

SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV - SEMESTER (MECHANICAL ENGINEERING)
 (Proposed for the Academic Year 2025-2026)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs./Week	CIE	SEE	Duration in Hours	
Theory Courses										
1	PC401ME	Kinematics of Machines	3	1	-	4	30	70	4	4
2	PC402ME	Design of Machine Elements	3	-	-	3	30	70	3	3
3	PC403ME	Manufacturing Processes	3	-	-	3	30	70	3	3
4	PC404ME	Thermal Engineering	3	-	-	3	30	70	3	3
5	PC405ME	Automobile Engineering	3	-	-	3	30	70	3	3
6	HS406ME	Managerial Economics and Accountancy	3	-	-	3	30	70	3	3
Practical/Laboratory Courses										
7	PC451ME	Manufacturing Processes Lab	-	-	2	2	25	50	3	1
8	PC452ME	Thermal Engineering Lab	-	-	2	2	25	50	3	1
9	PC453ME	Idea Generation & Product Innovation Lab	-	-	2	2	25	50	3	1
Total			18	01	06	25	255	570	28	22



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KINEMATICS OF MACHINES

PC401ME

Instruction: 4 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70marks

Course Objectives:

The Course Objectives of this course is to impart knowledge of

1. Analysis of mechanisms.
2. Drawing displacement diagrams for followers with various types of motions.
3. Cam profile drawing for various followers.
4. Estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
2. Analyse the planar mechanisms for position, velocity and acceleration.
3. Design frictional systems like belt drives, rope drives, clutches, bearings and screw threads
4. Design cams and followers for specified motion profiles.
5. Evaluate gear tooth geometry and select appropriate gears for the required applications

Unit-I

Definition of link, pair, kinematic chain, mechanism and machine, Kutzbach and Grubler criterion, Grashoff's law, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Fundamentals of coupler curves, Robert's law, Pantograph, Geneva mechanism, Hooke's joint, Davis and Ackerman's Steering gear mechanisms. Straight Line Motion Mechanisms: Peaucellier and Hart Mechanisms.

Unit-II:

Analysis of Mechanisms: Instantaneous centre, body centrode and space centrode, Kennedy's theorem, Graphical methods (relative velocity method, instantaneous center method) to find velocities and accelerations including Coriolis component of acceleration of planar mechanisms. Angular velocity theorem.

Unit-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis and friction circle of a link Belts and Rope drives: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension on power transmission, condition for maximum power transmission Brakes: Block or shoe brake, internal expanding shoe brake, differential band brake, block & band brake. **Dynamometers:** Prony brake, Rope brake, belt transmission and Torsion type dynamometers

Unit-IV

Cams: Types of cams and followers, Displacement, velocity, acceleration diagrams for follower motion, Analysis of uniform motion, parabolic motion, simple harmonic motion and cycloidal motion profiles. Design of Cam profiles: Cams with knife edge, roller and flat face followers.

Unit-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profiles. Gear trains- Simple, compound, reverted, and epicyclic gear trains.

Suggested Reading:

1. S.S. Rattan, —Theory of Machines”, Tata McGraw-Hill, 3rd Edition, 2009.
2. J. E. Shigley, —Theory of Machines and Mechanisms”, McGraw-Hill Publications, 2005.
3. Thomas Bevan, —Theory of Machines”, Pearson Education.
4. Norton RL, —Kinematics and Dynamics of Machinery”, McGraw-Hill Publications
5. Amitabha Ghosh and Ashok Kumar Mallik, —Theory of Mechanisms and Machines”, East West Press Pvt. Ltd, 2008.



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DESIGN OF MACHINE ELEMENTS

PC402ME

Instruction: 3 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70 marks

Course Objectives:

1. Importance of codes, materials, manufacturing process in design of mechanical components.
2. Importance of theories of failure and effects of fatigue and stress concentration on the life of the component.
3. Learn the concepts required to design machine components like keys, shafts, couplings.
4. Will learn to determine size of rivets, welds and cotter joints for specific applications.
5. Will Understand the concepts used for designing machine components like cotters, bolts, nuts.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Identify and use codes and standards, selection proper material & perform static design.
2. Analyze cyclic loading conditions and provide fatigue design of components.
3. Analyze machine elements like keys, shafts and couplings.
4. Evaluate various joining techniques like welding, riveting and cotter joints.
5. Synthesize an d design screw threads for fasteners and power screw applications.

Unit-I

Introduction: Materials used in Machine design, General Classification and Procedure in Machine design, preferred numbers, Review of type of loads and stresses. Stresses due to Bi-axial and Tri-axial loads, Factor of Safety, Stress concentration, Theories of failures for Bi-axial stress system, Fluctuating stresses, Fatigue strength, Notch sensitivity, Factor effecting fatigue strength, Gerber's, Soderberg's and Goodman's diagrams for fatigue design, Cumulative fatigue damage.

Unit-II:

Shafts: Introduction, Types of Shafts, Shafts subjected to twisting moment only, bending moment only, combined twisting & bending moment, axial loads in addition to combined twisting & bending moment and fluctuating loads. Keys: Introduction, Types of keys, Forces acting on sunk keys, Strength of a sunk key, Effect of keyways on shafts.

Unit-III

Couplings: Introduction, Types of Couplings, Rigid couplings-Muff, Spilt Muff, Flange and Flexible couplings- Bushed-pin. Cotter and Knuckle joints: Introduction, Type of Cotter joints, Design of Socket and Spigot Cotter joints, Sleeve Cotter joints and Knuckle joints.

Unit-IV

Riveted joints: Introduction, Type of Riveted joints, Terms used in Riveted joints, Caulking and Fullering, Failures of a Riveted joints, Efficiency of a Riveted joints, Design of Boiler joints and Lozenge joint, Riveted joints under eccentric loads.

Welded joints: Introduction, Type of Welded joints, Strength of Transverse, Parallel and Circular Fillet Welded joints, Strength of Butt joints, axially loaded Unsymmetrical sections Welded joints, eccentrically loaded Welded joints.

Unit-V

Screwed joints: Introduction, Type of Screwed joints, Locking devices, Stresses in Screwed joints due to static loads, Bolts of uniform strength, Bolted joints under eccentric loading. Power screws: Introduction, Design of a Screw Jack, Differential and Compound screws

Note: Design data sheets to be provided for the examination

Suggested Reading:

1. V. B. Bhandari, —Design of Machine Elements, Tata McGraw-Hill Publ, 3rd Edn. 2010.
2. J.E. Shigley & Charles R. Mischke —Mechanical Engineering Design, Tata McGraw-Hill, 6th ed., 2010.
3. P. Kannaiah, Machine Design, Sci-Tech Publ., 2009.
4. P.C. Sharma & D.K. Aggarwal, "Machine Design", S.K. Kataria & Sons, 10th edn, 2003.
5. V. B. Bhandari, —Design Data Book, 2nd edition, Tata McGraw-Hill Publ, 2019.



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MANUFACTURING PROCESSES

PC403ME

Instruction: 3 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70marks

Course Objectives:

1. To understand the principles of major manufacturing processes.
2. To know the advantages and limitations of each process.
3. To be able to select the optimal process to produce a product.
4. To know the applications of forming processes, ceramics and composites.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Describe the concepts of Foundry Technologies consisting of pattern making, mould making, gating design and solidification.
2. Discuss the importance of special casting processes, categorize various casting defects and describe the processing of plastics and powder metallurgical concepts.
3. Classify and differentiate various Arc welding, Gas welding and Advanced welding processes, discuss their advantages, applications and limitations.
4. Differentiate various Solid State welding and Resistance welding processes, discuss their applications, and identify various welding defects.
5. Differentiate various forming processes, sheet metal operations and discuss the importance of ceramics and composite materials.

Unit-I

Basic Casting Process: Casting terms, pattern materials, types of patterns, pattern allowances and colour codes, moulding sands, properties of moulding sand and its ingredients, core sands, core making process, machine moulding techniques, directional solidification, use of chills, chaplets, gating and risering systems.

Unit-II:

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

Polymers - Polymerization, Thermoplastics and thermosetting plastics, Processing of Plastics - Extrusion, Injection moulding, Blow moulding and Thermoforming.

Powder Metallurgy: Powder production methods, steps in powder metallurgy processes, cold and hot isostatic pressing, typical industrial applications.

Unit-III

Welding Processes: Introduction, Classification of welding processes, principle of **Gas welding**, gas welding equipment and techniques, types of flames and applications, advantages, limitations and applications of gas welding. **Arc welding** equipment electrode materials and specifications, polarity, types of arc welding - SMAW, SAW, GMAW, GTAW, PAW, Atomic hydrogen welding, principle of Electro slag welding, Gas cutting, Brazing and Soldering.

Unit-IV

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

Resistance welding processes: Spot welding, Seam welding, Projection welding, Butt welding, weldability, Welding defects.

Unit-V

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

Sheet Metal Operations: Blanking, Piercing, Bending, Deep drawing, Stretch forming, metal spinning.

Manufacturing of Composites: Concept of composites, Matrix and reinforcement, Rule of mixtures, Classification of composites, Manufacturing of Composites, Applications of composites.

Suggested Reading:

1. P.N. Rao, "Manufacturing Technology", Vol. 1, Tata McGraw Hill Publ., Ed., 2011.
2. Amitabh Gosh & Mallick, "Manufacturing Science", Assoc. East West Press Pvt. Ltd. 4th Ed., 2011.
3. Roy A. Lidnberg, Materials & Processes of Manufacturing, Prentice Hall of India, 5th Ed. 1992.
4. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006.
5. J.P. Kaushish, Manufacturing Processes, PHI Learning Pvt. Ltd., 2nd Ed., 2010.
6. P.C. Sharma, A Test book of "Production Technology"– Manufacturing Processes, S. Chand Jan. 2007.
7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, "Principles of Metal Casting", Tata McGraw-Hill edition 1976.
8. Parmer, R.S., "Welding Engineering and Technology", Khanna Publishers, 1997.
9. Sinha, A.K. *Powder Metallurgy*. Dhanpat Rai & Sons. 2002



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THERMAL ENGINEERING

PC404ME

Instruction: 3 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70 marks

Course Objectives:

1. To study the application of thermal science in mechanical engineering, consisting of the fundamental laws and processes for energy conversion.
2. To understand thermal design aspects of reciprocating machinery-reciprocating compressors and IC Engines.
3. To analyse Rankine cycle applied to thermal power plants and its improvements.
4. To gain the knowledge on the power plant thermal Devices-Boilers, Condensers, Pumps& Nozzles.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Quantify the behaviour of reciprocating compressors.
2. Explain thermal design and working principles of IC Engines, their supporting systems and Combustion chambers.
3. Quantify the behaviour of power plants based on the Rankine cycle including the effect of enhancements such as superheat, reheat and regeneration.
4. Explain the thermal design and working principles of Power plant devices..
5. Explain working principles of Boilers, Condensers, Pumps & Nozzles..

Unit-I

Reciprocating Air Compressors: Classification and applications. Ideal and actual P-V diagrams, work input and efficiency relations for single and multi-stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling and after cooling concepts.

Unit-II:

Internal Combustion Engines: Classification and applications. Working principles of four stroke and two stroke engines, Spark Ignition and Compression ignition engines. Performance parameters of I.C. Engines. Heat balance sheet of I. C. Engine. Overview of Engine supporting systems-Cooling Systems, Lubrication systems. Working principles of S.I. Engine fuel systems- Carburettors, Battery and Magneto Ignition systems. Working principles of C.I. Engine fuel systems- Fuel pump and Fuel injector.

Unit-III

I.C. Engine Combustion phenomena: Stages of combustion in S.I. Engines- Ignition delay, Flame front propagation and After burning. Abnormal combustion- Pre-ignition and Knocking. Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and after burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Type of combustion chambers of S.I. engines and C.I. engines

Unit-IV

Steam Boilers: Classification and Working Principles. Water tube boilers- Babcock & Wilcox and Stirling boilers. Fire tube boilers- Cornish, Cochran, Locomotive and Lancashire boilers. High Pressure boilers / Supercritical boilers: La-mont, Benson boiler, Loeffler boiler and Velox boiler. Boiler Mountings and Accessories. Boiler Draught. Calculation of Chimney height.
Steam Condensers: Jet and Surface condensers, Principle of Operation and Applications.

Unit-V

Steam Power Plant Cycles: Carnot and Rankine cycles of operation and their efficiencies. Analysis of Rankine cycle with superheating, reheating and regeneration (Direct and Indirect types).

Steam Nozzles: Flow of steam through convergent - divergent nozzles, velocity of steam flowing through the nozzle, mass of steam discharge through the nozzle, condition for maximum discharge, critical pressure ratio and nozzle efficiency.

Suggested Reading:

1. R.K. Rajput, " *Thermal Engineering* ", Laxmi Publications, 9th Edn., 2013
2. V. Ganesan, "*Internal Combustion Engines*", Tata McGraw Hill Publishing, 2007
3. P.L. Ballaney, "*Thermal Engineering*", Khanna Publishers, 19th Edn., 1993.
4. Richard Stone, —*Introduction to I.C. Engines*l, Mac Millan, 2nd Edn., 1997



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AUTOMOBILE ENGINEERING

PC405ME

Instruction: 3 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70 marks

Course Objectives:

1. To Understand the Working of Fuel, Ignition, and cooling Systems.
2. To Understand the Working of Lubrication and Electrical Systems
3. To Understand the Working of Suspension, Steering and Braking Systems.
4. To Understand the Working of Power Transmission.
5. To Understand the Necessity of Pollution Control and Maintenance.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Classify types of automobiles, list engine components, explain IC engine operation, and compare fuel systems in S.I. and C.I. engines.
2. Differentiate lubrication systems, identify vehicle lubrication and cooling systems, classify ignition systems, and explain battery and AC system functions.
3. Highlight steering mechanisms, explain wheel alignment and balancing, and describe various suspension systems and shock absorbers.
4. Identify power transmission components, design systems within real-world constraints, and explain braking systems.
5. Apply modern tools to control pollution, maintain vehicle parts, and design systems to reduce automobile emissions.

Unit-I

Types of automobiles: Normal, Hybrid and Hydrogen fuel vehicles. Engine location and its components, chassis layout, crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, mechanical fuel injection system & electronic fuel injection system.

Unit-II:

Lubricating systems: Wet sump, dry sump and petrol systems, and Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds. Types of Ignition systems, modern ignition systems, types of batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit-III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly – recent trends Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, types of suspension system, independent suspension coil and leaf springs, torsion bar, shock absorbers.

Unit-IV

Power train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system. Brake systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder, hand brake linkage, recent trends.

Unit-V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul, testing equipment, pollution control technologies used for petrol and diesel engines, types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – recent trends.

Suggested Reading:

1. Crouse & Anglin, 'Automotive Mechanics' Tata McGraw Hill, Publishing Co., Ltd., New Delhi, Tenth edition - 2004.
2. Kirpal Singh, —Automobile Engineering, Vol I & II Standard Publishers, Delhi.
3. Joseph Heitner, 'Automotive Mechanics', Affiliated East West Pvt., Ltd.,
4. C.P. Nakra, —Basic Automobile Engineering, Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2003.



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MANAGERIAL ECONOMICS AND ACCOUNTANCY

HS406ME

Instruction: 3 periods per week

CIE: 30 marks

Credits: 3

Duration of SEE: 3 hours

SEE: 70 marks

Course Objectives:

1. To understand responsibilities of a manager of a business undertaking.
2. To analyze various factors in influencing demand elasticity
3. To Forecast & compute the future sales level.
4. To understand the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
5. To understand the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Understand the responsibilities of a manager of a business undertaking
2. Able to Forecast & compute the future sales level
3. Outline the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
4. Assess various factors influencing demand elasticity and determine Break Even Point (BEP) of an enterprise.
5. Understands the principles of accounting and prepare Journal, Ledger, Trial Balance, Manufacturing A/c, Trading A/c., Profit & Loss A/c. and Balance Sheet of an enterprise

UNIT-I

Introduction to economics and its evolution: Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to engineers-Basic concepts of Managerial Economics.

UNIT-II

Demand: Analysis-concept of demand, determinants, law of demand, its assumptions, elasticity of demand, price, income and cross elasticity, demand forecasting-markets competitive structure, price-output determination under perfect competition and Monopoly.

UNIT-III

Theory of Production: Firm and industry-production function-input-output relations-laws of returns-internal and external economics of scale. Cost analysis-Cost concepts-fixed and variable costs-explicitly and implicitly costs-out pocket of costs and imputed costs-opportunity cost-cost output relation- ship-break even analysis.

UNIT-IV

Capital management: Significance, determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT-V

Book-keeping: Principles and significance of double entry book keeping, journal, subsidiary books, ledger accounts, trial balance concepts and preparation of final accounts with simple adjustments-analysis and interpretation of financial statements through ratios.

Suggested Readings:

1. Varshney, R. L., and K. L. Maheshwari. Managerial Economics. Sultan Chand & Sons. 2010.
2. Eugene F. Brigham, James L. Pappas, Managerial economics, Dryden Press, 1979
3. Grawal T.S. S CGupta, Introduction to Accountancy, S Chand Publications, 1978
4. I.M. Panday I.M. , Financial Management, Vikas Publishing House Pvt Limited, 11th Ed. 2015
5. S K Maheshwari S N Maheshwari, An Introduction to Accountancy, 8th Ed. Vikas Publishing House Pvt Limited, 2006



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MANUFACTURING PROCESSES LAB

PC451ME

Instruction: 2 periods per week

CIE: 25 marks

Credits: 1

Duration of SEE: 3 hours

SEE: 50 marks

Course Objectives:

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

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Conduct experiments and put hands-on experience on various processes in foundry, welding, forging, forming and plastic manufacturing technologies.
2. Demonstrate the understanding of the theoretical concepts of above technologies while working in small groups.
3. Demonstrate writing skills through clear laboratory reports
4. Identify the defects / imperfections and discuss their causes and suggest remedies to eliminate them.
5. Transfer group experience to individual performance of exercises and demonstrate effective oral communication skills.

Experiments:

Foundry Lab:

1. Producing different types of patterns considering draft, shrinkage and machining allowances.
2. Green sand mould making processes with complete gating and risering systems.
3. Testing of moulding sand properties.
4. Melting and pouring of aluminium to produce casting.

Welding Lab:

Welding processes:

1. Butt Joint prepared by gas welding using different types of flames
2. Lap joint by resistance welding process
3. V-Joint /T- joint by Arc welding process
4. Exercises using TIG and MIG welding processes.
5. Performing Brazing and Soldering operations.

Study of defects in welded joints

Forming Lab:

1. Evaluation of formability using Erichsen cupping test
2. Performing drawing operation on different materials (ex. MS, Cu, Al, etc.)
3. Performing blanking and piercing operations using hydraulic/fly presses.
4. Manufacturing of a simple component using Plastic Injection moulding machine

Note: At least ten experiments should be conducted in a Semester on above mentioned topics.


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THERMAL ENGINEERING LAB

PC452ME

Instruction: 2 periods per week

CIE: 25 marks

Credits: 1

Duration of SEE: 3 hours

SEE: 50 marks

Course Objectives:

1. Determining thermal conductivity of an insulating powder in composite slab or cylinder. The concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use
2. Evaluating the heat transfer coefficients under natural convection and forced convection phenomena Thermal analysis and sizing of heat exchanger.
3. determining the necessary constants pertaining to radiation
4. understanding the working principles of axial flow fan and its overall efficiency
5. Estimating overall efficiency of centrifugal compressors and pressure distribution over cylinder and an aerofoil section on turbo machines.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Interpret the link between refrigeration effects, work done and COP of the system, describe different methods adopted to evaluate COP, list the different psychrometric processes and describe how those processes can be maintained
2. Calculate the overall efficiency of centrifugal blower and axial flow fan at different volume flow rates, show the variation of overall efficiency with load and speed graphically to understand radiation heat transfer, heat exchangers and mechanism involved in boiling and condensation.
3. Identify the various components of low speed wind tunnel, plot a graph showing variation of pressure over the entire length of aerofoil blade and also evaluate the lift and drag coefficient values for a given aerofoil blade at different angle of assign.
4. Describe the modes of heat transfer, calculate thermal conductivity, heat transfer coefficient subjected to natural and forced convection environment and Stefan Boltzmann constant value of thermal radiation.
5. Express the working principle of heat exchangers and its application in real life, calculate the LMTD and effectiveness of a given heat exchanger for both parallel and counter flows.

List of Experiments:

1. Determination of thermal conductivity of metal bar.
2. Determination of thermal conductivity of composite wall.
3. Determination of the efficiency of pin-fin subjected to natural and forced convection.
4. Determination of effectiveness of parallel flow and counter flow heat exchanger.
5. Determination of emissivity of given test plate.
6. Determination of Stefan Boltzmann constant.
7. Determination of COP of the Air conditioning system.
8. Determination of percentage relative humidity and study of humidification and dehumidification process in Air Conditioning systems.
9. Determination of COP of refrigeration systems using capillary tube/ thermostatic expansion valve.
10. Determination of overall efficiency of centrifugal blower.
11. Determination of overall efficiency of axial flow fan.
12. Pressure distribution on symmetrical and non-symmetrical specimen in wind tunnel.

13. Measurement of lift and drag force of the models in wind tunnel test section.
14. Study of Nozzles.

Note: At least ten experiments should be conducted.



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IDEA GENERATION AND PRODUCT INNOVATION LAB

PC453ME

Instruction: 2 periods per week

CIE: 25 marks

Credits: 1

Duration of SEE: 3 hours

SEE: 50 marks

Course Objectives:

The Course will introduce the students to

1. Introduce the design thinking process and emphasize understanding user needs through observation and empathy.
2. Formulate problem statements and develop creative, engineering-based solutions.
3. Design and prototype mechanical components/products using tools like CAD and 3D printing.
4. Test and evaluate solutions and iterate based on user feedback and technical constraints.
5. Communicate design outcomes effectively through presentations, reports, and demonstrations.

Outcomes:

Upon successful completion of the course, the students will be able to

1. Identify user needs and explain the relevance of design thinking in real-world contexts.
2. Define clear and actionable problem statements aligned with design challenges.
3. Generate multiple innovative solutions and select optimal ideas using design thinking tools.
4. Develop, prototype and test mechanical systems or product solutions.
5. Collaborate effectively and communicate design ideas through technical documentation and pitching.

Week 1 – **Introduction and Identifying the Need** - Introduces the design thinking process - Empathize, Define, Ideate, Prototype, and Test - with a focus on understanding user needs. Students will explore real-world applications through Case studies, Guest lectures, videos, Field visits, and design-focused films, fostering appreciation for human-centred design and its relevance in engineering.

Week 2 - **Define Phase** - Craft Point-of-View (POV) statements, reframe problems into opportunities.

Week 3 - **Ideation Techniques I** - Brainstorming, SCAMPER, "How Might We" statements, mind mapping.

Week 4 - **Ideation Techniques II** - Idea evaluation and selection, concept sketching, feasibility vs innovation matrix.

Week 5 - **Prototyping I – Low Fidelity** - Sketch models using paper, cardboard, foam; storyboarding, role play.

Week 6 - **Prototyping II – CAD Modeling** - Intro to SolidWorks or Fusion 360, mechanical concept modeling.

Week 7 - **Prototyping III – 3D Printing & Fabrication** - Print functional parts, integrate simple mechanisms, tolerance checks, etc.

Week 8 - **Testing Phase** - Usability testing, collecting user feedback, identifying failure points.

Week 9 - **Iteration & Redesign** - Reflect, refine, update prototypes; engineering calculations where necessary.

Week 10 - **Engineering Validation** - Strength/material checks, motion studies (if applicable), DFMA review.

Week 11 - **Communication & Documentation** - Design reports, user manuals, video demos, poster preparation.

Week 12 - **Pitching and Final Preparation** - Present to panel/industry mentors; mock demos, pitch polishing

Week 13 - **Final Presentation & Demo Day** - Team project showcase, viva, peer feedback, reflection submission



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