**SCHEME OF INSTRUCTION & EXAMINATION**
**AICTE Model Curriculum**
**B. E. IV – Semester (MECHANICAL ENGINEERING)**
**(Proposed for the Academic year 2020-2021)**

| S. No. | Course Code | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hours/Week | CIE | SEE | Duration in Hours | |
| | | | | | | | | | | |
| **Theory Course** | | | | | | | | | | |
| 1 | ES304ME | Engineering Mechanic-II | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 2 | PC403ME | Fluid Mechanics | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | ES305ME | Energy Sciences and Engineering | 2 | - | - | 2 | 30 | 70 | 3 | 2 |
| 4 | PC404ME | Mechanics of Materials | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5 | PC405ME | Applied Thermodynamics | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | PC406ME | Kinematics of Machinery | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 7 | PC407ME | Manufacturing Processes | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical / Laboratory Course** | | | | | | | | | | |
| 7 | PC453ME | Thermal Engineering Lab -I | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC454ME | Manufacturing Processes Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| **Total** | | | | | | | | | | **22** |

**MC**: Mandatory Course **BS**: Basic Science **ES:** Engineering Science
**L**: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**Note:**
1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

*For the academic years 2020-2024*

**ENGINEERING MECHANICS-II**

# ES304ME

*Instruction: 2+1 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| The objectives of this course is to impart knowledge of |
|---|
| 1. Concepts of motion of particles, dynamic loads, their behaviour, analysis |
| 2. Principles of kinetics and its application to solve the problems of dynamics |
| 3. Rotation motion of rigid bodies in dynamic analysis |
| 4. Plane motion of rigid bodies in dynamic analysis |
| 5. to identify faults within a machines using the basic concepts of vibrations |

**Outcomes:**

| After completing this course, the student will be able to: |
|---|
| 1. Apply the laws of motion to study the kinematic parameters of rigid body motion |
| 2. Solve the problems involving translation of particle &rigid bodies by applying principles of kinetics. |
| 3. Analyze the rotation motion of rigid bodies by applying the principles of kinematics and kinetics of rotation |
| 4. Apply the laws of motion, kinematic and kinetic parameters of rigid bodymotion toanalyse plane motion of rigid bodies. |
| 5. Formulate mathematical models of problems in vibrations |

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| **Unit-I** |
| ***Kinematics of Particle:*** Motion of a particle – Rectilinear motion – Motion Curves – Normal and tangent coordinate systems – Projectile motion.<br>***General principles of Dynamics:*** Newtons laws of motion for a particle – fundamental equations of a particle. |
| **Unit**-II: |
| ***Kinetics of Particles:*** Kinetics of Rectilinear and curvilinear motion – D'Alembert's Principle – Principle of Impulse and Momentum – Work Energy and power – Direct and Oblique collision. |
| **Unit-III** |
| ***Rotation of Rigid Bodies:*** Moment of Inertia of Material bodies –Kinematics and Kinetics of Rotation – Equation of motion – Principle of Work and Energy – Principle of Impulse Momentum. |
| **Unit-IV** |
| ***Plane Motion of Rigid Bodies:*** Translation of a rigid body in a plane – Kinematic of Plane motion – Instantaneous center of rotation – Kinetics of Plane motion – Equation of motion – Principle of Work and Energy – Principleof Impulse Momentum. |
| **Unit-V** |
| ***Vibrations:*** Introduction – Simple Hormonic motion – Free Vibrations – Simple pendulum – Compound Pendulum – Torsion Pendulum – Free Vibration analysis by work energy method. |

**Suggested Reading:**


1. Ferdinand L. Singer, *Engineering Mechanics*, Collins, Singapore, 1975.

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| 2. Reddy Vijay Kumar K. and K. Suresh Kumar, *Singer"s Engineering Mechanics*, 2010. |
| 3. J.L. Meriam, *Engineering Mechanics: Statics and Dynamics*, John Wiley & Sons, Inc., N.J, 2003. |
| 4. R.C. Hibbeler, *Engineering Mechanics: Statics and Dynamics*, Pearson Prentice Hall, New Jersey, 2016. |
| 5. Beer & Johnston, *Vector Mechanics for Engineers: Statics and Dynamics*, McGraw-Hill Education, New York, 2019 |
| 6. S. Timoshenko & D.H. Young, *Engineering Mechanics*, McGraw-Hill Book Company, New York, 1959. |

*For the academic years 2020-2024*

**FLUID MECHANICS**

# PC403ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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|---|
| 1. To know various fluid properties, concept and method of fluid pressure measurement. |
| 2. To understand the basic concepts of fluid motion. |
| 3. To study different equations of fluid motion and fluid dynamics. |
| 4. To analyze different flow characteristics of laminar and turbulent flows. |
| 5. To study the motion of gasses for different conditions of expansion. |
| 6. To lay the groundwork for subsequent studies in courses like Hydraulics Machinery and Systems, Thermal Turbomachinery and Gas Dynamics etc. |

**Outcomes:**

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|---|
| 1. To explain the laws and terminology of fluid flows, classify fluid flows, state law of mass conservation and derive relevant equations |
| 2. To apply principles of energy and momentum conservation to analyze fluid flow and compute forces exerted on control volumes due to change of momentum |
| 3. To describe flow and pressure measurement devices and obtain relevant equations for computing flow in pipes and open channels. |
| 4. To describe flow regimes in pressure conduits and boundary layer development; compute drag and lift forces on aerofoil and also frictional losses in pressure conduits. |
| 5. To develop and apply laws of mass, energy and momentum conservation in compressible flow. |

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| **Unit-I** |
| ***Properties of fluids*:** Definition of fluid and concept of continuum. Fluid properties; pressure, density, specific weight, specific volume, dynamic and kinematic viscosity. Classification of fluids; ideal and real fluids.<br>***Fluid Kinematics:*** General concepts of path lines, stream lines, streak lines and stream tubes. Classification of fluid flow; steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational, one-, two-and three-dimensional flows. Definition and properties of stream function and velocity potential function, and use of flow nets. |
| **Unit**-II: |
| ***Fluid Dynamics:*** Energy of a fluid body, potential energy and potential head, pressure energy and pressure head, kinetic energy and kinetic head, energy equation. Derivation of Euler‘s and Bernoullis‘ equations, and their applications. Impulse momentum equation and its applications. |
| **Unit-III** |
| ***Measurement of Fluid Flows:*** Measurement of pressure, and use of pressure measuring devices such as manometers, Bourdon‘s pressure gauge and transducers. Measurement of velocity, and use of velocity measuring devices such as pitot tube and hot wire anemometer. Measurement of discharge, and use of discharge measuring devices such as venturimeter, orifice meter and rotameter; derivation of relevant formulae. Discharge formulae for weirs and notches. |
| **Unit-IV** |

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| ***Laminar and Turbulent Flow through Pipes:*** Distinction between laminar and turbulent flows; Reynold's number and its significance. Upper and lower critical values of Reynold's numbers for flow in pipes. Development of laminar and turbulent flow in circular pipes. Hagen-Poiseuille equation; frictional losses in pipes. Darcy's equation. Estimation of Darcy's friction factor. Empirical formulae and Moody's chart.<br>***Boundary Layer Theory:*** Development of laminar and turbulent boundary layers on a flat plate, pressure gradient, and phenomenon of separation. Fluid flow over an aerofoil, flow around a cylinder at rest, rotational flow around a cylinder at rest, lift and drag forces, and coefficients; circulation and Magnus effect. |
| **Unit-V** |
| ***Compressible fluid flow:*** Concepts of compressible flow, continuity, momentum and energy equation of compressible flow. Velocity of sound in compressible and incompressible fluids. Mach Number. Classification of compressible flow; adiabatic flow in perfect gas, stagnation pressure and temperature. Temperature, pressure, density ratios as functions of Mach number. |

**Suggested Reading:**


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| 1. K. L. Kumar, *Engineering Fluid Mechanics.* Eurasia Publishing House, 1997. |
| 2. R. K. Rajput, *Fluid Mechanics and Hydraulic Machines,* S. Chand & Co., 2003. |
| 3. P. N. Modi and S. M. Seth, *Hydraulic and Fluid Mechanics,* Standard Book House, Delhi, 1995. |
| 4. V. L. Streeter, *Fluid Mechanics.* McGraw-Hill Co. Ltd., |
| 5.Bansal, R.K., ‒*Fluid Mechanics and Hydraulics Machines*‖, ($5^{th}$ edition), Laxmi publications (P) Ltd. Delhi, 1995. |
| 6.Kumar D. S., ‒*Fluid Mechanics and Fluid Power Engineering*‖, S. K. Kataria & Sons. |

*For the academic years 2020-2024*

**ENERGY SCIENCES AND ENGINEERING**

# ES305ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 2*

**Objectives:**

| The objectives of this course is to impart knowledge of |
|---|
| 1. Able to identify various sources of energy. |
| 2. Understand the difference between Conventional and renewable energy sources. |
| 3. Identify various storage devices of Energy. |
| 4. Able to estimate the costing of power plant. |

**Outcomes:**

| After completing this course, the student will be able to: |
|---|
| 1. Understand the basics of various sources of energy |
| 2. Analyse the present status of conventional energy sources. |
| 3. Understand the working principles of Renewable Energy systems |
| 4. Design and develop waste heat recovery systems. |
| 5. Relate energy economics, standards and future challenges. |

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| **Unit-I** |
| ***Introduction:*** Various sources of energy, relative merits and demerits, Statistics and prospects of conventional and Renewable energy sources. |
| **Unit**-II: |
| ***Conventional Energy Sources:*** Fossil Fuels: Power generation using steam turbine and gas turbine power plants, Nuclear Fuels: Parts of reactor core, Nuclear power plant outline, Methods to dispose radioactive waste. Hydro Energy: Spillways, Hydroelectric power plant outline |
| **Unit-III** |
| ***Renewable Energy Systems:*** Solar Energy – Types of collectors and concentrators, Solar Photo Voltaic Cell. Wind Energy – Types of Wind Turbines and their working, geothermal power plant, Biomass conversion, Wave Energy power plant, Tidal Energy power plant, Ocean thermal energy power plant. |
| **Unit-IV** |
| ***Storage:*** Methods to store Mechanical Energy, Electrical Energy, Chemical Energy and Thermal Energy. Co-generation &Tri-generation: Definition, application, advantages, classification, saving Potential. Energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices |
| **Unit-V** |
| ***Power Plant Economics and Environmental Considerations:*** Costing, Estimation of power production - Pollutants and Pollution Standards -Methods of pollution control. Energy Efficiency rating and BEE standards, Future energy needs and challenges. |

**Suggested Reading:**


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| 1. Wakil MM, –*Power Plant Technology"*, McGraw Hill. |
| 2. P.K. Nag, –*Power Plant Engineering"*, McGraw-Hill. |
| 3. G.D. Rai, –*Non-Conventional Energy Sources",* Khanna Publishers. |
| **4.** Mili Majumdar, –*Energy Efficient Buildings in India",* Ministry of Non-Conventional Energy Sources. |

**MECHANICS OF MATERIALS**

# PC404ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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|---|
| 1. To understand the basic concept of stress and strains for different materials. |
| 2. To know the mechanism of the development of shear force and bending moment in beams and the stresses in thin cylinders & spheres. |
| 3. To know the theory of simple bending, direct & bending stress and distribution of shear stress. |
| 4. To analyse and understand shear stress, torsional stress and spring applications. |
| 5. To study the deflections and its applications. |

**Outcomes:**

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|---|
| 1. To understand the theory of elasticity and Hooke's law |
| 2. To analyse beams to determine shear force and bending moments |
| 3. Analyse shear stress distribution in different sections of beams. |
| 4. To analyse and design structural members subjected to combined stresses |
| 5. To solve problems on bars and to determine deflections at any point of the beams |

**Unit-I**

***Simple Stresses & Strains:*** Types of stresses & strains, Stress-Strain relations (Hooke's law), Relation between elastic constants, Volumetric strain, Composite bars, Temperature stresses.

***Strain energy*****:** Gradual, Sudden, Impact and Shock loading.

***Compound Stresses*****:** Stresses on oblique planes, Principal stresses and Principal planes. Mohr's circle and ellipse of stresses & strains.

**Unit**-II:

***Shear Force and Bending Moment*****:** Construction of S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure and Relation between S.F & B.M.

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

**Unit-III**

***Bending stresses in Beams:*** Assumptions made in pure bending, Derivation of bending moment equation, Modulus of section, Moment of resistance, Determination of bending stresses. Distribution of shear stress: Equation of shear stress, Distribution across rectangular section. Circular, triangular cross sections.

**Unit-IV**

***Torsion of Circular Shafts*****:** Theory of pure torsion, Assumptions made, Derivation of basic torsion equation, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion.

***Columns and Struts:*** Introduction to columns and struts, Buckling and Stability, types of

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| supports, critical load, Euler's formulae and Rankine formulae, Equivalent length of the column, eccentric axial loads |
| **Unit-V** |
| ***Deflection of Beams:*** Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by Double integration method, Macaulay's method, Strain energy method, Moment area method. |

**Suggested Reading:**


1. S. Ramamrutham, –*Strength of Materials",* Dhanpat Rai & Sons, 1993.B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.
2. R.K. Rajput, –*Strength of Materials",* S. Chand & Co., 2003.
3. EgorP.Popov, –*Engineering Mechanics of Solids",* Prentice Hall of India, NewDelhi, 2001.
4. Gere & Timoshenko, –*Mechanics of Materials",* 2nd Edition, CBS Publishers and Distributors Pvt. Ltd.
5. Ferdinand P. Beer et.al., –*Mechanics of Materials",* Tata McGraw-Hill Publishing Co. Ltd., New Delhi,2005

**APPLIED THERMODYNAMICS**

# PC405ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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| 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. |

**Outcomes:**

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

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| **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.<br>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** |
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| ***Steam Boilers:*** Classification and Working Principles. Water tube boilers- Babcok & 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.<br>***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).<br>***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*‖, Mac Millan, 2nd Edn., 1997

*For the academic years 2020-2024*

**KINEMATICS OF MACHINERY**

## PC406ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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| 1. The objectives of this course is to impart knowledge of |
| 2. Analysis of mechanisms. |
| 3. Drawing displacement diagrams for followers with various types of motions. |
| 4. Cam profile drawing for various followers. |
| 5. Estimation of transmission of power by belts and application of various gears and gear trains. |

**Outcomes:**

| After completing this course, the student 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** |
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| 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 gearmechanisms. ***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<br>***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<br>***Brakes**:* Block or shoe brake, internal expanding shoe brake, differential band brake, block& band brake.<br>***Dynamometers**:*Prony brake, Rope brake, belt transmission and Torsion type dynamometers |
| **Unit-IV** |

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| ***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 toothprofile.<br>***Gear trains***- Simple, compound, reverted, and epi cyclic 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

**MANUFACTURING PROCESS**

# PC407ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| |
|---|
| 1. To understand the basic principles of major manufacturing processes such as metal casting, welding and forming of engineering materials. |
| 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 basic principle of advanced forming processes. |

**Outcomes:**

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|---|
| 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 metallurgy 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. Describe various forming processes, sheet metal operations and discuss the importance of unconventional forming processes. |

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| **Unit-I** |
| ***Casting Process :*** Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, different types of moulding machines, Directional solidification, use of chaplets, chills, gating and risering systems. |
| **Unit**-II: |
| ***Special Casting Processes:*** Shell moulding, $CO_2$ moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of castings.<br>***Processing of Plastics*** - Extrusion, Injection moulding, Blow moulding and Thermoforming.<br>***Introduction to Powder Metallurgy***- Process, Production of powders, blending, mixing, compaction techniques and finishing operations employed in powder metallurgy processes |
| **Unit-III** |
| ***Welding Processes:*** Introduction, Classification of welding processes, principle of gas welding, gas welding equipment and techniques, types of flames and applications, advantages, limitations and applications of gas welding. Arc welding equipment electrode materials 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** |
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| ***Solid State Welding Process:*** Forge Welding, Friction Welding, Friction Stir Welding, and Explosive Welding.<br>***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.<br>***Sheet Metal Operations:*** Blanking, Piercing, Bending, Deep drawing, Stretch forming, Spinning.<br>***Advance Forming Processes***- High energy rate forming processes such as Explosive forming, Electro- magnetic forming and Electro-hydraulic forming; Rubber pad forming |

**Suggested Reading:**


1. P.N. Rao, –*Manufacturing Technology*,‖ Vol. 1, Tata McGraw Hill Publ., 3nd Ed., 2011
2. Amitabh Ghosh & Mallick, –*Manufacturing Science*‖, Assoc. East west Press Pvt. Ltd. 4th Ed., 2011
3. Roy A. Lindberg, *"Processes and Materials of Manufacture*", 3rd Edition, Pearson Education, 2015.
4. Serope Kalpakjian, –*Manufacturing Engineering and Technology*‖, Pearson Education, 2018
5. George. E. Dieter, *"Mechanical Metallurgy*", SI Metric Edition McGraw-Hill Book Company
6. J.P.Kaushish, *"Manufacturing Processes*", PHI Learning Pvt. Ltd., 2nd, 2010

*For the academic years 2020-2024*

**THERMAL ENGINEERING LAB-I**

## PC453ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits : 1*

**Objectives:**

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|---|
| 1. To understand applications of thermal engineering concepts through experimentation. |
| 2. To provide knowledge in testing of properties of fuels and lubricating oils |
| 3. To demonstrate and conduct experiments, Interpret and analyse data and report results of IC engine testing |

**Outcomes:**

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|---|
| 1. Perform experiments to find the efficiency of Petrol and Diesel engines. |
| 2. Find the properties of unknown fuels/lubricants. |
| 3. Perform experiments on CI and SI engines. |
| 4. Perform experiments on Reciprocating Air Compressor. |

| **List of Experiments:** |
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| 1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor. |
| 2. To determine valve timing diagram of a Petrol/Diesel engine. |
| 3. To determine port timing diagram of a Petrol/Diesel engine. |
| 4. To conduct performance test on single cylinder Diesel engine. |
| 5. To conduct heat balance test on a Diesel engine. |
| 6. To conduct Morse test on multi cylinder Petrol engine. |
| 7. To conduct performance test on multi cylinder Petrol engine. |
| 8. To conduct performance test on a two-stroke Petrol engine. |
| 9. To conduct performance test on multi cylinder Diesel engine. |
| 10. To study the performance of a Petrol engine under different compression ratios. |
| 11. Exhaust gas analysis of Petrol engine for carbon-monoxide and unburnt hydrocarbons. |
| 12. Exhaust gas analysis of Diesel engine for carbon deposits using smoke meter. |
| 13. Determination of viscosity of lubricating oil. |
| 14. Determination of flash and fire points of a fuel |
| 15. Study of Boiler Models |

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

**MANUFACTURING PROCESS LAB**

# PC454ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits : 1*

**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 |

**Outcomes:**

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|---|
| 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. Identity 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. |

| **List of Experiments:** |
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| **Foundry** |
| 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** |
| I. Evaluation of strength and hardness of |
| 1. Butt Joint prepared by gas welding using different types of flames |
| 2. Lap joint by resistance welding process |
| 3. V-Joint by Arc welding process |
| II. Exercises using TIG and MIG welding processes. |
| III. Performing Brazing and Soldering operations. |
| **Forming:** |
| 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 the Semester