

MATERIAL SCIENCE AND METALLURGY

Sub Code : 10ME32A/42A
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks: 100

PART - A

UNIT - 1

Crystal Structure: BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections -point line and surface imperfections. Atomic Diffusion: Phenomenon, Fick's laws of diffusion, factors affecting diffusion.

06 Hours

UNIT - 2

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, linear and non linear elastic behaviour and properties, mechanical properties in plastic range, yield strength offset yield strength, ductility, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip and twinning.

06 Hours

UNIT - 3

Fracture: Type I, Type II and Type III.

Creep: Description of the phenomenon with examples. three stages of creep, creep properties, stress relaxation.

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and SN diagram.

07 Hours

UNIT - 4

Solidification: Mechanism of solidification, Homogeneous and Heterogeneous nucleation, crystal growth, cast metal structures.

Phase Diagram I: Solid solutions Hume Rothery rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.

07 Hours

PART - B

UNIT - 5

Phase Diagram II: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

06 Hours

UNIT - 6

Heat treating of metals: TTT curves, continuous cooling curves, annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.

07 Hours

UNIT - 7

Ferrous and non ferrous materials: Properties, Composition and uses of

- Grey cast iron, malleable iron, S.G iron and steel
- Copper alloys-brasses and bronzes.
- Aluminium alloys-Al-Cu, Al-Si, Al-Zn alloys.

06 Hours

UNIT - 8

Composite Materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP and MMC's advantages and application of composites.

07 Hours

TEXT BOOKS:

1. **Foundations of Materials Science and Engineering**, Smith, 3rd Edition McGraw Hill, 2009
2. **Materials Science**, Shackelford., & M. K. Muralidhara, Pearson Publication – 2007.

REFERENCE BOOKS:

1. **An introduction to Metallurgy**; Alan Cottrell, University Press India Oriental Longman Pvt. Ltd., 1974.
2. **Engineering Materials Science**, W.C.Richards, PHI, 1965
3. **Physical Metallurgy**; Lakhtin, Mir Publications
4. **Materials Science and Engineering**, V.Raghavan , PHI, 2002
5. **Elements of Materials Science and Engineering**, H. VanVlack, Addison- Wesley Edn., 1998
6. **Materials Science and Engineering**, William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. **The Science and Engineering of Materials**, Donald R. Asklund and Pradeep.P. Phule, Thompson Learning, 4th Ed., 2003.

MECHANICAL MEASUREMENTS AND METROLOGY

Sub Code : 10ME32B/42B
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks: 100

PART- A

UNIT-1:

Standards of measurement: Definition and Objectives of metrology, Standards of length-International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-12), Numerical problems on building of slip gauges.

06 Hours

UNIT-2:

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

07 Hours

UNIT-3:

Comparators and Angular measurement: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators-principles, Zeiss ultra optimeter, electric and electronic comparators-principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges (numericals on building of angles), clinometers.

07 Hours

UNIT-4:

Interferometer and screw thread, gear measurement: Interferometer, interferometry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear to, terminology, use of gear tooth vernier caliper and micrometer.

06 Hours

PART-B

UNIT-5:

Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.

07 Hours

UNIT-6:

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters.

06 Hours**UNIT-7:**

Measurement of force, torque and pressure: Principle, analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure measurements, principle, use of elastic members, Bridgman gauge, McLeod gauge, Pirani gauge.

06 Hours

I

UNIT-8:

Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

07 Hours**TEXT BOOKS:**

1. **Mechanical Measurements**, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. **Engineering Metrology**, R.K. Jain, Khanna Publishers, 1994.

REFERENCE BOOKS:

1. **Engineering Metrology**, I.C. Gupta, Dhapat Rai Publications, Delhi.
2. **Mechanical Measurements**, R.K. Jain
3. **Industrial Instrumentation**, Alsutko, Jerry. D. Faulk, Thompson Asia Pvt. Ltd. 2002.
4. **Measurement Systems Applications and Design**, Ernest O. Doblin, McGraw Hill Book Co.

BASIC THERMODYNAMICS

(Common to ME/IP/AU/IM/MA)

Sub Code : 10ME33
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks: 100

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, state point, 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.

07 Hours**UNIT - 2**

Work and 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.

06 Hours**UNIT - 3**

First Law of Thermodynamics: Joules 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.

06 Hours**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; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM II and PMM I, Clausius statement of Second law of Thermodynamics, 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.

07 Hours**PART-B****UNIT - 5**

Entropy: Clausius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

06 Hours

UNIT - 6

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.

07 Hours**UNIT - 7**

Thermodynamic relations: Maxwell relation, Clausius Clapeyron's equation. Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasi-static processes.

07 Hours**UNIT - 8**

Ideal gas mixture : Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of properties, Analysis of various process. Real Gases: Introduction. Vander Waal's Equation of state, Vander Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart

06 Hours**TEXT BOOKS:**

1. **Basic and Applied Thermodynamics**, P.K.Nag, Tata McGraw Hill Pub. 2002
2. **Thermodynamics**, An Engineering Approach, Yunus A. Cengel and Michael A. Boles, Tata McGraw Hill publications, 2002

REFERENCE BOOKS:

1. **K.A.Venkatesh Basic Engineering Thermodynamics**, Thermodynamic data hand book by B.T. Nijaguna. (To be supplied in the examination)
2. **Engineering Thermodynamics**, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
3. **Fundamentals of Classical Thermodynamics**, G.J.Van Wylen and R.E.Sonntag, Wiley Eastern.
4. **An Introduction to Thermodynamics**, Y.V.C.Rao, Wiley Eastern, 1993,
5. **B.K Venkanna "Basic Thermodynamics**, PHI New Delhi

MECHANICS OF MATERIALS

Sub Code : 10ME34
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks: 100

PART-A

UNIT 1:

Simple Stress and Strain: Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behaviour in tension for Mild steel, cast iron and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

07 Hours

UNIT 2:

Stress in Composite Section: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

06 Hours

UNIT 3:

Compound Stresses: Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

07 Hours

UNIT 4:

Energy Methods: Work and strain energy, Strain energy in bar/beams, castigliano's theorem, Energy methods.

Thick and Thin Cylinder Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lamé's equation (compound cylinders not included).

06 Hours

PART-B

UNIT 5:

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

07 Hours

UNIT 6:

Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress, radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (composite / flitched beams not included).

07 Hours

UNIT 7:

Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method

06 Hours**UNIT 8:**

Torsion of Circular Shafts and Elastic Stability of Columns: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts

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 Hours**TEXT BOOKS:**

1. "**Mechanics of Materials**", by R.C.Hibbeler, Printice Hall. Pearson Edu., 2005
2. "**Mechanics of materials**", James.M.Gere, Thomson, Fifth edition 2004.
3. "**Mechanics of materials**", in S.I. Units, Ferdinand Beer & Russell Johnstan, TATA Mc GrawHill- 2003.

REFERENCE BOOKS:

1. "**Strength of Materials**", S.S. Rattan, Tata McGraw Hill, 2009
2. "**Strength of Materials**", S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. "**Mechanics of Materials**", K.V. Rao, G.C. Raju, First Edition, 2007
4. "**Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edison, 1998.
5. "**Strength of Materials**", W.A. Nash, Sehaum's Outline Series, Fourth Edition-2007.

MANUFACTURING PROCESS – I
(FUNDAMENTALS OF FOUNDRY & WELDING)

Sub Code	: 10ME35	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

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, BIS colour coding of Patterns.

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

Additives: Need, Types of additives used.

06 Hours

UNIT 2:

Sand Moulding : Types of base sand, requirement of base sand. Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds.

Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding.

Concept of Gating & Riser. Principle and types.

Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies.

Moulding Machines : Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

07 Hours

UNIT 3:

Special moulding Process: Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO₂ mould, Shell mould, Investment mould.

Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and Continuous Casting Processes.

07 Hours

UNIT 4:

Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

06 Hours

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 (**FSMAW**), Inert Gas Welding (**TIG & MIG**) Submerged Arc Welding (**SAW**) and Atomic Hydrogen Welding processes. (**AHW**)

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

07 Hours

UNIT 6:

Special types of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

07 Hours**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.

06 Hours**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.

06 Hours**TEXT BOOKS:**

1. **“Manufacturing Process-I”**, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2009.
2. **“Manufacturing & Technology: Foundry Forming and Welding”**, P.N.Rao 2nd Ed., Tata McGraw Hill, 2003.

REFERENCE BOOKS:

1. **“Manufacturing Technology”**, Serope Kalpakjian, Steuen.R.Se Schmid, Pearson Education Asia, 5th Ed. 2006.
2. **“Process and Materials of Manufacturing”**, Roy A Lindberg, 4th Ed. Pearson Edu. 2006.

COMPUTER AIDED MACHINE DRAWING

Sub Code	: 10ME36A/10ME46A	IA Marks	: 25
Hrs/week	: 04(1 Hrs. Theory & 2 Hrs Practical)	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

Introduction:

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap.

02 Hours

PART-A

UNIT 1:

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic Views: Conversion of pictorial views into orthographic projections. of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.

08 Hours

UNIT 2:

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

08 Hours

PART-B

UNIT 3:

Keys & Joints :

Parallel key, Taper key, Feather key, Gibhead key and Woodruff key

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

08 Hours

UNIT 4:

Couplings:

Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

08 Hours

PART - C
Assembly Drawings
(Part drawings should be given)

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool Head of a shaper

18 Hours

TEXT BOOKS:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat & V.M.Panchal

REFERENCE BOOKS:

1. 'A Text Book of Computer Aided Machine Drawing', S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication.
3. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005
4. 'Auto CAD 2006, for engineers and designers', Sham Tickoo. Dream tech 2005
5. 'Machine Drawing', N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata Mc GrawHill, 2006

NOTE:

Internal assessment: 25 Marks

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

Scheme of Examination:

Two questions to be set from each Part-A, Part-B and Part-C

Student has to answer one question each from Part-A and Part-B for 20 marks each. And one question from Part-C for 60 marks.

i.e.	PART-A 1x20	= 20 Marks
	PART-B 1x20	= 20 Marks
	PART-C 1x60	= 60 Marks
	Total	= 100 Marks

FLUID MECHANICS

Sub Code	: 10ME36B/ 46B	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

UNIT-1

Properties of Fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation

06 Hours

UNIT-2

Fluid Statics : Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

07 Hours

UNIT-3

Buoyancy and Fluid Kinematics:

Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically.

Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Coordinates only), velocity and acceleration, velocity potential function and stream function.

07 Hours

UNIT-4

Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

06 Hours

PART-B

UNIT-5

Fluid Flow Measurements : Venturimeter, orificemeter, pitot-tube, vertical orifice, V-Notch and rectangular notches.

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

07 Hours

UNIT-6

Flow through pipes : Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL.

06 Hours

UNIT-7

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 and stationary plates.

06 Hours

UNIT-8

Flow past immersed bodies : Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness.

Introduction to compressible flow : Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid.

07 Hours**TEXT BOOKS:**

1. Fluid Mechanics by Ojish.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechancis by Dr. Bansal, R.K.Lakshmi Publications, 2004.

REFERENCE BOOKS:

1. Fluid Mechanics and hydraulics, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
2. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala. Tata MaGrawHill, 2006.
3. Fluid Mechanics by John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning

METALLOGRAPHY AND MATERIAL TESTING LABORATORY

Sub Code	: 10 MEL 37A / 47A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART – A

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
4. Non-destructive test experiments like,
 - (a). Ultrasonic flaw detection
 - (b). Magnetic crack detection
 - (c). Dye penetration testing. To study the defects of Cast and Welded specimens

PART – B

1. Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine
2. Torsion Test
3. Bending Test on metallic and nonmetallic specimens.
4. Izod and Charpy Tests on M.S,C.I Specimen.
5. Brinell, Rockwell and Vickers's Hardness test.
6. Fatigue Test.

Scheme of Examination:

ONE question from part -A:	20 Marks
ONE question from part -B:	20 Marks
Viva -Voice:	10 Marks
Total:	50 Marks

MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY

Sub Code	: 10MEL 37B / 47B	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam 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

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using
 - a. Lathe tool Dynamometer
 - b. Drill tool Dynamometer.
5. Measurement of Screw thread Parameters using Two wire or Three-wire method.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. 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

FOUNDRY AND FORGING LABORATORY

Sub Code	: 10MEL 38A / 48A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam 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 Sieve Analysis to find Grain Finest number of Base Sand
- 5 Clay content determination in Base Sand

PART – B

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 – C

3. Forging Operations

- Calculation of length of the raw material required to do the model.
- 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 is to be set from Part-A: 10 marks

One question is to be set from either

Part-B or Part-C: 30 marks

Calculation part in case of forging is made compulsory

Calculation (Forging)	+ Foundry Model	= 05 +25 = 30 Marks
Calculation (Forging)	+ Foundry Model	= 05 +25 = 30 Marks

Viva-Voce: 10 marks.

Total: 50 marks.

MACHINE SHOP

Sub Code	: 10MEL 38 A / 48A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

PART – B

Cutting of V Groove/ dovetail / Rectangular groove using a shaper.

Cutting of Gear Teeth using Milling Machine.

Scheme of Examination:

One Model from Part – A	30 marks
One Model from Part – B	10 marks
Viva – Voce	10 marks
Total	50 marks

APPLIED THERMODYNAMICS

Sub Code : 10ME43
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks: 100

PART-A

Unit 1:

Combustion thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels. Excess air, mass balance, actual combustion. Exhaust gas analysis. A./ F ratio, Energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, Combustion efficiency

07 Hours

Unit 2:

I.C.Engine: Testing of two stroke and four stroke SI and CI engines for performance Related numerical problems, heat balance , Morse test.

06 Hours

Unit 3:

Gas power cycle: 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.

06 Hours

Unit 4:

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, analysis for performance , comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.

07 Hours

PART-B

Unit 5:

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. Multistage compressor, saving in work, optimum intermediate pressure, inter- cooling, minimum work for compression.

06 Hours

Unit 6:

Gas turbine and Jet propulsion: Classification of Gas turbines, Analysis of open cycle gas turbine cycle. Advantages and disadvantages of closed cycle. Methods to improve thermal efficiency, Jet propulsion and Rocket propulsion.

07 Hours

Unit 7

Refrigeration: Vapour compression refrigeration system ; description, analysis, refrigerating effect, capacity , power required, units of refrigeration, COP , Refrigerants and their desirable properties. Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle, Vapour absorption refrigeration system, steam jet refrigeration.

06 Hours

Unit 8

Psychrometry: Atmospheric air and psychrometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidities and the relation between the two enthalpy and adiabatic saturation temperature. Construction and use of psychrometric chart . Analysis of various processes; heating, cooling , dehumidifying and humidifying. Adiabatic mixing of moist air. Summer and winter air conditioning.

07 Hours

NOTE:

1. **Thermodynamics data hand book**, B.T.Nijaguna (to be supplied in the examination)
2. A copy of Psychrometry chart to be given along with answer book to the candidates (if needed)

TEXT BOOK

1. **Basic and applied Thermodynamics**, P.K. Nag, Tata Mc Graw Hill Pub.Co,2002
2. **Applied Thermodynamics**, Rajput, Laxmi Publication
3. **Applied Thermodynamics**, B.K. Venkanna, PHI, New Delhi

REFERENCE BOOKS

1. **Thermodynamics , An engineering approach**, Yunus, A. Cengel and Michael A.Boies, Tata Mc Graw Hill pub. Co., 2002,
2. **Fundamental of Classical Thermodynamics**, G.J. Van Wylen and R.E. Sonntag Wiley eastern.
3. **“Applied Thermodynamics”**, B.K Venkanna, PHI New Delhi

KINEMATICS OF MACHINES

Sub Code : 10ME44
Hrs/week : 04
Total Lecture Hrs : 52

IA Marks : 25
Exam Hours : 03
Exam Marks : 100

PART - A

UNIT 1:

Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

07 Hours

UNIT 2:

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism.

Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

06 Hours

UNIT 3:

Velocity and Acceleration Analysis of Mechanisms (Graphical Methods) Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident Particles on separate links-Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

07 Hours

UNIT 4:

Velocity Analysis by Instantaneous Center Method: Definition, Kennedy's Theorem, Determination of linear and angular velocity using instantaneous center method

Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism.

06 Hours

PART - B

UNIT 5:

Velocity and Acceleration Analysis of Mechanisms (Analytical Methods): Analysis of four bar chain and slider crank chain using analytical expressions. (Use of complex algebra and vector algebra)

06 Hours

UNIT 6:

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact. Arc of contact, Contact ratio of spur, helical, bevel and worm gears, Interference in involute gears. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. Profile Modification.

07 Hours

UNIT 7:

Gear Trains: Simple gear trains, Compound gear trains for large speed. reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

07 Hours**UNIT 8:**

Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

06 Hours**TEXT BOOKS:**

1. "**Theory of Machines**", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.
2. "**Theory of Machines**", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006

REFERENCE BOOKS:

1. "**Theory of Machines & Mechanisms**", J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009.
2. **Mechanism and Machine theory**, Ambakar, PHI

Graphical Solutions may be obtained either on the Graph Sheets or on the Answer Book itself.

MANUFACTURING PROCESS – II
Metal Removing Process
(Common to ME/IP/IM/AU/MA)

Sub Code : 06 ME 45
Hrs/week: 04
 Total Lecture Hrs: 52

IA Marks : 25
 Exam Hours: 03
 Exam Marks : 100

PART – A

UNIT - 1

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchant's circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

07 Hours.

UNIT - 2

Cutting Tool Materials: Desired properties and types of cutting tool materials – HSS, carbides coated carbides, ceramics. Cutting fluids. Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool and workpiece and chip. Measurement of tool tip temperature.

07 Hours.

UNIT - 3

Turning (Lathe), Shaping and Planing Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machines, Different operations on lathe, shaping machine and planing machine. Simple problems on machinery time calculations

07 Hours.

UNIT - 4

Drilling machines: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials. Introduction to CNC machines- Principles of operation. Axes of NC machine-Coordinate systems. Basics of Manual part programming methods.

06 Hours.

PART – B

UNIT - 5

Milling machines: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations.
Indexing: Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing.

06 Hours.

UNIT - 6

Grinding machines: Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Centreless, cylindrical and surface grinding). Selection of grinding wheel. Grinding process parameters. Dressing and truing of grinding wheels.

07 Hours.

UNIT - 7:

Broaching process - Principle of broaching. Details of a broach. Types of broaching machines-constructional details. Applications. Advantages and Limitations.
Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

06 Hours.

UNIT - 8

Non-traditional machining processes: Need for non traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

06 Hours

Text Books:

1. **Workshop Technology**, Hazara Choudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
2. **Production Technology**, R.K.Jain, Khanna Publications, 2003.
3. **Production Technology**, HMT, Tata MacGraw Hill, 2001.

Reference Books:

1. **Manufacturing Science**, Amitabha Ghosh and Mallik, affiliated East West Press, 2003.
2. **Fundamentals of Metal Machining and Machine Tools**, G. Boothroyd, McGraw Hill, 2000.