

**SYLLABUS**  
**MECHANICS OF MATERIALS**

**L:T:P 3:1:0**

**Sub Code: P08AU32**

**CIE Marks : 50**

**Hrs/week: 04**

**Exam Hours: 03**

**Total Lecture Hrs : 52**

**SEE Marks : 50**

**PART – A**

**Unit 1: Simple stresses and strains I:** Introduction, Stress, types of stresses – tensile, compressive & shear, Strain (tensile, compressive & shear), Mechanical properties of materials, St. Venant's principle, Stress – Strain behaviour (nominal & true) of mild steel (elastic), cast iron (brittle), and non-ferrous materials, proof stress, Working stress & factor of safety, Hooke's law, Modulus of elasticity. Strain energy due to gradually applied load. Longitudinal strain, lateral strain, Poisson's ratio. Stress-strain analysis of bars of uniform section, Stepped bars, bars with continuously varying section (rectangular and circular), Elongation due to self weight (circular & conical), Principle of super position. **08 Hrs**

**Unit 2: Simple stresses and strains II:** Stress analysis of composite sections, Thermal stresses in uniform and compound bars, Simple shear stress and shear strain, modulus of rigidity, Volumetric strain, expression for volumetric strain, Bulk modulus, relation among elastic constants. **06 Hrs**

**Unit 3: Compound stresses:** Introduction, stresses on inclined planes/sections, Principal planes and stresses, planes of maximum shear stress, – (i) Uniaxial direct loading, (ii) Biaxial direct loading, (iii) General two dimensional system, Mohr's circle diagram. **06 Hrs**

**Unit 4: Shear force and Bending moment diagrams in statically determinate beams:** Introduction, Types of beams, loads and supports, shear forces and bending moments, sign conventions, relationship between load intensity, shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (UDL), UVL & couple. **07 Hrs**

**PART – B**

**Unit 5: Bending and shear stresses in beams:** Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, section modulus, moment carrying capacity/moment of resistance of a section, Bending stresses in beams of uniform section. Shearing stresses in beams, shear stress across rectangular, circular, I and T sections. (Composite beams are not included). **07 Hrs**

**Unit 6: Deflection of beams:** Introduction, Relation between slope, deflection and radius of curvature, Double integration method for cantilever and simply supported beams for point load, UDL, and Couple, Macaulay's method for simply supported beam with point load, UDL & couple. **07 Hrs**

**Unit 7: Torsion of circular shafts and Theory of Columns:**

Introduction to torsion, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. (Stepped shaft, composite shaft & tapered shaft not included.)

Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

**06 Hrs**

**Unit 8: Thick and thin cylinders:** Introduction, types of cylinders, Stresses in thin cylinders (Hoop's and longitudinal stress), changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).  
**05 Hrs**

**Text books:**

1. "Strength of Materials", S.S.Bhavikatti, Vikas publications House – Pvt. Ltd., 2nd Ed., 2006.
2. "Mechanics of Materials" by Dr.B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi. 2002
3. "Strength of Materials" by Dr.R.K.Bansal, Laxmi Publications, New Delhi.

**Reference books:**

1. "Strength of Materials", W.A. Nash, Sehaum's Outline Series, Fourth Edition-2007.
2. "Mechanics of materials", Ferdinand P Beer, E Russell Johnston, JR., John T DeWolf adapted by N Shiva Prasad & S Krishnamurthy, Tata McGraw-Hill Publishing Company, New Delhi, Third Edition.
3. "Mechanics of Materials", James M. Gere, Stephen P. Timoshenko, CBS Publishers and Distributors, Delhi.
4. "Strength of Materials", S.S. Rattan, Tata McGraw-Hill Publishing Company, New Delhi.
5. "Strength of Materials", I.B.Prasad, Khanna Publishers, Delhi.

**Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

# THERMODYNAMICS

**L:T:P 3:1:0**

**Sub Code: P08AU33**  
**Hrs/week : 04**  
**Total Lecture Hrs : 52**

**CIE Marks : 50**  
**Exam Hours : 03**  
**SEE Marks : 50**

## **PART-A**

### **Unit-1. Fundamental Concepts & Definitions:**

Thermodynamics; definition and scope. Microscopic and Macroscopic approaches. Engineering Thermodynamics Definition, some practical applications of engineering thermodynamic. System (closed system) and Control Volume (open system); Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, statepoint, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium- Zeroth law of thermodynamics, Temperature; concepts, scales, measurement. Internal fixed points.

**7 Hrs**

### **Unit - 2. Work & Heat:**

Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention, what heat is not.

**6 Hrs**

### **Unit - 3. First Law of Thermodynamics:**

Joule's experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non -cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state steady flow energy equation, important applications, analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer.

**7Hrs**

**Unit - 4. Second Law of Thermodynamics:** Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reserved heat engine, schematic representation, coefficients of performance. Kelvin -Planck statement of the Second law of Thermodynamic; PMM II and PMM I. Claius's statement .of Second law of Thermodynamic; Equivalence of the two statements; Reversible and irreversible processes; factors that make a process .irreversible, reversible heat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale.

**7 Hrs**

## **PART-B**

**Unit - 5. Gas Power Cycles:** Air standard cycles; Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T-s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles.

**6 Hrs**

**Unit - 6. Reciprocating Compressors:** - Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, Saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression.

**7 Hrs**

### **Unit - 7. Psychometrics:**

Atmospheric air and psychometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidifies and the relation between the two Enthalpy and adiabatic saturation temperature. Construction and Use of psychometric chart. Analysis of various processes; heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air - conditioning.

**6 Hrs**

**Unit - 8. I.C. Engines:**

Testing of two-stroke and four-stroke SI and CI engines for performance, related numerical problems, heat balance, Morse test.

**6 Hrs**

**Text Books:**

1. "Basic and Applied Thermodynamics" by P .K. Nag, Tata McGraw Hill, 3rd Edi. 2002
2. "Thermodynamics an engineering approach", by Yunus A. Cengel and Michael A. Boles. Tata McGraw hill Pub. 2002
3. Fundamental of Classical Thermodynamics by G.J. Van Wylen and R.E.Sonntag, Wiley Eastern.

**Reference Books:**

1. Engineering Thermodynamics. By Rajput, Laxmi Publications pvt ltd., 3rd Edi. 2007.
2. Engineering Thermodynamics by J.B. Jones and G.A.Hawkins, John Wiley and Sons.
3. Thermo Dynamics by S.C.Gupta, Pearson Edu. Pvt. Ltd., 1st Ed. 2005.
4. Thermodynamics -An Engineering Approach by Yunus, A.Cengel and Michael A.Boles, Tata McGraw Hill Pub. Co., 2002
5. Applied Thermodynamics by R.K.Hegde and Niranjana Murthy, Sapna Book House, 2005.

**Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

## **METROLOGY AND MEASUREMENTS**

**L:T:P 4:0:0**

**Sub Code: P08AU34**

**Hrs/week : 04**

**Total Lecture Hrs : 52**

**CIE Marks : 50**

**Exam Hours : 03**

**SEE Marks : 50**

**PART-A**

**1. Standards of Measurement:**

Definition and objectives of metrology, Standard of length- International prototype meter, Imperial standard yard, Wave length standard, Subdivision of standards, line and end standard, comparison, Transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian standards (M-87, M-112)

**6 hours**

**2. Comparators:**

Introduction to Comparator, Characteristics, Classification of Comparators, Sigma comparators, dial indicators, optical comparators, principles, zies ultra optimeter, Electric and electronic comparators – principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators.

**7 hours**

**3. Angular Measurements and Interferometer:**

Bevel protractor. Sine principle, use of sine bars, sine centre, angle gauges (numericals on building of angles) Clinometers. Principle of inter-ferometry, autocollimator, optical flats.

**6 hours**

**4. Measurements and Measurement Systems:**

Definition, significance of measurement, generalized measurement system, definition and concept of accuracy, precision, sensitivity, Calibration, threshold, hysteresis, repeatability, linearity, loading effect,

system response, time delay, errors in measurement, classification of errors.  
**hours**

**6**

## **PART-B**

### **5. Transducers and Intermediate Modifying Devices:**

Transfer efficiency, primary and secondary transducers, Mechanical, electrical, electronic transducers, advantages of each type of transducers.

Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, signal transmission (hydraulic transmission, magnetic transmission, electrical transmission)

**6 hours**

### **6. Terminating devices and Strain Measurement:**

Mechanical, digital read out devices, ultra-violet recorders, servo-recorders cathode ray oscilloscope, Oscillographs, X-Y plotters. Strain gauge, preparation and mounting of strain gauges, gauge factor, Methods of strain measurement

**7 hours**

### **7. Measurement of Force and Torque:**

Principle, analytical balance, platform balance, proving ring, torque measurement, types of dynamometers prony brake, Hydraulic dynamometer, Eddy current dynamometer.

**7 hours**

### **8. Pressure Measurement and Temperature Measurement:**

Principle, use of elastic members, bridge man gauge, Mc leod gauge, thermal conductivity gauge, (pirani gauge and thermocouple vacuum gauge) ionization gauge,

Resistance thermometers, thermocouple, law of thermocouple, thermocouple circuits, thermocouple materials, pyrometers, optical pyrometer.

**7 hours**

#### **TEXT BOOKS:**

- 1) Engineering Metrology - R.K. JAIN - Khanna Publishers
- 2) Engineering Precision Metrology - R.C. GUPTA - Khanna Publishers
- 3) Mechanical Measurements and Control - D.S.KUMAR

#### **REFERENCES:**

- 1) ASTM- Hand book of Industrial Metrology - PHI
- 2) Engineering Metrology - Third (metric) Edition - KJ. HUME- Kalyani publishers
- 3) Mechanical Measurements - BECKWITH, BUCK & MARAN-GONI Narosa publishing House
- 4) Measurement systems - Application A Design, (4th Edition) -DOEBELIN'- McGraw Hill.

#### **Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

## MANUFACTURING PROCESS – I

**L:T:P 4:0:0**

**Sub Code : P08AU35**  
**Hrs/week : 04**  
**Total Lecture Hrs : 52**

**CIE Marks : 50**  
**Exam Hours : 03**  
**SEE Marks : 50**

### **PART – A**

#### **CASTING PROCESS:**

**Unit - 1. Introduction:** Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Varieties of components produced by casting process. Advantages & Limitations of casting process.

**Patterns:** Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns.

**Binder:** Definition, Types of binder used in moulding sand.

**Additives:** Need, Types of additives used.

**6 Hrs**

**Unit - 2. Sand Moulding :** Types of base sand, requirement of base sand. Types of sand moulds.

**Sand moulds:** Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding.

**Cores:** Definition, Need, Types. Method of making cores, Binders used. Concept of Gating & Riser. Principle involved. and types. Fettling and cleaning of castings. Basic steps involved. Casting defects- causes, features and remedies.

**Moulding machines :** Jolt type, squeeze type, Jolt & Squeeze type and Sand slinger.

**7 Hrs**

**Unit - 3. Special moulding Process :Study of important moulding processes** Green sand, Core sand, Dry sand, Sweep mould, CO<sub>2</sub> sand, Shell mould, Investment mould & Full mould.

**Metal moulds :** Gravity die-casting, Pressure die casting, centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and continuous casting processes.

**7 Hrs**

**Unit - 4. Melting Furnaces:** Classification of furnaces . Constructional features & working principle of Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

**6 Hrs**

### **PART – B**

#### **WELDING:**

**Unit - 5. Welding process:** Definition, Principles, Classification, Application, Advantages & limitations of welding.

**Arc Welding:** Principle, Metal Arc welding (**MAW**), Flux Shielded Metal Arc Welding (**FSAW**), Inert Gas Welding (**TIG & MIG**) Submerged Arc Welding (**SAW**) and Atomic Hydrogen Welding processes. (**AHW**)

**Gas Welding:** Principle, Oxy – Acetylene welding, Reaction in Gas welding, Flame characteristics, Gas torch construction & working. Forward and backward welding.

**7 Hrs**

**Unit - 6. Special type of welding:** Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding Electron beam welding. **7 Hrs**

**Unit - 7. Metallurgical aspect in welding :** Structure of welds, Formation of different zones during welding. Heat affected zone (**HAZ**). Parameters affecting **HAZ**. Effect of carbon content on structure and properties of steel. Shrinkage in welds & Residual stresses. Concept of electrodes, Filler rod and fluxes. Welding defects –Detection causes & remedy.  
**6 Hrs**

**Unit - 8. Principles of soldering & brazing:** Parameters involved & Mechanism. Different Types of Soldering & Brazing Methods.  
**Inspection Methods** – Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.  
**6 Hrs**

**Text Books:**

1. “Manufacturing & Technology: Foundry Forming and Welding”, P.N.Rao 2nd Ed., Tata McGraw Hill, 2003.
2. “Manufacturing Process-I”, Dr.K.Radhakrishna, Sapna Book House, 5th Ed, 2006.

**Reference Books:**

1. “Manufacturing Technology”, Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. “Process and Materials of Manufacturing:”, Roy A Lindberg, 4th Ed. Pearson Edu. 2006.

**Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

**FLUID MECHANICS**

**L:T:P 3:1:0**

**Subject Code: P08AU36**

**Hrs/week : 04**

**Total Lecture Hrs : 52**

**CIE Marks : 50**

**Exam Hours : 03**

**SEE Marks : 50**

**PART A**

**Unit – 1:**

**Properties of Fluids:** Introduction, properties of fluids, classifications, viscosity, thermodynamic properties, Surface tension and Capillarity, Vapour pressure and Cavitation

**Fluid Statics - Pressure and its Measurement:** Fluid pressure at a point, Pascal’s law, pressure variation in a static fluid, Absolute, gauge, atmospheric and vacuum pressures, simple manometers, differential manometers.  
**7 Hrs**

**Unit – 2:**

**Fluid Statics - Hydrostatic forces on surfaces:** Total pressure and center of pressure, vertical plane surface submerged in liquid, horizontal plane surface submerged in liquid, inclined plane surface submerged in liquid, curved surface submerged in liquid.

**Buoyancy and floatation:** Buoyancy center of buoyancy, metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies.

**7 Hrs**

**Unit –3:**

**Fluid Kinematics:** Introduction, Types of fluid flow, continuity equation in one and three dimension (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream

function for 2D flow and types of motion.

**6Hrs**

**Unit – 4:**

**Fluid Dynamics:** Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids.

**Fluid flow measurements:** Introduction, venturimeter, orifice meter, Pitot tube and v-notch.

**6Hrs**

## **PART B**

**Unit – 5:**

**Laminar flow and viscous effects:** Reynold's number, critical Reynold's number, Laminar flow through circular pipe-Hagen Poiseuille's equation, Laminar flow between parallel stationary plates.

Introduction to turbulent flow, friction loss in pipe flow, expression for loss of head due to friction in pipes-Darcy-Weisbach equation.

**6 Hrs**

**Unit – 6:**

**Flow through pipes:** Loss of energy in pipes, Darcy- Equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, hydraulic gradient and total energy line.

**6 Hrs**

**Unit – 7:**

**Dimensional Analysis:** Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's  $\Pi$  theorem, Rayleigh's method, dimensionless numbers, similitude, types of similitudes.

**6 Hrs**

**Unit – 8:**

**Flow past immersed bodies:** Drag, Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, calculation of laminar boundary layer thickness, displacement thickness, momentum thickness and energy thickness.

**Introduction to compressible flow:** Sonic velocity, Velocity of sound in a fluid, Mach number, Propagation of pressure waves in a compressible fluid.

**8 Hrs**

### **Text Books**

1. Fluid Mechanics by Ojish K.Kundu, IRAM COCHEN, EL SEVIER 3rd Ed. 2005.
2. Fluid Mechanics by Dr. Bansal.R.K, Lakshmi Publications, 2004.
3. Fluid Mechanics and hydraulics, Dr. Jagadishlal: Metropolitan Book Co-Ltd., 1997.
4. Fluid Mechanics (SI Units), Yunus A. Cengel John M. Oimbala. Tata MaGrawHill,2006.

### **Reference books:**

1. Fluid Mechanics, Fundamental & applications, by Yunus A, Cenegel, John M,Cimbala, Tata MacGraw Hill, 2006.
2. Fluid Mechanics by John F.Douglas, Janul and M.Gasiosek and John A. Swaffield, Pearson Education Asia, 5th ed., 2006
3. Kumar.D.S: Fluid Mechanics and Fluid Power Engineering," Kataria and Sons.,2004.
4. Fluid Mechanics R.K.Hegde, Niranjana Murthy Spana Book House, 2005.

**Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

**METROLOGY AND MEASUREMENTS LAB**

**L:T:P 0:0:3**

**Subject Code: P08AUL37**  
**Hrs/week : 04**  
**Total Lecture Hrs : 42**

**CIE Marks : 50**  
**Exam Hours : 03**  
**SEE Marks : 50**

**PART-A: MECHANICAL MEASUREMENTS**

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

**PART-B: METROLOGY**

6. Measurements using Optical Projector / Toolmaker Microscope.
7. Measurements of angle using Sine Center / Sine bar / bevel protractor
8. Measurements of alignment using Autocollimator / roller set
9. Measurements of cutting tool forces using
  - a) Lathe tool Dynamometer
  - b) Drill tool Dynamometer.
10. Measurements of Screw thread Parameters using two wire or three-wire method.
11. Measurements of Surface roughness. Using Tally surf/mechanical Comparator.
12. Measurements of gear tooth profile using gear tooth vernier /gear tooth micrometer.
13. Calibration of micrometer using slip gauges
14. Measurement using Optical Flats

**Scheme of Examination:**

ONE question from Metrology (part -A) 20 Marks  
ONE question from Instrumentation (part -B) 20 Marks  
Viva –Voce 10 Marks  
**Total 50 Marks**

**WORKSHOP PRACTICE (FOUNDRY AND FORGING LABORATORY)**

**L:T:P 0:0:3**

**Subject Code: P08AUL38**  
**Hrs/week : 03**  
**Total Lecture Hrs : 42**

**CIE Marks : 50**  
**Exam Hours : 03**  
**SEE Marks : 50**

**Part-A**

**1. Testing of Moulding sand and Core sand**

Preparation of sand specimens and conduction of the following tests:

- 1 Compression, Shear and Tensile tests on Universal Sand Testing Machine.
- 2 Permeability test
- 3 Core hardness & Mould hardness tests.

- 4 Grain fineness number test (Sieve Analysis test)
- 5 Clay content test.
- 6 Moisture content test.

## **2. Foundry Practice**

Use of foundry tools and other equipments.

Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes).

Preparation of one casting (Aluminum or cast iron-Demonstration only)

### **Part -B**

## **3. Forging Operations**

Preparing minimum three forged models involving upsetting, drawing and bending operations.

Out of these three models, at least one model is to be prepared by using Power Hammer.

### **Scheme of Examination:**

ONE question from Metrology (part -A) 20 Marks

ONE question from Instrumentation (part -B) 20 Marks

Viva –Voce 10 Marks

**Total 50 Marks**

