BACHELOR OF TECHNOLOGY
MECHANICAL ENGINEERING
THIRD YEAR (FIFTH SEMESTER)
W.E.F. ADMISSION BATCH 2023-24

Sl. No.	Category	Course Code	Course	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
Subject (Theory)							
1	PC	MEPC3001	Design of Machine Elements - II	3-0-0	3	100	50
2	PC	MEPC3002	Heat Transfer	3-0-0	3	100	50
3	PC	MEPC3003	Metal Cutting & Machining	3-0-0	3	100	50
4	PE	MEPE3001	Optimization Method In Engineering Design	3-0-0	3	100	50
		MEPE3002	Metrology, Quality Control and Reliability				
		MEPE3003	Production and Operation Management				
		MEPE3004	Refrigeration & Air Conditioning				
		MEPE3005	Advanced Mechanics of Solids				
		-	-				
		-	-				
5	HS	HSHS3001	Business Management	3-0-0	2	100	50
		HSHS3002	Entrepreneurship Development				
6	MC	MCMC3001	Environmental Engineering	3-0-0	2	100	50
		MCMC3002	Industrial Safety Engineering				
Subject (Sessional / Practical)							
7	PC	MEPC3201	Design of Machine Elements - II Laboratory	0-0-3	1.5	-	100
8	PC	MEPC3202	Machining Laboratory	0-0-3	1.5	-	100
9	PC	MEPC3203	Soft Computing Laboratory	0-0-3	1.5	-	100
10	PSI	MEPS3201	Seminar on SIRE - I	0-0-3	1.5	-	100
			Total	**18-0-12**	**22**	**600**	**700**

Click here to view/download the syllabus of the subjects.

MEPC3001 DESIGN OF MACHINE ELEMENTS-II (3-0-0)

Course Objectives:
This course focuses on advanced machine element design, covering stress analysis, fatigue failure theories, and component design (cylinders, pistons, gears). Students will learn to design power transmission elements (belts, chains, clutches, brakes) and apply engineering principles to solve practical problems using design handbooks and failure criteria (Goodman, Soderberg).

Module–I: (06 Hours)
Review of axial, bending and torsional stresses in machine parts; Theories of Failure, Applications in practical problems.
Variables stresses (Fatigue), Endurance limit, S-N curve, Fatigue stress concentration factor, Goodman, Gerber and Soderberg criteria, Application to design and practical problems.

Module–II: (06 Hours)
Design of cylinder, piston, connecting rod, flywheel, crank shaft and valve.

Module–III: (06 Hours)
Design of clutches (friction and centrifugal type), Brakes (block, band brakes and internal expanding brake).

Module-IV: (06 Hours)
Design of belts (flat and V-belt), rope and chain drives.

Module–V: (06 Hours)
Design of straight and helical spur gears, bevel gears and worm gears.

Course Outcomes:
- CO1: Remembering (Knowledge): Recall fundamental principles of stress analysis (axial, bending, torsional) and theories of failure (Goodman, Gerber, Soderberg) for machine components.
- CO2: Understanding (Comprehension): Explain the design considerations for cylinders, pistons, gears, and power transmission elements (belts, chains, clutches, brakes) based on load and fatigue analysis.
- CO3: Applying (Application): Design machine elements (e.g., gears, flywheels, brakes) using standard design handbooks and failure criteria to meet functional requirements.
- CO4: Analyzing (Analysis): Evaluate the impact of variable stresses, fatigue, and stress concentration factors on the performance and lifespan of machine components.
- CO5: Creating (Synthesis): Develop integrated solutions for real-world mechanical systems by combining multiple machine elements (e.g., gear drives with shafts) and optimizing designs for safety and efficiency.

Design Data Hand Books:

1. Design Hand Book by S. M. Jalaluddin; Anuradha Agencies Publications
2. P. S. G. Design Data Hand Book, PSG College of Tech Coimbatore
3. Machine Design Data Book, K. Lingaiah, Tata McGraw Hill

Reference Books:

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition
2. Mechanical Engineering Design, J. E. Shigley, C. R. Mischke, R. G. Budynas and K. J. Nisbett, Tata Mc Graw-Hill, 11th Edition, 2020
3. Design of Machine Elements, M. F. Spotts
4. Machine Design, P. C. Sharma and D. K. Agrawal, S. K. Kataria & Sons
5. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
6. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3 rd Edition, 2007
7. Machine Design, P. Kanaiah, SciTech Publications.

MEPC3002 HEAT TRANSFER (3-0-0)

Course Objectives:

This course provides a comprehensive understanding of heat transfer mechanisms—conduction, convection, and radiation. Students will analyze steady/transient heat conduction, convective heat transfer (forced/natural), radiative exchange, and phase-change processes. Emphasis is placed on solving engineering problems, designing heat exchangers, and applying empirical correlations for real-world thermal systems.

Module-I: (06 Hours)

Introduction: Modes of heat transfer: conduction, convection, and radiation, Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance & Thermal resistance, Contact resistance, convective heat transfer coefficient, radiation heat transfer coefficient, Electrical analogy, combined modes of heat transfer. Initial conditions and Boundary conditions of 1st, 2nd and 3rd Kind.

Module-II: (06 Hours)

Heat Conduction: General heat conduction in Cartesian, polar-cylindrical and polar-spherical coordinates, Simplification of the general equation for one- and two-dimensional steady transient conduction with constant/ variable thermal conductivity with / without heat generation. Solution of the one-dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases. Critical insulation thickness, Heat transfer in extended surfaces (pin fins) without heat generation, long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness. Conduction in solids with negligible internal temperature gradient (Lumped heat analysis).

Module-III: (06 Hours)

Convective Heat Transfer: Introduction to convective flow - forced and free. Dimensional analysis of forced and free connective heat transfer. Application of dimensional analysis, physical significance of Grashoff, Reynolds, Prandtl, Nusselt and Stanton numbers. Conservation equations for mass, momentum and energy for 2-dimensional convective heat transfer in case of incompressible flow, Hydrodynamic and thermal boundary layers for flow over a flat plate. Critical Reynolds number: general expressions for drag coefficient and drag force Reynolds- Colbourn analogy. Thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Flow inside a duct-velocity boundary layer, hydrodynamic entrance length and hydrodynamically developed flow; flow through tubes (internal flow). Use of empirical relations for solving turbulent conditions for external and internal flow. Mechanism of heat transfer during natural convection, Experimental heat transfer correlations for natural convection in the following cases(a) Vertical and horizontal plates(b) Inside and outside flows in case of tubes.

Module-IV: (06 Hours)

Radiative heat exchange: Introduction, Radiation properties, definitions of various terms used in radiation heat transfer; Absorptivity, reflectivity & transmissivity. Emissive power & emissivity, Kirchoff's identity, Planck's relation for monochromatic emissive power of a black body, Derivation of Stefan-Boltzmann law and Wien's displacement law from Planck's relation, Radiation shape factor, Relation for shape factor and shape factor algebra. Heat exchange between blackbodies through non-absorbing medium. Gray bodies and real bodies, Heat exchange between gray bodies. Radiosity and Irradiation, Radiation shields.

Module-V: (06 Hours)

Heat transfer for boiling liquids and condensing vapors: Types of condensation, use of correlations for condensation on vertical flat surfaces, horizontal tube and regimes of pool boiling, pool boiling correlations. Critical heat flux, concept of forced boiling. Numerical problems.

Heat Exchangers: Introduction, Types of heat exchanger, The overall heat transfer coefficient and fouling factors, LMTD and NTU analysis of heat exchangers.

Course Outcomes:

CO1: Remembering (Knowledge): Recall fundamental laws (Fourier's, Newton's cooling, Stefan-Boltzmann) and modes of heat transfer (conduction, convection, radiation).

CO2: Understanding (Comprehension): Explain concepts like boundary layers, fin efficiency, and shape factors, and interpret dimensionless numbers (Reynolds, Nusselt, Grashof).

CO3: Applying (Application): Solve problems involving steady/transient conduction, convective heat transfer, and radiative exchange using empirical correlations and LMTD/NTU methods.

CO4: Analyzing (Analysis): Evaluate the impact of variables (e.g., insulation thickness, flow conditions) on heat transfer rates and system performance.

CO5: Creating (Synthesis): Design heat exchangers and thermal systems by integrating conduction, convection, and radiation principles for optimal efficiency.

Reference Books:

1. Heat Transfer Incropera and Dewitt, Willey publications
2. Heat Transfer: J.P.Holman, TMH Publications
3. Heat Transfer: P.S. Ghosdastidar, Oxford University Press
4. Fundamentals of Engineering Heat and Mass Transfer: R.C. Sachdeva, New Age International Publishers, 4th Edition.
5. Heat Transfer by P.K. Nag, TMH
6. Heat Transfer by S.P. Sukhatme, TMH
7. Heat Transfer: A.F. Mills and V. Ganesan, Pearson Education, 2nd Edition
8. Heat and Mass Transfer: Domkundwar and Arora, Danpatrai and sons
9. Heat Transfer: R. K. Rajput, Laxmi Publications
10. Heat and Mass Transfer: A Practical Approach, Y.A. Cengel, Tata Macgraw Hills Education Private Limited

MEPC3003 METAL CUTTING & MACHINING (3-0-0)

Course Objectives:

This course explores metal cutting principles, tool geometry, and machining processes (conventional and non-traditional). Students will analyze tool wear, cutting forces, and machinability criteria, and apply Taylor's tool life equation. Emphasis is placed on machine tool operations, CNC technology, and advanced processes like EDM, laser machining, and ultrasonic machining.

Module – I: (06 Hours)

Geometry of cutting tools in ASA and ORS, Effect of Geometrical parameters on cutting force and surface finish, Mechanics of chip formation, Merchant's theory, Force relationship and velocity relationship, Cutting tool materials. Types of Tool Wear: Flank wear, Crater wear, Wear measurement, Temperature in metal Cutting, Cutting fluid and its effect.

Module – II: (06 Hours)

Machinability Criteria, Tool life and Taylor's equation, Effect of variables on tool life and surface finish, Measurement of cutting force, Lathe tool dynamometer, and Drill tool dynamometer. Economics of machining: Minimum cost, Maximum production and Maximum profit rate.

Module – III: (06 Hours)

Conventional machining process and machine tools: Turning, Drilling, Shaping, Planning, Milling, Grinding. Machine tools used for these processes, their specifications and various techniques used.

Module – IV: (06 Hours)

Tool holding and job holding methods in different Machine tools, Types of surface generated. Production Machine tools: Capstan and turret lathes, single spindle and multi spindle semiautomatics, CNC Machine tools.

Module – V: (06 Hours)

Non-traditional Machining processes: Ultrasonic Machining, Electro Chemical Machining, EDM, Wire EDM, Abrasive Jet Machining, Plasma Arc Machining and Laser Beam Machining.

Course Outcomes:

CO1: Remembering (Knowledge): Recall tool geometry systems (ASA, ORS), types of tool wear, and fundamentals of chip formation.
CO2: Understanding (Comprehension): Explain the impact of tool geometry, cutting fluids, and variables on tool life and surface finish.
CO3: Applying (Application): Calculate tool life using Taylor's equation and analyze cutting forces using dynamometers.
CO4: Analyzing (Analysis): Compare conventional and non-traditional machining processes (e.g., EDM, laser) based on efficiency, precision, and applications.
CO5: Creating (Synthesis): Design machining strategies for cost-effective production, integrating CNC and advanced processes for complex geometries.

Reference Books

1. A Bhattacharryya, Metal Cutting, Theory and Practice, New Central Book Agency (p) Ltd, 1st Edition, 2022.
2. A B Chattopadhyay, Machining and Machining tool, Wiley Publisher, 2nd. Edition, 2021.
3. Sreeramulu Moinikunta, Production Technology, Volume 2, Wiley Publisher, 1st. Edition 2019.
4. P. K. Mishra, Nonconventional Machining, Narosa Publishing House, 2007.
5. Production Technology HMT, Tata McGraw Hill, 2001.
6. M. C. Shaw, Metal Cutting Principles, Second Edition, Oxford University Press, 2005.

MEPE3001 OPTIMIZATION METHOD IN ENGINEERING DESIGN (3-0-0)

Course Objectives:

This course introduces optimization techniques for engineering design, covering linear/nonlinear programming, multivariable algorithms, and global methods (GA, simulated annealing). Students will learn to formulate problems (variables, constraints, objectives) and apply methods like simplex, Fibonacci search, and Kuhn-Tucker conditions to solve real-world engineering challenges.

Module-I: (06 Hours)

Introduction and overview of optimization- Definition, Design variables, Constraints, Objective function, Classification of problems; Single-many variable problems, Single-many objectives problem.

Module-II: (06 Hours)

Single variable optimization algorithm, Linear programming, Simplex and BIG M method.

Module-III: (06 Hours)

Nonlinear Programming- Elimination methods, Exhaustive Search Method, Fibonacci Search method, Golden section search method, Cubic Search Method, Newton-Raphson method, Secant Method.

Module-IV: (06 Hours)

Multivariable Optimization Algorithms- Direct search methods. Simplex search method and Hooke-Jeeves pattern search method. Constrained Optimization Algorithms- Kuhn-Tucker conditions, penalty function.

Module-V: (06 Hours)

Global optimization using genetic algorithms and simulated annealing.

Course Outcomes:

CO1: Remembering (Knowledge): Define optimization terms (variables, constraints, objectives) and classify problem types.

CO2: Understanding (Comprehension): Explain linear/nonlinear programming methods (simplex, BIG M) and search algorithms (Fibonacci, Golden section).

CO3: Applying (Application): Implement single/multivariable optimization techniques (e.g., Hooke-Jeeves) for engineering problems.

CO4: Analyzing (Analysis): Evaluate constrained optimization solutions using Kuhn-Tucker conditions and penalty functions.

CO5: Creating (Synthesis): Design global optimization strategies using genetic algorithms or simulated annealing for complex systems.

Reference Books

1. Engineering Optimization: Theory and Practice- S.S. Rao
2. Optimization Methods for Engineering Design- R.L. Fox
3. Optimization methods- K. V. Mital and C. Mohan
4. Optimization and Probability in System Engineering- J.G. Rau

MEPE3002 METROLOGY, QUALITY CONTROL AND RELIABILITY (3-0-0)

Course Objectives:
This course covers metrology principles, quality control techniques, and reliability engineering. Students will learn about measurement systems, tolerances, control charts, sampling plans, and Taguchi methods. Emphasis is placed on statistical quality control, ISO standards, and reliability analysis (MTTF, MTBF) to ensure product quality and performance in manufacturing.

Module-I: (08 Hours)
Metrology: Need of Inspection, Precision and accuracy, Sources of error, Types of error. Line standard, end standard, limits, fits, tolerances, Hole & shaft basis system, Interchangeability, selective assembly, ISO system for limits & fits, Limit gauges-Snap, plug, ring, taper, position gauges-Gauge design, Taylor's principle.

Module-II: (06 Hours)
Comparators- Characteristics, Relative Advantages of various types of comparators, Mechanical, optical, Pneumatic, Fluid displacement type, Measurement by light wave Interference.

Module-III: (06 Hours)
Control charts for variable (X,R,S, CUSUM, EWMA), Control charts for fraction, non-conforming control charts for non-conformation.

Module-IV: (05 Hours)
Design of single sampling plan. Double, multiple and sequential sampling plans, O.C. curve, AOQ, AOQL, Taguchi's Loss function, Orthogonal Arrays, Linear Graphs, parametric design, signal-to noise Ratio, ANOVA, TQM, Taguchi, ISO 9000, ZIT, Quality circle.

MODULE-V: (05 Hours)
Bath-tub-curve, system reliability, reliability improvement, maintainability and availability, Availability of single repairable system using Markov model, Life tests, acceptance sampling plan based on life tests, Sequential acceptance sampling plan based on MTTF & MTBF.

Course Outcomes:

CO1: Remembering (Knowledge): Define metrology terms (precision, accuracy, tolerances) and recall ISO standards for limits and fits.

CO2: Understanding (Comprehension): Explain the working principles of comparators (mechanical, optical, pneumatic) and Taguchi's loss function.

CO3: Applying (Application): Construct control charts (X, R, CUSUM) and design sampling plans (single/double) for quality assessment.

CO4: Analyzing (Analysis): Evaluate system reliability using bath-tub curves and Markov models for repairable systems.

CO5: Creating (Synthesis): Develop quality improvement strategies using ANOVA, orthogonal arrays, and TQM principles.

Reference Books:

1. Engineering Metrology- R.K. Jain
2. Engineering Metrology and Measurement- K. Duraivelu and S. Karthikeyan
3. Introduction to Statistical Quality control- D.C. Montgonery
4. Statistical Quality Control- M. Mahajan & Dhanpat Rai
5. Production Technology- P.C. Sharma

MEPE3003 PRODUCTION AND OPERATION MANAGEMENT (3-0-0)

Course Objectives:

1. To impart fundamental knowledge of production and operations functions in manufacturing and service organizations.
2. To expose students to production planning, process design, facility layout, and scheduling.
3. To equip students with inventory and quality control techniques used in operations management.
4. To understand lean, ERP, forecasting, and optimization tools for process efficiency.

Module-I Introduction to Production & Operations Management (07 Hours)

Nature, scope and objectives of POM. Evolution of production systems (craft, mass, lean production). Interface with marketing, finance, HR, R&D, and supply chain. Characteristics of manufacturing vs service operations. Role of operations manager; decision types in operations. Trends: Industry 4.0, sustainability, AI in operations. Basics of Operations Research and its application in decision-making.

Module-II Production & Operation Systems (09 Hours)

Types of production systems: job shop, batch production, mass production, continuous flow. Characteristics, advantages, and limitations of each system. Automation in production: types, role of robotics and IoT. Overview of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). Facility location decisions: qualitative and quantitative models, break-even analysis. Capacity planning: definition, types (design, effective, actual), tools and capacity requirement planning (CRP).

Module-III Production & Operations Planning (09 Hours)

Plant layout types: product, process, cellular, fixed-position. Facility layout planning tools: block diagramming, relationship charts (REL), CRAFT. Production process planning: routing, sequencing, scheduling. Production Planning and Control (PPC): functions, phases (pre-planning, planning, control). Aggregate Production Planning (APP): objectives, strategies (chase, level, mixed). Master Production Schedule (MPS) and capacity utilization. Tools for resource allocation: linear programming (overview).

Module-IV Operations Management Processes (09 Hours)

Process selection strategies and process lifecycle. Work study:
Method study: process chart symbols, flow process charts. Time study: stopwatch method, standard time calculation.
Value engineering and value analysis: definition, procedure, benefits. Materials Requirement Planning (MRP I) and MRP II: logic and structure. TOC (Theory of Constraints) and Critical Chain Project Management (CCPM). Line balancing: objectives, heuristics, practical examples. Forecasting: types (qualitative vs quantitative), methods (moving average, exponential smoothing, regression models).

Module-V Controlling Production & Operations (09 Hours)

Inventory functions, types and classification. Inventory models: EOQ (Economic Order Quantity), reorder point, safety stock. Inventory management techniques: ABC, VED, FSN, JIT (Just-in-Time). Introduction to ERP systems and modules in production. Maintenance strategies: preventive, predictive, and breakdown maintenance. Statistical Quality Control (SQC): Control charts for variables ($\bar{X}$ and R), Control charts for attributes (p, np, c charts). Introduction to Total Quality Management (TQM), Six Sigma, and Kaizen. Principles of Lean Manufacturing and overview of SCM (Supply Chain Management).

Course Outcomes:

On successful completion of the course, students will be able to:

CO1: Describe the role and scope of operations management in manufacturing and service sectors.
CO2: Classify production systems and apply methods for facility and capacity planning.
CO3: Formulate production plans and layouts using planning techniques and decision tools.
CO4: Apply work study and forecasting techniques to improve productivity.
CO5: Use quality and inventory management tools for effective control and continuous improvement.

Textbooks:

1. Kanishka Bedi, Production and Operations Management, Oxford University Press.
2. Martand Telsang, Industrial Engineering and Production Management, S. Chand & Co.
3. Norman Gaither and G. Frazier, Operations Management, Thomson Learning.

Reference Books:

1. S.N. Chary, Production and Operations Management, Tata McGraw Hill.
2. B. Mahadevan, Operations Management – Theory and Practice, Pearson Education.
3. William Stevenson, Operations Management, McGraw Hill.

MEPE3004 REFRIGERATION AND AIR CONDITIONING (3-0-0)

Course Objectives:
This course provides fundamental knowledge of refrigeration and air conditioning systems, covering vapor compression/absorption cycles, psychrometrics, and comfort air conditioning. Students will analyze system performance (COP, cooling load), compare refrigerants, and design HVAC solutions for diverse applications, including multi-stage systems and thermoelectric refrigeration.

Module-I: (05 Hours)
Air Refrigeration System: Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Aircraft with problems.

Module-II: (06 Hours)
Vapour Compression System: Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, subcooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution.
Multi-stage compression and multi-evaporator systems: Different arrangements of compressors and inter-cooling, Multistage compression with inter-cooling, multi-evaporator system, Dual compression system. Simple problems

Module-III: (8 Hours)
Vapour Absorption System: Simple Ammonia - absorption system, Improved absorption system, Analysis of vapour absorption system (Specifically of analyzing coloumn and rectifier), Electrolux / Three fluid system, Lithium bromide-water vapour absorption system, comparison of absorption system with vapour compression system. Simple Problems and solutions.
Thermoelectric Refrigeration:
Basics and Principle. Defining the figure of Merit. (No Problem)
Refrigerants: Classification of refrigerants and its designation- Halocarbon (compounds, Hydrocarbons, Inorganic compounds, Azeotropes), Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Brines. Alternative refrigerants (Organic and inorganic compounds).

Module-IV: (06 Hours)
Psychometrics: Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, De-humidification, Mixture of air streams. Review question and discussions
Requirements of comfort air conditioning: Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart, effective temperature, factors governing optimum effective temperature

Module-V: (05 Hours)
Air Conditioning System: Process in air conditioning, Summer air conditioning, Winter air conditioning and year-round air conditioning, Cooling load calculations. Review question and discussions.

Course Outcomes:
CO1: Remembering (Knowledge): Define key terms (COP, effective temperature) and classify refrigerants (halocarbons, azeotropes).

CO2: Understanding (Comprehension): Explain vapor compression/absorption cycles, psychrometric processes, and comfort chart principles.

CO3: Applying (Application): Calculate cooling loads, system performance (COP), and analyze multi-stage compression/inter-cooling setups.

CO4: Analyzing (Analysis): Evaluate refrigerant properties and compare system efficiencies (absorption vs. compression, thermoelectric).

CO5: Creating (Synthesis): Design HVAC systems (summer/winter/year-round) integrating psychrometrics and load calculations for optimal performance.

Textbooks:

1. Refrigeration and Air Conditioning by R.C. Arora, PHI Publication
2. Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons. Chapters; 3,4,5,6,7,11,16,17,19,20
3. Refrigeration and Airconditioning Data book by Manohar Prasad

Reference Books:

1. Refrigeration and Air conditioning by P.L. Balloney, Khanna Publishers.
2. Refrigeration and Air conditioning by Manohar Prasad, New Age international publishers.
3. Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill.

MEPE3005 ADVANCED MECHANICS OF SOLIDS (3-0-0)

Course Objectives:
This course explores advanced concepts in solid mechanics, including 3D stress-strain analysis, unsymmetrical bending, torsion of non-circular shafts, rotating disc design, and curved beam theory. Students will apply mathematical models (Mohr's circle, Winkler-Bach formula) to solve complex engineering problems involving stress distribution and structural integrity.

Module – I: (06 hours)
Introduction: Elementary concept of elasticity, stresses in three dimensions, Principal Stresses, Stress Invariants, Mohr's Circle for 3-D state of stress, Octahedral Stresses, State of pure shear, Differential equations of equilibrium and compatibility conditions, plane stress. Analysis of strain, State of strain at a point, Strain Invariant, Principal Strains, Plane state of strain, Strain measurements.

Module – II: (06 hours)
Unsymmetrical Bending and Shear Centre: Introduction; product of inertia – parallel axes theorem for product of inertia – principal axes and principal moments of inertia; bending stresses in beams due to unsymmetrical bending; deflection of straight beams due to unsymmetrical bending. Concept of shear center; determination of shear center for symmetrical and unsymmetrical sections.

Module – III: (06 hours)
Torsion Of Non-Circular Shafts: Introduction; Membrane Analalogy; torsion of non-circular solidsections; thin wall tubular sections; thin-walled multi-cell sections.

Module – IV: (06 hours)
Design Of Rotating Discs: Introduction to Centrifugal stresses- Rotating ring; flat discs-Disc of uniform thickness and Disc of uniform strength.

Module – V: (06 hours)
Curved Beam Theory: Winkler bach formula for circumferntial stresses – Limitations; corrections factors – Radial stress in curved beams – closed rings subjected to concentrated and uniform loads.

Course Outcomes:
- CO1: Remembering (Knowledge): Recall stress invariants, strain measurements, and key formulas (Winkler-Bach, Mohr's circle for 3D stress).
- CO2: Understanding (Comprehension): Explain unsymmetrical bending, shear center determination, and membrane analogy for torsion.
- CO3: Applying (Application): Calculate stresses in rotating discs (uniform thickness/strength) and curved beams under concentrated loads.
- CO4: Analyzing (Analysis): Evaluate principal stresses/strains and compatibility conditions for 3D elasticity problems.
- CO5: Creating (Synthesis): Design structural components (shafts, beams) by integrating advanced mechanics principles for optimal performance.

Reference Books:

1. Boresi, "Advanced Mechanics of Materials", 6th Edition, John Wiley and Sons, 2003.
2. Timoshenko and S. Woinowsky - Krieger, "Theory of Plates and Shells", 2nd Edition, Tata Mc Graw Hill, 2010.
3. J.P. Den Hartog, "Advanced Strength of Materials", 1st Edition, Dover Publications, 1987.
4. L.S. Srinath, "Advanced Solid Mechanics", 3rd Edition, Tata Mc Graw Hill, 2009.
5. R.K. Rajput, "Strength of Materials", 3rd Edition, S. Chand Publications, 2007.
6. B.C. Punmia, "Strength of Materials and Theory of Structures",12th Edition, Lakshmi Publications, 2004.

HSHS3001 BUSINESS MANAGEMENT (3-0-0)

Course Objectives

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

- Understand fundamental management principles
- Learn project management techniques and its application
- Understand the financial aspects of engineering decisions
- Demonstrate leadership, communication, and team management skills
- Understand the basics of entrepreneurship and innovation management

Module-I: Management Foundations and Organizational Dynamics

Introduction to Management: Functions of Management; Evolution of management thought and its relevance to engineering; Management vs. Leadership: Key distinctions; Decision-making processes; Organizational design and structure; Team dynamics and group behaviour; Motivation theories and their application to technical teams; Organizational Communication; Cultural considerations in global business environment

Module-II: Project Management and Financial Decision Making

Project lifecycle and phases; Work breakdown structure and scheduling; Resource allocation and budgeting; Risk management in engineering projects; Quality management and control; Basic financial statements and their interpretation; Time value of money; Budgeting and cost control; Return on investment (ROI) and net present value (NPV); Funding sources for engineering projects; Cost-benefit analysis for technical decisions

Module-III: Leadership, Innovation and Entrepreneurship

Leadership styles and their effectiveness; Managing technical teams and professionals; Performance management and feedback; Recruitment and selection in engineering roles; Training and development of technical staff; Ethical leadership in engineering; Innovation management; Technology transfer and commercialization; Startup fundamentals; Intellectual property basics; Business model development

Course Outcomes

CO1: Recall fundamental management principles, organizational theories, and project management methodologies, key financial concepts used in engineering decision-making.
CO2: Explain the relationship between management functions (planning, organizing, leading, controlling) and their application.
CO3: Demonstrate project management skills and apply financial analysis techniques for decision making.
CO4: Analyse organizational behaviour patterns, team dynamics, and performance issues in engineering management contexts.
CO5: Judge ethical implications of management decisions and leadership actions in professional engineering practice.
CO6: Create integrated management solutions for solving complex business problems.

Reference Books:

1. Management Theory and Practice" by C.B. Gupta
2. Essentials of Management" by Koontz, Weihrich, and Aryasri (Indian Edition)
3. Project Management for Engineering and Technology" by N.K. Sharma
4. Financial Management: Theory and Practice" by Prasanna Chandra
5. Organizational Behaviour" by Aswathappa K.
6. Human Resource Management" by V.S.P. Rao
7. Entrepreneurship Development" by S.S. Khanka
8. Operations Management" by R. Panneerselvam

HSHS3002 ENTREPRENEURSHIP DEVELOPMENT (3-0-0)

Course Objectives –

1. To explain concept of entrepreneurship and build and understanding about business situation in which entrepreneurs act.
2. To explain classification and type of entrepreneurs and the process of entrepreneurial project development
3. To discuss the steps in venture development and new trends in entrepreneurship.
4. The more focus is given on creativity and innovation.

Module-I: (10 hours)
Entrepreneurship: Concept of entrepreneurship and intrapreneurship, Types of Entrepreneurs, Nature and Importance, Entrepreneurial Traits and Skills, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality

Module-II: (08 hours)
Entrepreneurial Environment, Identification of Opportunities, Converting Business Opportunities into reality. Start-ups and business incubation, Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Environmental pollution Act, Industrial Policies and Regulations

Module-III: (10 hours)
Need to know about Accounting, Working capital Management, Marketing Management, Human Resources Management, and Labour Laws. Organizational support services - Central and State Government, Incentives and Subsidies.

Module-IV: (12 hours)
Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Governments in reviving industries.

Course Outcomes
After completion of this course, students

CO1: will aware about foundation of entrepreneurship development and its theories
CO2: will identify the type of entrepreneur and the steps involved in a entrepreneurial venture.
CO3: will understand various steps involved in starting a venture and to explore marketing methods & new trends in entrepreneurship.
CO4: Think creative and innovative

Books:

1. Entrepreneurship Development and Management, Vasant Desai, HPH
2. Entrepreneurship Management, Bholanath Dutta, Excel Books
3. Entrepreneurial Development, Sangeeta Sharma, PHI
4. Entrepreneurship, Rajeev Roy, Oxford University Press

MCMC3001 ENVIRONMENTAL ENGINEERING (3-0-0)

Course Objectives:

- To acquire basic knowledge of source of water and various treatment processes
- To determine the sewage quantity, and understand its treatment and disposal
- To Identify and value the effect of the pollutants in atmosphere
- To formulate strategies to solid waste management

Module-I: (08 Hrs)
Water: Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Module-II: (08 Hrs)
Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage-Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module-III: (08 Hrs)
Air - Composition and properties of air, Quantification of air pollutants, monitoring of air pollutants, Air pollution-Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module-IV: (08 Hrs)
Noise-Basic concept, measurement and various control methods. Solid waste Management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Course Outcomes:
After successfully studying this course, students will able to:

- Understand the impact of humans on environment and environment on humans
- Identify and value the effect of the pollutants on the environment: atmosphere, water and soil
- Formulate strategies to control, reduce and monitor pollution
- Determine the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air

Books

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi

MCMC3002 INDUSTRIAL SAFETY ENGINEERING (3-0-0)

Course Objectives:

1. Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls.
2. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.

Course Outcomes:

By the end of this course, a student should:

CO1: Evaluate workplace to determine the existence of occupational safety and health hazards

CO2: Identify relevant regulatory and national consensus standards along with best practices that are applicable.

CO3: Select appropriate control methodologies based on the hierarchy of controls

CO4: Analyze injury and illness data for trends

Module-I: (07 hrs)

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Module-II: (07 hrs)

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module-III: (07 hrs)

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module-IV: (07 hrs)

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module-V: (08 hrs)

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MEPC3201 DESIGN OF MACHINE ELEMENTS-II LABORATORY (0-0-3)

Course Objectives:

This laboratory course provides hands-on experience in designing critical machine elements such as cranks, pistons, shafts, clutches, brakes, and gear systems. Students will apply theories of failure and fatigue analysis to solve practical design problems, reinforcing theoretical concepts through computational and analytical exercises.

1. Problems for practice on theories of failure.
2. Problems for practice on fatigue failure.
3. Design of crank piston and cylinder.
4. Design of connecting rod and shaft.
5. Design of clutches.
6. Design of Brakes (block, band brakes and internal expanding brake)
7. Design of belts, rope and chain drives
8. Design of Spur/ Bevel/ Helical gear.

Course Outcomes:

CO1: Remembering (Knowledge): Recall theories of failure (e.g., Von Mises, Soderberg) and fatigue analysis principles.

CO2: Understanding (Comprehension): Explain the design considerations for machine elements like cranks, pistons, and gears under dynamic loads.

CO3: Applying (Application): Perform calculations to design clutches, brakes, and power transmission elements (belts, chains, gears).

CO4: Analyzing (Analysis): Evaluate the impact of load conditions and material properties on the performance of machine components.

CO5: Creating (Synthesis): Develop optimized designs for machine elements by integrating failure theories and practical constraints.

MEPC3202 MACHINING LABORATORY (0-0-3)

Course Objectives:

This laboratory course provides hands-on experience in fundamental machining operations, including turning, milling, grinding, and threading. Students will analyze tool geometry (ASA/ORS systems), measure cutting forces, and evaluate the role of coolants. Emphasis is placed on practical skills for operating lathes, milling machines, and grinders to manufacture precision components.

List of Experiments:

1. A study on tool geometry in both ASA and ORS system.
2. Preparation of a threaded joint using drilling and tapping operations.
3. Perform operations like taper turning, thread cutting, knurling and groove cutting on a lathe machine.
4. Determine the cutting forces during turning of a cylindrical component in lathe machine.
5. Perform the gear cutting on milling machine.
6. Working with shaper/planer/slotting machine.
7. Working with surface and cylindrical grinding machine.
8. A study on the importance of coolant during machining.

Course Outcomes:

CO1: Remembering (Knowledge): Identify tool geometry systems (ASA, ORS) and components of machining tools (e.g., lathe, milling machine).

CO2: Understanding (Comprehension): Explain the principles of operations like taper turning, thread cutting, and gear milling.

CO3: Applying (Application): Perform machining operations (drilling, tapping, grinding) and measure cutting forces using instrumentation.

CO4: Analyzing (Analysis): Compare the effects of coolants and cutting parameters on surface finish and tool life.

CO5: Creating (Synthesis): Manufacture components by integrating multiple machining processes (e.g., turning + threading) to meet design specifications.

MEPC3203 SOFT COMPUTING LABORATORY (0-0-3)

Course Objectives:

This laboratory course introduces soft computing techniques (fuzzy logic, neural networks, genetic algorithms) using MATLAB/Python. Students will design fuzzy systems, implement perceptron models, and solve optimization problems (e.g., truss design). Emphasis is placed on hybrid systems (GA-ANN/Fuzzy) and real-world applications like thermal modeling and robotics path planning.

List of Experiments

1. Introduction to MATLAB/Python Fuzzy Logic Toolbox / scikit-fuzzy - Create a simple fuzzy inference system (FIS).
2. Application of Fuzzy Logic in Mechanical Systems
3. Introduction to Neural Networks in MATLAB / Python (Tensor Flow/Keras) - Implement a Perceptron model.
4. ANN Application in Mechanical Engineering
5. Introduction to Genetic Algorithms - Implement a basic GA using MATLAB / Python (DEAP library).
6. Solving Optimization Problems using GA - Example: Design optimization (truss structure, spring, or shaft design).
7. Hybrid Soft Computing Systems - Combining GA with ANN/Fuzzy for performance enhancement.
8. Case Study / Mini Project - Example: Thermal system modeling, CFD optimization, or Robotics path planning etc.
9. Simulation and Analysis of Soft Computing Models - Test performance, compare models, and analyze real data.

Course Outcomes:

CO1: Remembering (Knowledge): Recall fundamentals of fuzzy logic, neural networks, and genetic algorithms.

CO2: Understanding (Comprehension): Explain the working principles of FIS, perceptrons, and GA optimization.

CO3: Applying (Application): Implement soft computing models (FIS, ANN, GA) to solve mechanical engineering problems.

CO4: Analyzing (Analysis): Compare performance of different soft computing techniques for specific applications.

CO5: Creating (Synthesis): Develop hybrid systems (e.g., GA-Fuzzy) for enhanced performance in case studies like CFD optimization.