Analyze the damping characteristics in various mechanical systems.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			3	2	2
CO2	3			3	3
	3		**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25112 AUTOMATION AND SENSOR INTERFACE LABORATORY

0 0 4 2

In this course, students will begin with a 12-hour orientation module during which faculty will introduce the essential components and technologies involved in mechatronics systems design. The orientation will cover the coordinated control of multiple pneumatic actuators using both the Cascade method and electropneumatic circuits, followed by the implementation of programmable logic controllers (PLCs) for flexible sequence control. Students will then explore sensor calibration and interfacing using virtual instrumentation platforms, enabling accurate data acquisition for closed-loop control. This will lead into the implementation of real-time monitoring and control strategies for electromechanical systems. Finally, students will gain exposure to embedded control techniques using microcontrollers and digital interfaces to manage and automate subsystem operations.

This interconnected orientation is designed to provide students with a system level understanding of mechatronic integration—linking sensing, actuation, control logic, and embedded platforms. Following this module, each student is expected to identify and complete a mini-project that incorporates multiple topics from the orientation. The project should reflect a practical and integrated approach to mechatronic systems, demonstrating the student's ability to apply concepts in control, interfacing, and automation. A detailed project report, including literature review, problem statement, objectives, methodology, experimental validation, and conclusions, will be submitted and evaluated for course credit

Total P: 60 periods

REFERENCES:

1. Department of Mechanical Engineering, 'Automation and Sensor Interface Laboratory Manual'. PSG Institute of Technology and Applied Research, 2025.
2. Frank Lamb, '*Industrial Automation Hands On'.* McGraw Hill Book Company,2013
3. Festo Didactic. '*Textbooks and Workbooks on Pneumatics, Electro-pneumatics, and PLC-based Automation Systems'.* Festo Didactic SE, Germany, 2002.
4. Festo LX. '*Online Learning Platform for Automation and Mechatronics'.* Festo Didactic SE, Germany. Available at: https://lx.festo.com
5. Robert H. Bishop, '*LabVIEW Student Edition'*, Pearson, 2016.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Implement automation sequences using pneumatic actuators, PLCs, and sensor interfaces for real-time control of electromechanical systems.	K3
CO2	Design and validate an integrated mechatronic mini-project by applying concepts of sensing, actuation, control logic, and embedded system interfacing.	K5

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			3	3	3
CO2	3			3	3
	3		**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25201 DESIGN FOR MANUFACTURE AND ASSEMBLY

3 1 0 4

TOLERANCE AND PROCESS CAPABILITY ANALYSIS: Rules and methodologies used to design components for manual, automatic and flexible assembly, DFA index, poka-yoke, six sigma concepts; Cumulative effect of tolerances, dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method, equivalent influence method; Process capability, process capability metrics, Cp, Cpk, cost aspects. **(12+4)**

GEOMETRIC TOLERANCING AND SELECTIVE ASSEMBLY: Limits and fits, surface finish, review of relationship between attainable tolerance grades and different machining processes; Geometric tolerancing for manufacture as per Indian standards and ASME Y 14.5-2018 standard; Interchangeable part manufacture; Selective assembly – Model-I: Group tolerances of mating parts equal; Model-II: Total and group tolerances of shaft equal; Control of axial play - introducing secondary machining operations, laminated shims, selective assembly, examples. **(10+3)**

TRUE POSITION THEORY AND DATUM SYSTEMS: True position theory - comparison between coordinate and conventional method of feature location, true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, compound assembly; Functional inspection techniques using CMM and paper layout gauging; Degrees of freedom, grouped datum systems - different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot - recess pair and tongue – slot pair - computation of translational and rotational accuracy, geometric analysis and applications; Datum features - functional and manufacturing, re-dimensioning to suit manufacturing. **(12+4)**

REDESIGN, TOLERANCE CHARTING AND DFE: Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, design guidelines for welding. Redesign of components to facilitate machining; Tolerance charting: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples; Design for the Environment – environmental objectives, global issues, regional and local issues-basic DFE methods-design guidelines-examples of application. **(11+4)**

Total L: 45 + T:15 = 60 periods

REFERENCES:

1. Boothroyd G, Dewhurst P and Knight W, ‘*Product Design for Manufacture and Assembly’.* Marcell Dekker, 2015.
2. Bryan R Fischer, ‘*Mechanical Tolerance Stackup and Analysis’.* Taylor & Francis, 2011.
3. James G Bralla, ‘*Design for Manufacturability Handbook’.* McGraw Hill Professional, 1999.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom’s Level**
CO1	Apply process capability analysis, tolerance charting, and geometric tolerancing standards to ensure functional and manufacturable mechanical designs.	K3
CO2	Analyse the cumulative effect of tolerances and datum systems to evaluate assembly feasibility and dimensional accuracy in precision manufacturing	K4
CO3	Evaluate component redesign and selective assembly strategies based on functional requirements, environmental impact, and cost-effectiveness.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	2	2
CO2			3	3	3
CO3		1	1	2	2
		1	**3**	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25202 FINITE ELEMENT ANALYSIS IN MECHANICAL DESIGN

3 1 0 4

STATIC ANALYSIS USING ONE DIMENSIONAL ELEMENTS: Finite element formulation: Concepts of finite element method, finite element formulation using variational, weighted residual and weak form techniques; Static analysis using one dimensional elements: Linear and quadratic spar elements, truss and beam elements, beams on elastic foundation - treatment of boundary condition and temperature effects, solution of problems. **(12 + 3)**

STATIC ANALYSIS USING TWO DIMENSIONAL ELEMENTS: Triangular element: Formulation of stiffness matrix and load vectors, temperature effects, torsion of circular and non-circular cross-sections; Quadrilateral element: Evaluation of stiffness and stress matrices by Gaussian quadrature based on isoparametric formulation; Solution of plane stress and plane strain problems; Axisymmetric triangular element: Formulation of stiffness matrix and load vectors, problem modelling and boundary conditions, solution of problems; Higher order elements; Overview of three dimensional stress analysis. **(11 + 4)**

EIGENVALUE ANALYSIS: Formulation and solution of undamped and damped free vibration problems - lumped and consistent mass matrices, solution of longitudinal, transverse and torsional vibration problems using 1D elements; Formulation and solution of buckling problems using 1D element. **(11 + 4)**

HEAT TRANSFER ANALYSIS: Review of differential equations of heat transfer, one dimensional and two-dimensional finite element formulation using variational and Galerkin's methods, solution of steady state heat transfer problems, analysis of tapered fin. **(11 + 4)**

Total L: 45 + T: 15 = 60 periods

REFERENCES:

1. Cook, R. D., Malkus, D. S., Plesha,M. E., and Witt R. J. ' *Concepts and Applications of Finite Element Analysis',* Wiley, 2007.
2. Chandrupatla T R and Belegundu A D. '*Introduction to Finite Elements in Engineering'.* Pearson Education, New Delhi, 2011.
3. Logan D L, '*A First Course in the Finite Element Method'.* Thomson Learning, 2010.
4. Bhavikatti S. S, '*Finite Element Analysis'.* New Age International Publishers, 2015.
5. Dixit U. S, '*Finite Element Methods for Engineers'.* Cengage Learning India Pvt. Ltd., 2009.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply finite element methods to formulate and solve structural, vibration, and heat transfer problems using one- and two-dimensional elements.	K3
CO2	Analyze structural and thermal systems by interpreting the behavior of elements under mechanical and thermal loads using stiffness matrices and boundary conditions.	K4
CO3	Exhibit proficiency in articulating finite element principles, formulations, and applications in structural, vibration, and heat transfer analysis.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			1	2	2
CO2			3	3	3
CO3		1		2	2
		1	**3**	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25203 FAILURE ANALYSIS AND PREVENTION

3 0 0 3

INTRODUCTION TO FAILURE ANALYSIS: Introduction: Need and scope of failure analysis and prevention, engineering disasters and understanding failures. Fundamental sources of failures: Deficient design and upgrading of a part, imperfections in base metals, improper manufacturing, poor assembly, service and maintenance. **(10)**

FAILURE MECHANISMS AND MODES: Fracture modes, ductile fracture of metallic materials and their interpretations, brittle fracture in ductile metallic alloy, microstructural aspects of brittle fracture, factors affecting ductile-brittle relationships. Failure characteristics of ceramics and plastics; Fatigue fracture, macroscopic and microscopic characteristics, statistical aspects of fatigue, fatigue failure prediction and life assessments. **(13)**

FAILURE EVALUATION: Overview of the failure analysis process, organisation of failure investigation, conducting a failure examination, determination and classification of damage, examination of damage and material evaluation, modelling and accident reconstruction, finite element modelling in failure analysis. **(10)**

FAILURE ANALYSIS AND PREVENTION TOOLS: Pareto diagram, fishbone diagram and FMEA, fault tree analysis, reliability, general procedure of failure analysis, background information collection, preliminary examination, NDT for failure analysis, destructive testing: Selection, preservation, cleaning & sectioning of samples. Case studies. **(12)**

Total L: 45 periods

REFERENCES:

1. ASM Handbook, '*Failure analysis and prevention'.* Volume 11, The Materials Information Society, 2002
2. V. Ramachandran, A.C. Raghuram, R.V. Krishnan and S.K. Bhaumik, Failure analysis of engineering structures: Methodology and case histories, ASM International, 2005.
3. A.J. McEvily, Metal Failures: Mechanisms, Analysis, Prevention, John Wiley and Sons, 2002.
4. D.J Wulpi, '*Understanding how components fail'.* ASM International, The Materials Information Society, 1999

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply standard failure analysis procedures and diagnostic tools such as FMEA, fault tree analysis, and NDT methods to investigate engineering failures.	K3
CO2	Analyze failed components using fracture surface features, damage classification, and modelling approaches to determine root causes and recommend preventive actions.	K4
CO3	Present failure case studies through structured reports, synthesizing findings and communicating effectively.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			1	2	2
CO2			3	3	3
CO3		2	2	2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25211 COMPUTER AIDED ENGINEERING LABORATORY

0 0 4 2

In this course, students will be exposed to the various hardware/software needed for the list of topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topic of Orientation:

1. Generative design for performance and weight reduction.
2. Static analysis of typical industrial components.
3. Dynamic analysis of mechanical systems.
4. Steady state and transient thermal analysis of parts/processes.
5. Thermo-mechanical analysis of components.
6. Estimation of fatigue life of mechanical/automotive components.
7. Design optimization using FEA.
8. Fluid flow analysis.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by Department of Mechanical Engineering, PSG Institute of Technology and Applied Research, Coimbatore, 2025.
2. Nitin S. Gokhale, '*Practical finite element analysis*'. Finite to Infinite 2008.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply simulation tools and finite element techniques to perform structural, thermal, and fluid analyses on mechanical components.	K3
CO2	Analyze the influence of design parameters and boundary conditions on the behavior of mechanical components using CAE tools.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			1	2	2
CO2			3	3	3
			3	**3**	**3**

1 - Low, 2- Medium, 3 – High

Third ACM

ED25212 DATA ANALYTICS LABORATORY

0 0 4 2

This course provides students with hands-on exposure to Python programming and data analysis techniques applied to mechanical engineering problems. Students will work with real-world mechanical datasets sourced from online repositories such as the NASA Prognostics Data Repository and other mechanical system datasets. The course includes an orientation phase covering Python fundamentals, data visualization, statistical analysis, and optimization. Following this, students will undertake an industrially relevant project guided by faculty, applying learned skills to analyze mechanical engineering data and communicate findings effectively.

Topic of Orientation:

1. Core Python Programming:
2. Algorithmic problem solving, Python data types, input/output, looping, built-in functions, standard modules (math, random).
3. Python Sequences and Functions:
4. Strings, lists, tuples, dictionaries, sets; function definition, recursion, lambda functions, modular programming.
5. Data Visualization:
6. Data processing, exploratory data analysis using pandas; bar, line, pie charts; interactive visualizations with matplotlib, plotly, seaborn.
7. Statistical and Mathematical Data Analysis:
8. Numerical computing with numpy; reading and exploring mechanical datasets (CSV format); linear regression with scikit-learn; optimization using pulp library; application to mechanical prognostics and diagnostics.
9. Mechanical Engineering Datasets:
10. Exposure and practice with mechanical datasets from NASA Prognostics Data Repository, CMAPSS turbofan engine datasets, and other relevant online sources.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by Department of Mechanical Engineering, PSG iTech, 2025.
2. Nitin S. Gokhale, '*Practical finite element analysis'.* Finite to Infinite 2008.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Analyze mechanical engineering problems through literature review, problem formulation, and application of statistical and optimization models.	K4
CO2	Design and communicate structured technical reports synthesizing data analysis, solution development, and engineering interpretations.	K6

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2	3	3		3	3
	3	**3**	**2**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25213 INDUSTRIAL VISIT & TECHNICAL SEMINAR

0 0 4 2

The student will make at least four one-and-a-half-day industry visits and technical presentations. The same will be assessed by the committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his / her presentations together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

Total P: 60 periods

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Analyze real-world engineering practices and emerging technologies to evaluate their applicability, effectiveness, and alignment with current research and professional trends.	K4
CO2	Prepare and present comprehensive technical reports and seminar presentations effectively, integrating insights gained through industrial visits/technical reports.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1		2	2	3
CO2		3		2	3
	2	**3**	**2**	**2**	**3**

1 - Low, 2- Medium, 3 - High

ED25311 PROJECT WORK I

0 0 12 6

The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Independently carry out research, investigation, or development work to address a defined engineering problem in their specialization.	-
CO2	Design appropriate experimental, analytical, or case study methods to develop and validate solutions with a high degree of technical mastery.	K6
CO3	Prepare and present a comprehensive technical report and effectively communicate project outcomes through viva-voce examination.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3			3	3
CO2			3	3	3
CO3		3		2	2
	3	**3**	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25411 PROJECT WORK II

0 0 24 12

The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Independently carry out research, investigation, or development work to address a defined engineering problem in their specialization.	-
CO2	Design appropriate experimental, analytical, or case study methods to develop and validate solutions with a high degree of technical mastery.	K6
CO3	Prepare and present a comprehensive technical report and effectively communicate project outcomes through viva-voce examination.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	3			3	3
CO2			3	3	3
CO3		3		2	2
	3	**3**	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

PROFESSIONAL ELECTIVE COURSES

ED25P01 MECHANICS OF COMPOSITES MATERIALS

3 0 0 3

COMPOSITE MATERIALS: Modern materials in design, types, metals, polymers, ceramics, composites, classification of composites, advantages, applications and limitations, matrix and reinforcement-their roles, principal types of fiber and matrix materials. Manufacturing methods of glass, graphite and boron fibers. **(11)**

MANUFACTURE OF COMPOSITE COMPONENTS: Lay-up and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, injection moulding, blow moulding; An overview of metal matrix composite processing and ceramic matrix composite processing; Quality inspection methods. **(10)**

MICRO AND MACRO MECHANICAL BEHAVIOUR OF A LAMINA: Volume and mass fractions, evaluation of elastic moduli, strength of unidirectional lamina, Hooke's law for different materials, engineering constants for orthotropic materials; Stress, strain relations for plane stress in an orthotropic material and in a lamina of arbitrary orientation, strength of an orthotropic lamina, failure theories. **(12)**

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Classical laminate theory, laminate code, stress-strain relationship; Resultant forces and moments in a laminate, types of laminates-stiffness matrices, inter laminar stresses; Analysis of composite structures: Fatigue, fracture mechanics-basic principles, environmental effects; Composite joints-bonded, bolted joints. **(12)**

Total L: 45 periods

REFERENCES:

1. Autar K Kaw, '*Mechanics of Composite Materials'*, CRC Press, NY, 2006.
2. Bhagwan D Agarwal, Lawrence J Broutman, K Chandrashekhara '*Analysis and Performance of Fiber Composites'.* Wiley, 2017
3. Matthews F L and Rawlings R D, '*Composite Materials: Engineering and Science'.*, Woodhead Publishing, 1999.
4. Ronald F Gibson, '*Principles of Composite Material Mechanics'.* McGraw Hill Book Co, 2016.
5. Mallick P K, '*Fiber Reinforced Composites: Materials, Manufacturing and Design'*, CRC press, 2012.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply principles of composite material selection to choose appropriate fiber-matrix combinations for specific engineering applications.	K3
CO2	Analyze the composition, processing, and mechanical behavior of composite materials to assess their engineering applicability.	K4
CO3	Prepare and present technical findings on composite failures and suggest improvements through appropriate selection of materials.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P02 CONCEPTS OF ENGINEERING DESIGN

3 0 0 3

FUNDAMENTALS OF ENGINEERING DESIGN: Definitions and importance of design – Types of design: adaptive, original, variant – Design versus analysis – Characteristics of good design – Role of creativity and innovation – Design as a decision-making process – Phases of engineering design – Product life cycle and design considerations – Problem formulation and design requirements. **(11)**

DESIGN THINKING AND PROBLEM-SOLVING STRATEGIES: Structured problem solving – Design thinking methodology – Empathize, define, ideate, prototype, test – Divergent and convergent thinking – Function decomposition and abstraction – Creativity tools: brainstorming, TRIZ, morphological analysis – Design heuristics – Decision matrices and trade-off analysis. **(11)**

ENGINEERING DESIGN PROCESS AND MODELS: Stages of the design process – Conceptual, embodiment and detailed design – Design process models: Pahl and Beitz, Ulrich and Eppinger – Product architecture – Design documentation – Design review and iteration – Risk and failure analysis in design. **(12)**

DESIGN FOR X AND ETHICS IN DESIGN: Design for Manufacturing, Assembly, Cost, Reliability, Sustainability, and Environment (DFX) – Concurrent engineering – Design for robustness – Human factors and ergonomics – Intellectual property and patents – Design ethics and professional responsibilities – Case studies in engineering ethics and failures. **(11)**

Total L: 45 periods

REFERENCES:

1. Pahl, G., Beitz, W., Feldhusen, J., and Grote, K.H., '*Engineering Design: A Systematic Approach*'. Springer, 3rd Edition, 2007.
2. Dieter, G.E., and Schmidt, L.C. '*Engineering Design'.* McGraw-Hill, 5th Edition, 2013.
3. Cross, N. '*Engineering Design Methods: Strategies for Product Design'.* Wiley, 4th Edition, 2008.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply structured problem-solving approaches and engineering design methodologies to develop feasible solutions for given design requirements.	K3
CO2	Analyze engineering problems using design thinking tools, process models, and DFX principles to evaluate alternative solutions and optimize design outcomes.	K4
CO3	Demonstrate the ability to document, present, and communicate engineering design concepts, processes, and ethical considerations effectively.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P03 APPLIED PROBABILITY AND STATISTICS FOR DESIGN ENGINEERS

3 0 0 3

PROBABILITY DISTRIBUTIONS AND RANDOM VARIABLES: Random variables – Probability mass and density functions – Moments and moment generating functions – Common distributions: Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, and Normal – Functions of a random variable. **(11)**

JOINT DISTRIBUTIONS AND ESTIMATION THEORY: Two-dimensional random variables – Joint, marginal, and conditional distributions – Correlation and regression – Unbiased estimators – Method of moments – Maximum likelihood estimation – Principle of least squares. **(11)**

HYPOTHESIS TESTING AND INFERENTIAL STATISTICS: Sampling distributions – Errors in hypothesis testing – Large and small sample tests – Tests for mean, variance and proportion using Normal, t, Chi-square and F distributions – Independence of attributes – Goodness-of-fit tests. **(12)**

MULTIVARIATE ANALYSIS AND APPLICATIONS: Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal distribution – Principal Component Analysis (PCA) – Population principal components – PCA from standardized variables – Applications in data reduction and pattern recognition. **(11)**

Total L: 45 periods

REFERENCES:

1. Devore, J. L., '*Probability and Statistics for Engineering and the Sciences'*. 8th Edition, Cengage Learning, 2014.
2. Gupta S. C. and Kapoor V. K., '*Fundamentals of Mathematical Statistics'*. 12th Edition, Sultan and Sons, New Delhi, 2020.
3. Johnson, R. A., Miller I. and Freund J., *'Miller and Freund's Probability and Statistics for Engineers'*. 9th Edition, Pearson Education, Asia, 2016.
4. Richard A. Johnson and Dean W. Wichern, '*Applied Multivariate Statistical Analysis'*. 6th Edition, Pearson Education, Asia, 2012.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply probability and statistical methods to model engineering problems and perform appropriate analyses for decision-making.	K3
CO2	Analyze experimental and observational data using estimation theory, hypothesis testing, and multivariate analysis to extract meaningful engineering insights.	K4

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P04 SURFACE ENGINEERING

3 0 0 3

FRICTION AND WEAR: Topography and surface features – Surface interaction – Measurement techniques – Sliding and rolling friction – Friction behavior of metals and non-metals – Friction under extreme conditions – Basic wear mechanisms: Abrasive, erosive, cavitation, adhesion, fatigue, and fretting – Laws and models of wear – Wear of metals and non-metals. **(12)**

CORROSION AND PROTECTION: Principles and classification of corrosion – Types and influencing factors – Testing methods: In-service and laboratory – Evaluation and monitoring – Corrosion prevention: Material selection, environmental control, design considerations, cathodic and anodic protection, inhibitors. **(10)**

SURFACE MODIFICATION TECHNIQUES: Surface layers and their role – Surface property enhancement – Coating and treatment techniques: PVD, CVD, ion implantation, surface welding, thermal spraying – Laser-based methods: Hardening, alloying, and cladding – Industrial applications of surface treatments. **(12)**

ENGINEERING MATERIALS AND ADVANCED COATINGS: Materials for surface applications: Super alloys, titanium, magnesium, aluminium, nickel-based alloys – Ceramics, polymers, biomaterials – Introduction to bio-tribology and nano-tribology – Emerging coatings: DLC, CNC, thick and nano-engineered coatings, corrosion-resistant coatings. **(11)**

Total L: 45 periods

REFERENCES:

1. Gwidon Stachowiak, Andrew W Batchelor, '*Engineering Tribology*'. 5th Edition, Butterworth-Heinemann, 2025.
2. P. A. Dearnley, '*Introduction to Surface Engineering*'. Cambridge University Press, 2017.
3. Ankit Tyagi, Qasim Murtaza, R.S. Walia, Shailesh Mani Pandey, '*Surface Engineering: Methods and Applications*'. 1st Edition, Taylor & Francis Ltd, CRC Press, 2022.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply engineering concepts and theoretical knowledge to solve practical problems involving material degradation and surface interaction in mechanical systems	K3
CO2	Analyze performance data and experimental results to evaluate the effectiveness of design strategies or material choices in enhancing component reliability.	K4
CO3	Develop and deliver a research-based technical presentation that critically examines recent advancements or challenges in the field of surface engineering.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P05 PRODUCT DESIGN AND DEVELOPMENT

3 0 0 3

INTRODUCTION TO PRODUCT DESIGN AND CUSTOMER NEEDS: Characteristics of successful product development – Duration and cost of product development – Challenges of product development – Product development processes and organizations – Product planning process – Process of identifying customer needs – Establishing target and final product specifications. **(12)**

CONCEPT GENERATION, SELECTION AND TESTING: Concept generation activities – Concept screening and scoring – Concept testing methodologies – Product architecture – Establishing architecture and implications – Delayed differentiation – Platform planning – Related system-level design issues. **(11)**

INDUSTRIAL DESIGN, DESIGN FOR MANUFACTURE AND PROTOTYPING: Need and impact of industrial design – Industrial design process – Managing the industrial design process – Assessing the quality of industrial design – Design for Manufacture (DFM): Estimation of manufacturing cost – Reducing component, support, and assembly costs – Impact of DFM decisions – Prototype basics – Prototyping principles and technologies – Planning for prototypes. **(11)**

ROBUST DESIGN AND PROJECT MANAGEMENT: Robust design – Robust design process – Product development economics – Elements of economic analysis – Understanding and representing tasks – Baseline project planning – Accelerating the project – Project execution – Postmortem project evaluation. **(11)**

Total L: 45 periods

REFERENCES:

1. Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, '*Product Design and Development'.* McGraw –Hill Education (India) Pvt. Ltd, 4th Edition, 2012.
2. Kevin N Otto, Kristin L Wood, '*Product Design – Techniques in Reverse Engineering and New Product Development'.* Pearson Education, Inc, 2016

COURSE OUTCOMES:

At the end of this course, students will be able to:

At the end of the course, students will be able to		Bloom's Level
CO1	Apply structured product design and development methodologies to generate, select, and refine concepts that meet customer needs and specifications.	K3
CO2	Analyze product architectures, industrial design considerations, manufacturing aspects, and project management strategies to optimize product performance and development efficiency.	K4
CO3	Demonstrate the ability to present and communicate product design concepts, prototypes, and development plans effectively to stakeholders.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P06 TOPOLOGY OPTIMIZATION AND GENERATIVE DESIGN

3 0 0 3

INTRODUCTION TO DESIGN OPTIMIZATION: Introduction to optimization in engineering design – Types of optimization: sizing, shape, and topology – Problem formulation: objective functions, design variables, constraints – Introduction to finite element method (FEM) for structural analysis – Design sensitivity analysis – Optimization algorithms: gradient-based and non-gradient methods – Applications in structural and multidisciplinary design. **(11)**

TOPOLOGY OPTIMIZATION METHODS: Principles of topology optimization – Material distribution methods – SIMP (Solid Isotropic Material with Penalization) method – Level-set method – Evolutionary structural optimization (ESO) – Manufacturing constraints in topology optimization – 2D and 3D examples – Case studies in mechanical and structural systems.

(11)

GENERATIVE DESIGN CONCEPTS AND WORKFLOWS: Introduction to generative design – Difference between generative design and topology optimization – Generative design workflows and design space exploration – Integration of CAD/CAE tools – AI and machine learning in generative design – Design intent, constraints, and boundary conditions – Material and manufacturing considerations – Applications in automotive, aerospace, biomedical, and consumer products. **(11)**

DIGITAL TOOLS, VALIDATION AND INDUSTRY APPLICATIONS: Software platforms for topology optimization and generative design– Geometry cleaning and interpretation – Additive manufacturing and DfAM (Design for Additive Manufacturing) – Prototyping and validation – Real-world industrial case studies – Challenges and future trends. **(12)**

Total L: 45 periods

REFERENCES:

1. Martin Philip Bendsoe, Ole Sigmund, *'Topology Optimization: Theory, Methods, and Applications'.* Springer Berlin Heidelberg, 2013.
2. Brent R. Bielefeldt, Darren J. Hartl, Marcelo H. Kobayashi, '*Topology Optimization via L-Systems and Genetic Algorithms: Bioinspired Encoding for Generative Design*'. Cambridge University Press, 2025.
3. Amir M. Mirzendehdel, Krishnan Suresh, '*A Hands-on Introduction to Topology Optimization*'. Createspace Independent Pub, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply topology optimization and generative design methodologies using appropriate computational tools to develop optimized engineering solutions.	K3
CO2	Analyze design problems considering structural performance, manufacturing constraints, and material behavior to select optimal topology and generative design strategies.	K4
CO3	Demonstrate the ability to prepare, present, and interpret topology optimization and generative design results effectively for industrial and research applications.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			**2**	3	3
CO2			**3**	3	3
CO3		**2**		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P07 DESIGN AND ANALYSIS OF THERMAL SYSTEMS

3 0 0 3

INTRODUCTION TO THERMAL SYSTEM DESIGN: Design methodology – Characteristics of thermal systems – Design factors: objectives, constraints, and criteria – Design process overview: conceptual, preliminary, and detailed design – Role of modeling and simulation in design – Performance evaluation: analytical vs. experimental – Case examples from power, HVAC, and process industries **(11)**

MODELING OF THERMAL SYSTEM COMPONENTS: Mathematical modeling of thermal systems – Conservation equations: mass, momentum, and energy – Lumped and distributed parameter models – Heat exchangers, pumps, fans and compressors – Working fluid properties and their influence on design – Use of empirical correlations – Numerical solution techniques for thermal systems **(11)**

SYSTEM SIMULATION, OPTIMIZATION AND ECONOMIC ANALYSIS: System simulation techniques – Steady-state vs. transient simulation – Sequential and simultaneous solution strategies – Optimization: problem formulation, objective functions, constraints – Single and multi-variable optimization techniques – Economic analysis: life cycle cost, payback period, present worth analysis – Case studies. **(12)**

DESIGN CASE STUDIES AND RELIABILITY CONSIDERATIONS: Thermal system design case studies: Heat exchangers, refrigeration and air-conditioning systems, solar thermal systems, cogeneration plants – Safety, reliability, and maintainability in thermal system design – Uncertainty analysis – Fault diagnosis and system monitoring – Design for manufacturability and sustainability. **(11)**

Total L: 45 Periods

REFERENCES:

1. Jaluria, Y., '*Design and Optimization of Thermal Systems'.* CRC Press, 3rd Edition, 2019.
2. Incropera, F.P., and DeWitt, D.P., '*Fundamentals of Heat and Mass Transfer'.* Wiley, 7th Edition, 2011.
3. Cengel, Y. A., and Boles, M. A., '*Thermodynamics: An Engineering Approach'.* McGraw-Hill, 9th Edition, 2019.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply design methodologies, modeling techniques, and simulation tools to develop thermal system solutions that meet specified performance criteria.	K3
CO2	Analyze thermal systems by integrating component models, optimization techniques, and economic evaluation to identify optimal and sustainable design solutions.	K4
CO3	Articulate the ability to compile, communicate, and interpret analyses and case study results in thermal system design.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P08 FRACTURE MECHANICS

3 0 0 3

FRACTURE MECHANISMS IN METALS AND NONMETALS: Linear elastic fracture mechanics, elastic plastic fracture mechanics, fracture toughness testing; Fracture mechanisms in metals: Ductile fracture, cleavage, the ductile-brittle transition, intergranular fracture; Fracture mechanisms in non-metals: Structure and properties of polymers, yielding and fracture in polymers, fiber-reinforced plastics, ceramics and ceramic composites, concrete and rock. **(10)**

CREEP: Mechanics of creep, inter-granular, trans-granular creep, creep test, creep strain rate-time curves, deformation mechanism map, high temperature properties of materials long time creep-stress-time relations creep contribution to the fracture mechanism; DVM, DVL German-standard, Hatifield time yield test. **(12)**

APPLICATION TO STRUCTURES: Linear elastic fracture mechanics, CTOD design curve, failure assessment diagrams original concept, J-based FAD, application to welded structures, probabilistic fracture mechanics. **(11)**

FATIGUE CRACK PROPAGATION AND COMPUTATIONAL FRACTURE MECHANICS: Similitude in fatigue, empirical fatigue crack growth equations, crack closure, growth of short cracks, micro-mechanisms of fatigue, fatigue crack growth experiments, damage tolerance methodology. Overview of numerical methods, traditional methods in computational fracture mechanics, the energy domain integral, mesh design, linear elastic convergence study, analysis of growing cracks. **(12)**

Total L: 45 periods

REFERENCES:

1. Anderson T L, ‘*Fracture Mechanics: Fundamentals and Applications’.*, Taylor and Francis, 2017.
2. ASM Handbook- Vol.11, ‘*Failure Analysis and Prevention’.* Metals Park, Ohio, USA, 2002.
3. Prashant Kumar *‘Elements of Fracture Mechanics’.* McGraw Higher Ed, 2009.
4. Surjya Kumar Maiti, ‘*Fracture Mechanics: Fundamentals and Applications*’. Cambridge University Press, 2015.
5. Tribikram Kundu, ‘Fundamentals of Fracture Mechanics’. Taylor & Francis, 2008.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom’s Level**
CO1	Apply fracture mechanics principles to interpret failure mechanisms in metals and non-metals under static, creep, and fatigue loading conditions.	K3
CO2	Analyze fracture behavior in engineering structures using experimental data, design curves, failure assessment diagrams, and computational fracture mechanics methods.	K4
CO3	Communicate and interpret fracture mechanics analyses, experimental results, and case study findings effectively in technical and professional contexts.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P09 ADVANCED FINITE ELEMENT ANALYSIS

3 0 0 3

BENDING OF PLATES AND SHELLS: Review of elasticity equations, bending of plates and shells – finite element formulation of plate and shell elements, conforming and non-conforming elements, C0 and C1 continuity elements, degenerated shell elements, application and examples. **(11)**

NON-LINEAR ANALYSIS: Introduction, non-linear differential equation, solution procedures for non-linear problems, linearization and directional derivative; Material non-linearity: Analysis of axially loaded bars, significance of sampling rate, material models for isotropic, orthotropic, anisotropic, hyper-elastic, hardening rules; Geometric non-linearity: Basic continuum mechanics concepts, governing differential equations and weak forms; Introduction to contact problems. **(12)**

TIME-DEPENDENT ANALYSIS: Numerical integration in time, natural frequencies of one-dimensional bar, time dependent one-dimensional bar analysis; Time dependent heat transfer -transient thermal analysis; Solution of one-dimensional problems. **(12)**

ERROR, ERROR ESTIMATION AND CONVERGENCE: Sources of error, ill-conditioning, the condition number, diagonal decay test, residuals, discretization error, convergence rate, multi-mesh extrapolation, mesh revision methods, gradient recovery and smoothing, A-Posteriori error estimate, adaptive meshing. **(10)**

Total L: 45 periods

REFERENCES:

1. Bathe K. J., *'Finite Element Procedures in Engineering Analysis'.*, Prentice Hall, 2006.
2. Cook, R. D., Malkus, D. S., Plesha,M. E., and Witt,R..J, *'Concepts and Applications of Finite Element Analysis'.* Wiley, 2007.
3. Logan D L, '*A First Course in the Finite Element Method'*. Thomson Learning, 2010.
4. Rao S S, '*The Finite Element Method in Engineering'*., Elsevier, 2018.
5. Reddy J.N, '*An Introduction to Finite Element Method'.* McGraw Hill Education, 2015.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply advanced finite element formulations to analyze bending behavior of plates and shells, and model complex engineering components.	K3
CO2	Analyze non-linear, time-dependent, and contact problems in structural and thermal domains, incorporating error estimation and convergence studies to ensure solution accuracy.	K4
CO3	Present and interpret finite element analysis results effectively, including model assumptions, computational procedures, and validation against experimental or benchmark data.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P10 MICRO ELECTRO MECHANICAL SYSTEMS

3 0 0 3

INTRODUCTION TO MEMS AND MICROFABRICATION: Overview of MEMS – Historical background – MEMS and Microsystems – Scaling laws – Applications in automotive, biomedical, aerospace, and consumer electronics – Materials for MEMS: silicon, polymers, metals, ceramics – Overview of microfabrication techniques: photolithography, doping, etching, deposition – Cleanroom standards. **(11)**

MICROSENSORS AND ACTUATORS: Classification and working principles of microsensors: piezoresistive, capacitive, piezoelectric, thermal, and optical sensors – Actuation mechanisms: electrostatic, thermal, magnetic, piezoelectric – Microactuators for positioning, switching, and fluid control – Performance metrics – Design considerations and integration issues. **(11)**

MEMS DESIGN AND MODELING: Mechanical design of MEMS structures: beams, diaphragms, comb drives – System-level modeling – Lumped and distributed parameter modeling – Finite element modeling – Coupled-domain simulation – Introduction to MEMS CAD tools – Reliability issues in MEMS design – Packaging of MEMS devices. **(12)**

SPECIALIZED APPLICATIONS AND CASE STUDIES: MEMS in inertial sensing (accelerometers and gyroscopes) – Microfluidics and lab-on-chip devices – RF MEMS: switches, resonators – BioMEMS – Optical MEMS (MOEMS) – Energy harvesting using MEMS – Commercial MEMS devices – Case studies on design, fabrication, and integration challenges. **(11)**

Total L: 45 periods

REFERENCES:

1. Mohamed Gad-el-Hak, '*The MEMS Handbook*'. CRC Press, 2nd Edition, 2005.
2. Tai-Ran Hsu, '*MEMS and Microsystems: Design and Manufacture'.* McGraw-Hill, 2nd Edition, 2008.
3. Marc Madou, '*Fundamentals of Microfabrication and Nanotechnology'.* CRC Press, 3rd Edition, 2011.
4. Chang Liu, '*Foundations of MEMS*'. Pearson Education, 2nd Edition, 2011.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply MEMS design principles and microfabrication techniques to develop microsensors, microactuators, and microstructures for engineering applications.	K3
CO2	Analyze MEMS device performance using modeling, simulation, and reliability assessment, considering material properties and fabrication constraints.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P11 OPTIMIZATION TECHNIQUES IN DESIGN

3 0 0 3

UNCONSTRAINED AND CONSTRAINED OPTIMIZATION: Introduction to optimum design – Principles of optimization – Problem formulation and classification – Single and multivariable optimization – Techniques of unconstrained minimization: Golden section, random, pattern, and gradient search methods – Interpolation methods – Optimization with equality and inequality constraints – Direct and indirect methods – Penalty function approach – Lagrange multipliers – Geometric programming. **(12)**

INTELLIGENT OPTIMIZATION METHODS: Artificial Neural Networks – Activation functions and types – Neural network architectures – Single layer and multilayer feedforward networks – Applications of neural networks in design – Swarm Intelligence – Behavior-inspired algorithms – Ant Colony Optimization – Particle Swarm Optimization. **(11)**

ADVANCED OPTIMIZATION TECHNIQUES: Multistage optimization – Dynamic programming – Stochastic programming – Multi-objective optimization – Genetic algorithms – Simulated annealing – Application of metaheuristic techniques in complex engineering design problems. **(11)**

APPLICATIONS TO STRUCTURAL AND DYNAMIC SYSTEMS: Structural applications – Design of truss members, axial and transverse loaded members – Design for minimum cost and weight – Design of shafts and springs – Dynamic applications – Optimum design of single and two-degree-of-freedom systems – Vibration absorbers – Design of simple linkage mechanisms.

(11)

Total L: 45 periods

REFERENCES:

1. Singiresu S Rao, '*Engineering Optimization: Theory and Practice',* John Wiley & Sons, Inc, 4th Edition, 2009.
2. Deb K., '*Optimization for Engineering Design: Algorithms and Examples',* Prentice Hall India Learning Private Limited, 2nd Edition, 2012.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply classical and intelligent optimization methods to solve unconstrained and constrained engineering design problems.	K3
CO2	Analyze structural and dynamic system designs using advanced and metaheuristic optimization techniques to achieve performance and cost objectives.	K4
CO3	Prepare and present optimized design solutions and computational results effectively for engineering applications.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			**2**	3	3
CO2			**3**	3	3
CO3		**2**		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P12 SOLID FREEFORM MANUFACTURING

3 0 0 3

INTRODUCTION & DESIGN ASPECTS: Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing – Slicing – Design for Additive Manufacturing (DfAM) - Part Consolidation - Topology Optimization – Lightweight Structures – DFAM for Part Quality Improvement - Part Orientation - Support Structure Design and Support Structure Generation. **(11)**

VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES: Stereolithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins – Pre-Build Process – Part-Building and Post-Build Processes - Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications. Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies. **(10)**

MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES: Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM. Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder metallurgy - Surface Deviation and Accuracy - Applications. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes – Materials – Advantages - Limitations and Applications. Case Studies. **(12)**

JETTING AND DIRECT ENERGY DEPOSITION PROCESSES: Binder Jetting: Three-Dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages - Limitations - Applications. Material Jetting - Principles - Process - Materials - Advantages and Limitations. Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies. **(12)**

Total L: 45 periods

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hotter, '*Additive Manufacturing:3D Printing for Prototyping and Manufacturing'.* Hanser publications Munchen, Germany, 2016.
2. Ben Redwood, Brian Garret, Filemon Schöffer, and Tony Fadel, *'The 3D Printing Handbook: Technologies, Design and Applications'.* 3D Hubs B.V., Netherland, 2017.
3. Ian Gibson, David W. Rosen and Brent Stucker, '*Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing'.* Springer - New York, USA, 2nd Edition, 2015.
4. Liou, L.W. and Liou, F.W., '*Rapid Prototyping and Engineering Applications: A tool box for prototype development'.* CRC Press, 1st Edition, 2007.

COURSE OUTCOMES:

At the end of this course, students will be able to:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply Design for Additive Manufacturing and Additive Manufacturing principles to develop and optimize CAD models, data workflows, process parameters, and post-processing strategies for lightweight, topology-optimized components with improved mechanical properties and surface finish.	K3
CO2	Analyze the AM processes to establish part design and process design rules for improved performance	K4

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
			3	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P13 MATERIAL HANDLING SYSTEMS AND DESIGN

3 0 0 3

HOISTING SYSTEMS AND LOAD HANDLING ELEMENTS: Types and selection of hoists – Applications – Design of hoisting elements: chains, wire ropes, pulleys, sprockets, drums – Load handling attachments – Design of hooks, crane grabs, lifting magnets, grabbing attachments – Arresting gear – Brakes: shoe, band, cone types. **(12)**

DRIVES, ELEVATORS AND CONVEYORS: Hand and power drives – Traveling mechanisms – Rail, cantilever, and monorail cranes – Slewing, jib and luffing gear – Cogwheel drive – Motor selection – Bucket elevators: design and loading – Cage elevators: hoisting machine, shaftway, safety devices – Design of fork lift trucks – Overview of belt, apron, screw, pneumatic and vibratory conveyors. **(12)**

DESIGN OF CONVEYING SYSTEMS: Types and design considerations – Belt conveyors, apron conveyors, escalators – Pneumatic, screw and vibratory conveyors – Application-based material handling system design – Selection of conveying components based on capacity, material type and energy efficiency. **(10)**

INTEGRATED DESIGN APPLICATIONS: System-level design – Valve gear mechanisms – Portable air compressor – Hay bale lifter – Cam testing machine – Power screws – Gearbox design (6-speed and above) – Integration of mechanical elements in complete handling systems. **(11)**

Total L: 45 periods

REFERENCES:

1. Norton.L Robert.'*Machine Design–An Integrated Approach'.* 2nd Edition, Pearson Education, 2005.
2. Matthew P Stephens, Matthew P. Stephens, "*Manufacturing Facilities Design & Material Handling*'. 6th Edition, Purdue University Press, 2019.
3. David E. Mulcahy, '*Materials Handling Handbook'.* McGraw-Hill Companies, 1999.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply design principles to develop hoisting, load handling, and conveying systems suited to specific industrial applications.	K3
CO2	Analyze material handling systems considering mechanical components, drive mechanisms, and operational constraints to optimize performance and safety.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2		
CO2			3		
		2	**3**		

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P14 LIFE CYCLE ASSESSMENT AND ECO DESIGN

3 0 0 3

INTRODUCTION TO LIFE CYCLE THINKING: Need for sustainable product development – Concepts of sustainability, environmental impact, and circular economy – Life Cycle Thinking (LCT) – Overview of product life cycle stages – Life Cycle Assessment (LCA): Definition, importance, and framework – International standards– Applications of LCA in industry and policy. **(11)**

LIFE CYCLE ASSESSMENT METHODOLOGY: Goal and scope definition – Functional unit and system boundary – Life Cycle Inventory (LCI): Data collection, databases, and tools – Life Cycle Impact Assessment (LCIA): Impact categories, classification, characterization, normalization and weighting – Interpretation of LCA results – Limitations and assumptions in LCA – Case studies. **(12)**

ECO DESIGN PRINCIPLES AND STRATEGIES: Definition and objectives of Eco Design – Guidelines and strategies for Eco Design – Design for Environment, Design for Disassembly, Design for Recycling, Design for Energy Efficiency – Eco-innovation and sustainable materials selection – Integration of LCA into Eco Design – Environmental product declarations and labeling – Tools and software for Eco Design. **(11)**

APPLICATIONS AND INDUSTRIAL CASE STUDIES: Life cycle-based decision making – Product development and improvement using LCA and Eco Design – Environmental benchmarking – Case studies from automotive, electronics, packaging, and consumer goods – Challenges and future trends in sustainable design – Regulatory and market-driven requirements for sustainable products. **(11)**

Total L: 45 periods

REFERENCES:

1. Hauschild, M.Z., Rosenbaum, R.K., and Olsen, S.I., *'Life Cycle Assessment: Theory and Practice*'. Springer, 2018.
2. Graedel, T.E., and Allenby, B.R., '*Industrial Ecology and Sustainable Engineering'.* Pearson, 2010.
3. ISO 14040 and ISO 14044 Standards for '*Environmental Management – Life Cycle Assessment*'. 2006.
4. Wimmer, W., Züst, R., and Lee, K.M., '*Ecodesign Implementation'.* Springer, 2004.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply life cycle assessment (LCA) frameworks and eco design strategies to develop sustainable products with reduced environmental impact.	K3
CO2	Analyze product systems using LCA methodology and eco design tools to identify environmental hotspots and propose improvement strategies.	K4
CO3	Prepare and present sustainability-focused design proposals and case study evaluations effectively for industrial and policy contexts.	-

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P15 SYSTEM DESIGN FOR SUSTAINABILITY

3 0 0 3

FUNDAMENTALS OF SUSTAINABLE DESIGN: Introduction to sustainability and systems thinking – Environmental, economic, and social dimensions – Design for sustainability (DfS) principles – Circular economy – Sustainable product and system life cycles – Role of engineers in sustainability – Sustainable development goals (SDGs) and their relevance to system design. **(11)**

TOOLS AND METHODS FOR SUSTAINABLE SYSTEM DESIGN: Life Cycle Assessment (LCA): goal, scope, inventory, impact assessment – Eco-design and Design for Environment (DfE) – Material flow analysis – Sustainable material and energy choices – Environmental impact indicators – Carbon and water footprints – Introduction to sustainability rating and assessment tools (LEED, GRI, ISO 14001). **(11)**

SYSTEM INTEGRATION AND OPTIMIZATION: Design integration for energy efficiency and resource optimization – Systems modeling for sustainability – Trade-offs and optimization under environmental constraints – Multi-objective optimization – Industrial symbiosis and resource recovery – Design for remanufacturing, reuse, and recycling – Case studies from manufacturing, energy, and mobility sectors. **(12)**

POLICIES, ETHICS AND CASE STUDIES IN SUSTAINABLE DESIGN: Policy frameworks and regulations for sustainable design – Extended Producer Responsibility (EPR) – Life Cycle Costing (LCC) – Sustainable supply chain and logistics – Ethical and social considerations – Barriers and enablers for sustainable innovation – Case studies on sustainable system design from different industries. (**11)**

Total L: 45 periods

REFERENCES:

1. Fiksel, J., '*Design for Environment: A Guide to Sustainable Product Development'* McGraw-Hill, 2nd Edition, 2009.
2. Graedel, T.E., and Allenby, B.R., '*Industrial Ecology and Sustainable Engineering*'. Pearson, 2010.
3. Hauschild, M.Z., Rosenbaum, R.K., and Olsen, S.I., '*Life Cycle Assessment: Theory and Practice*'. Springer, 2018.
4. Sherwin, C., and Bhamra, T., '*Design and Sustainability: A Practical Guide*'. Ashgate Publishing, 2014.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply sustainable design principles, tools, and system integration approaches to develop environmentally responsible and resource-efficient engineering solutions.	K3
CO2	Analyze product and system designs using sustainability assessment methods to optimize performance considering environmental, economic, and social impacts.	K4

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1			2	3	3
CO2			3	3	3
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

ED25P16 ADVANCED CHARACTERIZATION OF MATERIALS

3 0 0 3

MECHANICAL AND MICROSTRUCTURAL CHARACTERIZATION: Mechanical testing: tensile, compression, hardness, impact, fatigue, and creep – Nanoindentation – Sample preparation for microstructural analysis – Optical microscopy: bright field, dark field, polarized light – Image analysis and grain size measurement – Applications in quality control and failure analysis. **(11)**

X-RAY AND ELECTRON MICROSCOPY TECHNIQUES: X-ray diffraction: principles, instrumentation, phase identification, stress measurement, crystallite size – Scanning Electron Microscopy: imaging modes, detectors, sample preparation – Energy Dispersive Spectroscopy – Transmission Electron Microscopy: diffraction contrast, bright and dark field imaging, selected area diffraction pattern. **(11)**

SURFACE AND THERMAL ANALYSIS TECHNIQUES: Surface analysis: Atomic Force Microscopy, Scanning Tunneling Microscopy, X-ray Photoelectron Spectroscopy, Auger Electron Spectroscopy, Secondary Ion Mass Spectrometry – Thermal analysis: Thermogravimetric Analysis, Differential Scanning Calorimetry, Dynamic Mechanical Analysis. **(12)**

ADVANCED TECHNIQUES AND APPLICATIONS: Fourier Transform Infrared Spectroscopy – Raman spectroscopy – Nuclear Magnetic Resonance – Residual stress measurement – Ultrasonic Testing – Non-destructive Evaluation methods – Atom probe tomography - Correlative microscopy. **(11)**

Total L: 45 periods

REFERENCES:

1. Cullity, B.D., and Stock, S.R., Elements of X-Ray Diffraction, Pearson, 3rd Edition, 2001.
2. Goldstein, J.I. et al., Scanning Electron Microscopy and X-ray Microanalysis, Springer, 4th Edition, 2017.
3. Egerton, R.F., Physical Principles of Electron Microscopy, Springer, 2nd Edition, 2016.
4. Williams, D.B., and Carter, C.B., Transmission Electron Microscopy, Springer, 2nd Edition, 2009.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply advanced characterization techniques to identify microstructural and compositional features of engineering materials.	K3
CO2	Analyze complex materials data obtained from different characterization methods to evaluate structure–property relationships.	K4
CO3	Present advanced characterization case studies, emphasizing the analysis, interpretation of test data, and articulation of key findings.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P17 ADVANCED NANOMATERIALS

3 0 0 3

INTRODUCTION TO NANOMATERIALS AND THEIR PROPERTIES: Definition and classification of nanomaterials – Types: nanoparticles, nanowires, nanotubes, quantum dots, 2D materials – Surface-to-volume ratio and size effects – Physical, chemical, mechanical, magnetic, optical, and electrical properties of nanomaterials – Comparison with bulk materials – Role of surface energy and confinement effects. **(11)**

SYNTHESIS TECHNIQUES: Top-down and bottom-up approaches – Physical vapor deposition, chemical vapor deposition, molecular beam epitaxy, sol-gel, hydrothermal and solvothermal methods – Mechanical milling, laser ablation, electrodeposition – Synthesis of carbon-based nanomaterials (CNTs, graphene) – Green synthesis methods – Scalability and challenges in industrial production. **(11)**

CHARACTERIZATION METHODS: Overview of nanoscale characterization – Electron microscopy (SEM, TEM, HRTEM, SAED) – Scanning probe techniques (AFM, STM) – Spectroscopy techniques: XRD, Raman, FTIR, UV-Vis, XPS – Thermal analysis: TGA, DSC – Surface area and porosity: BET – Zeta potential and particle size analysis – Case studies. **(12)**

APPLICATIONS AND CHALLENGES: Nanomaterials in energy (batteries, supercapacitors, solar cells), electronics (transistors, sensors), healthcare (drug delivery, imaging, cancer therapy), environment (water purification, pollutant detection) – Structural and coating applications – Nanotoxicology and environmental impact – Regulatory and ethical issues – Commercialization and future trends. **(11)**

Total L: 45 periods

REFERENCES:

1. Cao, G., and Wang, Y., '*Nanostructures and Nanomaterials: Synthesis, Properties and Applications*'. World Scientific, 2nd Edition, 2011.
2. Poole, C.P., and Owens, F.J. '*Introduction to Nanotechnology'.* Wiley, 2003.
3. Bhushan, B., '*Springer Handbook of Nanotechnology*'. Springer, 4th Edition, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply synthesis and characterization techniques to develop nanomaterials with tailored properties for specific engineering applications.	K3
CO2	Analyze nanomaterial properties, performance, and limitations using experimental data and advanced characterization methods.	K4
CO3	Prepare and present nanomaterial research findings, application case studies, and associated ethical and environmental considerations effectively.	-

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

Third ACM

ED25P18 MACRO AND NANO COMPOSITE MATERIALS

3 0 0 3

INTRODUCTION TO MACRO AND NANO COMPOSITES: Definition and scope of macro and nano composites; comparison with traditional composites; classification based on scale, reinforcement, and matrix; matrix materials: polymers, metals, ceramics; reinforcements: fibers, whiskers, particulates, nanotubes, graphene, nanoclay; interfaces and interphases – significance in nano composites; applications in engineering design. **(9)**

MATERIALS AND SYNTHESIS TECHNIQUES: Nano fillers: carbon nanotubes, graphene, metal oxides, nanocellulose; macro reinforcements: surface functionalization and dispersion techniques; processing methods for nano composites: solution mixing, melt blending, in-situ polymerization, electrospinning; processing of macro composites: lay-up, compression moulding, injection moulding. **(9)**

CHARACTERIZATION TECHNIQUES: Microscopic analysis: SEM, TEM, AFM; spectroscopic techniques: FTIR, Raman, XRD; thermal analysis: TGA, DSC, DMA; mechanical property evaluation: tensile, flexural, impact, and fatigue testing; electrical and thermal conductivity measurements; interfacial strength and morphology studies. Stress-strain behavior of macro and nano composites; effect of filler geometry, distribution, and orientation; thermal and electrical behavior of nano composites; mechanical failure modes and toughening mechanisms; environmental and long-term durability aspects; nano-reinforcement effect on damping, barrier, rheological, and fire-retardant properties **(18)**

MODELING, DESIGN AND APPLICATIONS: Micromechanics and multiscale modelling of composites; prediction of composite properties; finite element analysis of macro and nano composite structures; design considerations for advanced applications; sustainability and recycling of nano composites; case studies from aerospace, automotive, biomedical, and construction sectors. **(9)**

Total L: 45 periods

REFERENCES:

1. Clyne, T.W. and Hull, D. '*An Introduction to Composite Materials*'. Cambridge University Press, Second Edition, 2019.
2. Gao F, '*Advances in Polymer Nanocomposites: Types and Applications*'. WP Woodhead Publishing, Elsevier; 2012.
3. Haghi A. K, Oluwafemi O. S, Jose J. P, Maria H. J, '*Composites and Nanocomposites*'. CRC Press, 2013.
4. Friedrich K, Fakirov S, Zhang Z, *'Polymer Composites: from nano-to macro-scale'.* Springer Science & Business Media, 2005.
5. Rajeshkumar G, Devnani G. L, Sinha S, Sanjay M. R, Siengchin S. '*Bast Fibers and Their Composites Processing, Properties and Applications*'. Springer, 1st Edition, 2022.
6. Muthukumar C, Thiagamani S. M, Krishnasamy S, Nagarajan R, Siengchin S. '*Polymer Based Bio-Nanocomposites: Properties, Durability and Applications*'. Berlin/Heidelberg, Germany: Springer; 2022.

COURSE OUTCOMES:

At the end of the course, students will be able to		**Bloom's Level**
CO1	Apply synthesis and processing techniques to fabricate macro and nano composite materials and use them in various engineering applications.	K3
CO2	Analyze the influence of material composition, processing methods, and microstructural features on the behavior of macro and nano composite materials.	K4
CO3	Develop technical reports and presentations based on the synthesis, characterization, and behavior of macro and nano composite materials.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	3	3
CO2			3	3	3
CO3		2		2	2
		2	**3**	**3**	**3**

1 - Low, 2- Medium, 3 - High

AUDIT COURSES

SE25A01 SUSTAINABLE DEVELOPMENT GOALS

2 0 0 0

FOUNDATIONS OF SDGs: The “5P’s” of the SDGs – People, Planet, Prosperity, Peace, Partnership - No Poverty, End poverty in all its forms everywhere – Zero Hunger, End hunger, achieve food security and improved nutrition and promote sustainable agriculture –Good Health and Well-Being, ensure healthy lives and promote well-being for all at all ages. **(8)**

SOCIAL DEVELOPMENT: Quality Education, promote lifelong learning opportunities for all – Gender Equality, Achieve gender equality and empower all girls and women – Clean Water and Sanitation – Affordable and Clean Energy, Ensure access to affordable, reliable, sustainable and modern energy for all – Decent Work and Economic Growth. **(7)**

SUSTAINABLE GROWTH: Industry, Innovation and Infrastructure, Build resilient infrastructure, promote sustainable industrialization and foster innovation – Reduced Inequalities – Sustainable Cities and Communities – Responsible Consumption and Production, Ensure sustainable consumption and production patterns. **(7)**

ENVIRONMENTAL SUSTAINABILITY: Climate Action, Take urgent action to combat climate change and its impacts – Life below Water, Conserve and sustainably use our oceans, seas and marine resources – Life on Land, Sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss – Promote just, peaceful and inclusive societies **(8)**

Total L: 30 periods

REFERENCES

1. The United Nations, ‘The Sustainable Development Goals’. The United Nations, 1st Edition, 2017.
2. Stephen Browne, ‘Sustainable Development Goals and Un Goal-Setting’. Routledge, 1st Edition, 2017.
3. Korbla P. Puplampu, Kobena Hanso, Timothy Shaw, Kobena T. Hanson, and Timothy M. Shaw, ‘From Millennium Development Goals to Sustainable Development Goals’. Routledge, 1st Edition, 2021.
4. Julia Walker, Alma Pekmezovic and Gordon Walker, ‘Sustainable Development Goals’. John Wiley& Sons Limited, 1st Edition, 2019.
5. Rianne Mahon, Susan Horton, Simon Dalby and Diana Thomaz, ‘Achieving the Sustainable Development Goals’. Routledge, 1st Edition, 2019.

ONLINE RESOURCES

1. https://sustainabledevelopment.un.org/resourcelibrary
2. https://en.unesco.org/themes/education/sdgs/material
3. https://www.unicef.org/sdgs/resources
4. https://www.undp.org/content/undp/en/home/sustainable-development-goals/resources.html
5. https://sdghub.com/resources/

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Explain the significance of Sustainable Development Goals (SDGs) in global, national, and local development contexts.	**K2**
CO2	Analyze real-world issues through case studies and propose sustainable solutions aligned with relevant SDGs.	**K4**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1					
CO2			1	1	1
			1	1	1

1-low, 2-medium, 3-high

Third ACM

SE25A02 ENGLISH FOR RESEARCH PAPER WRITING

2 0 0 0

INTRODUCTION TO RESEARCH PAPER WRITING: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. **(6)**

PRESENTATION AND TITLE WRITING SKILLS: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check **(12)**

RESULT WRITING SKILLS: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions **(6)**

VERIFICATION SKILLS: Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission **(6)**

Total L: 30 periods

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006.
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles of academic writing, including clarity, conciseness, proper structuring of sentences, and the avoidance of ambiguity, redundancy, and plagiarism in research papers.	**K2**
CO2	Apply effective writing and presentation skills to prepare well-structured sections of a research paper (title, abstract, introduction, methods, results, and discussion), ensuring academic integrity and readiness for publication.	**K3**

COs – POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	2	2	2	2	2
CO2	2	2	2	1	3
	2	**2**	**2**	**1**	**3**

1-low, 2-medium, 3-high

Third ACM

SE25A03 DISASTER MANAGEMENT

2 0 0 0

INTRODUCTION TO DISASTERS: Disaster: Definition, Factors and Significance – Difference between Hazard and Disaster – Natural and Manmade Disasters: Differences, Nature, Types and Magnitude. **(8)**

IMPACTS AND TYPES OF DISASTERS: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystems – Natural Disasters: Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches – Man-made Disasters: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. **(7)**

DISASTER VULNERABILITY AND PREPAREDNESS IN INDIA: Disaster-Prone Areas in India: Seismic Zones, Areas Prone to Floods, Droughts, Landslides, Avalanches, Cyclones, and Coastal Hazards (with special reference to Tsunami) – Post-Disaster Diseases and Epidemics – Preparedness: Monitoring of Phenomena Triggering Disasters, Risk Evaluation, Use of Remote Sensing, Meteorological Data, Media Reports – Government and Community Preparedness. **(8)**

DISASTER RISK ASSESSMENT AND MANAGEMENT STRATEGIES: Disaster Risk: Concept and Elements – Disaster Risk Reduction – Global and National Disaster Risk Situations – Techniques of Risk Assessment – Global Cooperation and Early Warning Systems – People's Participation – Strategies for Survival. **(7)**

Total L: 30 periods

REFERENCES

1. Goel S. L., 'Disaster Administration and Management Text and Case Studies'. Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh AK, 'Disaster Management in India: Perspectives, issues and strategies'. New Royal book Company, 2007.
3. Sahni and Pardeep. , 'Disaster Mitigation Experiences and Reflections'. Prentice Hall of India, New Delhi, 2001.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the nature, types, and impacts of natural and man-made disasters, along with India's disaster-prone regions and their vulnerabilities.	**K2**
CO2	Apply disaster preparedness and risk assessment strategies using tools such as remote sensing, meteorological data, and community participation to propose suitable management practices.	**K3**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				1	2
CO2			1	1	3
			1	**1**	**3**

1-low, 2-medium, 3-high

Third ACM

SE25A04 CONSTITUTION OF INDIA

2 0 0 0

HISTORY AND PHILOSOPHY OF THE CONSTITUTION: History of the Indian Constitution – Drafting Committee: Composition and Working – Philosophy of the Constitution – Preamble – Salient Features. **(8)**

FUNDAMENTAL RIGHTS AND DUTIES: Fundamental Rights – Right to Equality – Right to Freedom – Right against Exploitation – Right to Freedom of Religion – Cultural and Educational Rights – Right to Constitutional Remedies – Directive Principles of State Policy – Fundamental Duties. **(7)**

STRUCTURE OF GOVERNANCE: Organs of Governance: Parliament – Composition, Qualifications and Disqualifications – Powers and Functions – Executive: President, Governor, Council of Ministers – Judiciary: Appointment and Transfer of Judges – Qualifications, Powers and Functions. **(8)**

LOCAL ADMINISTRATION AND ELECTORAL PROCESS: Local Administration: District Administration – Role of District Collector – Municipalities – Mayor and Elected Representatives – Municipal Commissioner – Panchayati Raj Institutions (PRI): Zila Panchayat, Block Level, Village Level – Roles of Elected and Appointed Officials – Importance of Grassroots Democracy – Election Commission: Role and Functions – Chief Election Commissioner and Election Commissioners – Institutions for the Welfare of SC/ST/OBC and Women. **(7)**

Total L: 30 periods

REFERENCES

1. The Constitution of India,1950(Bare Act), Government Publication.
2. Dr.S. N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D. D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the historical evolution, philosophy, and salient features of the Indian Constitution, including its fundamental rights, duties, and directive principles.	**K2**
CO2	Evaluate the structure and functioning of governance, local administration, and electoral processes in India, and assess their role in ensuring democracy, justice, and social welfare at both national and grassroots levels.	**K2**

COs – POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1					
CO2			2	1	1
			2	**1**	**1**

1-low, 2-medium, 3-high

SE25A05 BUILDING COMMUNICATION SKILLS

2 0 0 0

INTRODUCTION: This course is aimed at enhancing the students' ability to land internships through improved communication skills. This course will cover two crucial elements –
1. Communication skills enhancement and
2. Career skills orientation with broader career guidance
At the end of this course, the students will

- be able to confidently communicate in English with improved outcomes in internships, and other career pathways
- have an orientation to the necessary digital tools & resources that can enhance communication skills
- have an understanding of best practices in professional communication
- have increasing digital literacy and understand the important of digital communication both in personal and professional lives

COMMUNICATION SKILLS
In this module, essential communication skills required for the workplace are covered in a multi-part lecture series. This includes skill sets in Writing, Speaking, Vocabulary & Grammar. **(18)**

CAREER SKILLS
In this module, an overall career orientation approach is taken to introduce students to the essential skills required to plan and progress towards crucial career choices. Sessions on profile building, workplace communication, reasoning & critical thinking, social media, privacy, digital communication, workplace communication tools & etiquette are discussed. The module concludes with a session on career planning and milestone tracking. **(12)**

Total L: 30 periods

REFERENCES

1. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary by Norman Lewis
2. The Elements of Style (Fourth Edition or later) by William Strunk Jr and E B White
3. Idioms & Phrasal Verbs List (Various sources and provided in class)
4. The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century by Steven Pinker (Optional Resource)

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate improved oral and written communication skills applicable in internships and workplace environments.	**K3**
CO2	Analyze and apply career development strategies including digital tools, professional etiquette, and personal branding.	**K4**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			3	3	3
CO2		3	3	3	3
		3	**3**	**3**	**3**

1-low, 2-medium, 3-high