FLUID MECHANICS

Sub Code : 16IM/IP 32
Hrs/week : 04
Total Lecture Hrs : 50
IA Marks : 20
Exam Hours : 03
Exam Marks : 80

PART – A

MODULE-1
Properties of Fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation

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.

12 Hours

MODULE -2
Buoyancy and Fluid Kinematics:

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

Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration

12 Hours

PART-B

MODULE-3
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.


07 Hours

MODULE-4
Flow through pipes: Minor losses through pipes. Darey’s and Chezy’s equation for loss of head due to friction in pipes. HGL and TEL (no problems).
Flow past immersed bodies: Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness.

**09 Hours**

**MODULE-5**

**Dimensional Analysis**: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh’s method, Buckingham \(\pi\) theorem, dimensionless numbers, similitude (theory and no problems)

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

**10 Hours**

**TEXT BOOKS:**

**REFERENCE BOOKS:**

**Course objective**

To provide the students with
1. The fundamentals of fluid mechanics, fluids and its properties.
2. An understanding of fluid statistics and hence the usage of manometers, forces on submerged bodies.
3. Study of Buoyancy, metacenter, continuity equation and different functions
4. Application of Bernoulli’s equation to measure energy levels
5. Using different fluid equipment’s to calculate fluid flow and using dimensional analysis to solve flow problems.
6. Understanding the phenomenon of losses during flow in pipes.
7. Study of Laminar flow and the viscous effects.
8. Evaluating the various parameters connected to flow around immersed bodies.
Course outcomes

After the completion of the course, a student will
1. examine the fundamental of fluid mechanics and fluids and apply the basic equations to find the force on submerged surfaces.
2. Calculate using known formula to calculate the center of buoyancy and find the velocity and acceleration.
3. Calculate various flow parameters using fluid flow meters and using dimension analysis to predict flow phenomena.
4. Use Euler’s and Bernoulli’s equations and the conservation of mass to determine velocities & pressures. Calculate frictional losses through pipes and to calculate the drag and lift, displacement, momentum and energy thickness.
BASIC THERMODYNAMICS

MODULE -1

Fundamental Concepts & Definitions: Thermodynamics definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, 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, fixed points and measurements.

Work and Heat: Definition of work and its limitations.Thermodynamic definition of work; examples, sign convention.

10 HOURS

MODULE-2

Displacement work; as a part of a system boundary, as a whole of a system boundary,expressions for displacement work in various processes through p-v diagrams.

First Law of Thermodynamics: Joules experiments, equivalence of heat andwork. Statement of the First law of thermodynamics, extension of the First law tonon - cyclic processes, energy, energy as a property, modes of energy, puresubstance; definition, two-property rule, Specific heat at constant volume,enthalpy, specific heat at constant pressure.

10 HOURS

MODULE-3

APPLICATION OF FIRST LAW OF THERMODYNAMICS: Extension of the First law to controlvolume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and evacuation of vessels with and without heat transfer.

SECOND LAW OF THERMODYNAMICS –Qualitative difference between heat & work; Cyclic heat engine; Energy Reservoirs; Kelvin-Planck statement of
the Second law of Thermodynamics; Clausius's statement of Second law of Thermodynamics; (Equivalence of two statements not included); 10 HOURS

MODULE -4

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, Diesel and dual cycles. Introduction To Gas Turbine And Its Classification. 10 HOURS

MODULE-5


10 HOURS

TEXT BOOKS:
3. Thermal Engineering, R.K. Rajput, Laxmi Publication

REFERENCE BOOKS:
2. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
4. An Introduction to Thermodynamics, Y.V.C.Rao, Wiley Eastern, 1993,
5. B.K Venkanna, Swati B. Wadavadagi “Basic Thermodynamics, PHI, New Delhi, 201
MECHANICAL MEASUREMENTS AND METROLOGY

Sub Code   : 16IM/IP 34               IA Marks : 20
Hrs/week   : 04                                 Exam Hours : 03
Total Lecture Hrs : 50                        Exam Marks: 80

PART- A

MODULE 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

MODULE 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, limit gauge and gauge materials.

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.

12 Hours

MODULE 3
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 terminology, use of gear tooth vernier caliper and micrometer.

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.

13 Hours

MODULE 4
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
MODULE 5


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.

13 Hours

TEXT BOOKS:


REFERENCE BOOKS:

2. Mechanical Measurements, R.K. Jain
Mechanics of Materials

Code: 16 IM/IP 35  
Hours / week: 04  
Total Hours: 50  
IA Marks: 20  
Exam Marks: 80

Module – 1

Simple Stress and Strain: Introduction, Stress and types, Strain, Tensile test on a mild steel bar, Hooke's Law and Poisson's ratio, Stress-Strain relation for cast iron and non-ferrous materials, Extension / Shortening of bars – uniform cross section, with cross sections varying in steps, with continuously varying cross sections (circular and rectangular), Principle of superposition, Elongation due to self weight.

Volumetric strain, expressions for volumetric strain for bars with uniform circular and rectangular cross sections, Simple shear stress and shear strain, Elastic constants (No derivation for relationship between elastic constants), Temperature stresses (excluding compound bars). Simple numerical problems on tensile test and determining change in dimensions.

Module – 2

Principal stresses: Stresses in a tensile member, Stresses due to pure or simple shearing, mutually perpendicular direct stresses, Principal planes and stresses, Two-dimensional stress system, Graphical method (Mohr's circle) for plane stresses.

Thick and Thin Cylinder: Stresses in thin cylinders, change in dimensions of cylinder (diameter, length and volume). Thick cylinders - Lame’s equations for radial and hoop stresses (compound cylinders and spherical shells not included).


Columns: Introduction, End conditions, Assumptions in deriving Euler’s equations, Sign conventions for bending moments, Euler’s formulas (no derivation) for axially loaded elastic long columns, Limitations of Euler’s theory, Rankine's formula.

Module – 3

Bending Moment and Shear Force in Beams: Introduction - types of beams, loads and reactions, Shear force and bending moment, Sign conventions, Relationship between load intensity, shear force and bending moment; 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.

Module – 4

Bending Stresses in Beams: Moment of inertia and section modulus for different sections (I, T, rectangular, and circular – only formulas) Introduction to theory of simple bending, assumptions in simple bending theory, Bending stress equation - relationship between bending stress and radius of curvature, relationship between bending moment and radius of curvature; Moment carrying capacity of a section. Simple problems on rectangular, symmetrical I (about NA) and T sections. (composite / notched beams not included).

Module – 5

Deflection of Beams: Introduction, Differential equation for deflection (flexure), Sign conventions and assumptions, Equations for deflection and slope - Double integration method and Macaulay's method for cantilever and simply supported beams for point load, uniformly distributed load, uniformly varying load, and couple.

Texts:
References:


Note: Two questions of 20 marks each to be set from each module. Student is required to answer FIVE full questions choosing one question from each module. There should not be mix of questions from modules. However, questions within the module can be mixed.

Course Outcomes:

At the end of this course students will be able to:

- Explain the fundamental concepts of stress and strain and the relationship between both through the strain -stress equations in order to solve problems for simple elastic solids.
- Determine different stresses induced in cylinders carrying fluids at a pressure.
- Explain the phenomena of torsion in circular shafts and determine the power transmitted by solid and hollow circular shafts.
- Explain the concept of buckling in columns and be able to compute buckling load using Euler’s and Rankine’s equations.
- Explain the concept of bending in beams and determine the shear force and bending moment in beams subjected to different types of loads.
- Explain the theory behind deflection of beams and determine the deflection amount caused by different loads.
Manufacturing Process I

CODE 16IM/IP 36
Total Hrs. : 50
Exam Hours : 03
Course Objective:
The objective of the course is to study a broad range of manufacturing processes and be able to select a suitable process (Casting and welding) for the manufacture of a given component.

MODULE-1
CASTING PROCESS
Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns.
Sand Moulding: Types of base sand, requirement of base sand. Moulding sand mixture ingredients for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds.
Binder: Definition, Types of binder used in moulding sand.
Additives: Need, Types of additives used and their properties.

MODULE 2
Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding.
Concept of Gating & Risers. 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 Sandslinger.
Special moulding Process: Study of important moulding processes, No bakemoulds, Flaskless moulds, Sweep mould, CO2 mould, Shell mould, Investment mould.

MODULE 3
Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes.
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.

MODULE 4
WELDING
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).

MODULE 5
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.

**Inspection Methods** – Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection. (06 Hrs)

**Course Outcomes:**
On completion of project of this course, student are able to
- To understand various processes carried out in Foundry.
- To understand about ingredient of sand and types of Sand.
- To understand various specialized casting process.
- To understand the principles, advantage, application and limitation of various type of joining process.
- Able to make a Comparative study of all the joining processes such as welding, Soldering and Brazing along with metallurgical aspects and changes.

**Scheme of Examination:**
Two full question (with a maximum of four sub question) of twenty marks each to be set from each module. Each question should cover all content of the respective module.
- Student have to answer five full question choosing one full question from the each module.

**TEXT BOOKS:**

**REFERENCE BOOKS:**
MACHINE SHOP

Sub Code : 16 IML/IPL 37A / 37B  IA Marks : 20
Hrs/week : 03  Exam Hours : 03
Total Lecture Hrs : 48  Exam Marks : 80

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:

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<tr>
<td>One Model from Part – A</td>
<td>30 marks</td>
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<tr>
<td>One Model from Part – B</td>
<td>30 marks</td>
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<td>Viva – Voce</td>
<td>20 marks</td>
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PART – A


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.


6. Fatigue Test.

Scheme of Examination:

ONE question from part -A:  20 Marks

**ONE question from part -B:**  **40 Marks**

Viva -Voice: 20 Marks

Total: 80 Marks
COMPUTER AIDED MACHINE DRAWING

Sub Code   : 16IM/IP 42   IA Marks    :   20
Hrs/week   : 04                        Exam Hours   :   03
Total Lecture Hrs: 50      Exam Marks    :   80

MODULE 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.

10 Hours

MODULE 2

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

MODULE 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

MODULE 4

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

08 Hours

MODULE 5

(Part drawings should be given)
1. Plummer block (Pedestal Bearing)
2. Screw jack (Bottle type)
3. Machine vice

16 Hours

TEXT BOOKS:
2. 'Machine Drawing', N.D.Bhat&V.M.Panchal
REFERENCE BOOKS:
3. 'Machine Drawing with Auto CAD', GoutamPohit&Goutham Ghosh, 1st Indian print Pearson Education, 2005
4. 'Auto CAD 2006, for engineers and designers', Sham Tickoo. Dream tech 2005

NOTE:
Internal assessment: 20 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.
PART - A

MODULE 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

MODULE 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.

06 Hours

MODULE 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

MODULE 4
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.


12 Hours

MODULE 5
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.

08 Hours

TEXT BOOKS:
REFERENCE BOOKS:
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

Course Objective

The objective of this course are to make student to study the fundamentals of single point cutting tool and basic machining processes in shaping, drilling, milling, grinding machine. To know the need and properties of cutting fluids and to familiarize with Non conventional manufacturing process.

Module 1

Module 2

Turning (Lathe), Shaping Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Different operations on lathe, shaping machine.(08 Hrs)

Module 3
Drilling machines: drilling & related operations, Classification of drilling machine, constructional features and working principle of Radial, multi spindle, Gang, Deep hole and automatic drilling machine, Types of drill & drill bit nomenclature.

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.(09 Hrs)

Module 4
Grinding machines: Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding ).


Module 5
Finishing and other Processes Lapping and Honing operations Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

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 (09 Hrs)

Course Outcomes

- To understand Tool Nomenclature, different types of machine tools, types, applications and operations
- Ability to understand failure criteria, heat generation and selection of cutting fluids.
- To understand the tool life of different cutting tool materials and Indexing in milling machine.
- To understand the working of shaping and grinding.
- To understand the principles, advantages, application and limitations of Non-conventional Machining.

Scheme of Examination:

- Two full question (with a maximum of four sub question) of twenty marks each to be set from each module. Each question should cover all content of the respective module.
- Student has to answer five full question choosing one full question from each module.

Text Books:


Suggested Readings:

6. Bhattacharyya A, Theory & Practice of Metal Cutting, New Central Book Agency
7. Trent, E. M. Metal cutting: Butterworth Heinemann
Materials Science and Metallurgy

Course objectives:
To make students understand how and when such imperfections are formed and what could be the effects of such imperfections on the properties of the material
To distinguish between steady and non-steady types of diffusions
To appreciate the significance and construction of phase diagrams
To construct the iron carbon equilibrium diagram and identify different phases
To understand the properties of different metals resulting from different heat treatments

MODULE- I
Crystal Structure-Unit Cells, Crystal systems, BCC, FCC, and HCP structures, Coordination number and atomic packing factors Crystal Imperfection-Point, line and surface imperfections
Atomic Diffusion-Fick's laws of diffusion, Factors affecting Diffusion, Steady and non-steady state diffusions

MODULE-II
Dislocation
Characteristics of dislocations slip systems, slip in single crystals, Plastic deformation of polycrystalline materials, Deformation by twinning
Fracture
Types of fracture, ductile and brittle fracture, Ductile to brittle transition temperature Fatigue and creep Cyclic stresses, SN curves, crack initiation and propagation, Factors affecting fatigue life, Creep behavior Stress and temperature effects, Data extrapolation methods

MODULE-III
Phase Diagrams
Solid solutions, Hume Rothary rules-substitutional, and interstitial solid solutions, Intermediate phases, Gibbs phase rule, Construction of equilibrium diagrams, lever rule Iron carbon equilibrium diagram Description of phases, Solidification of steels and cast irons, Invariant reactions, TTT curves, Continuous cooling curves

MODULE- IV
Heat Treatment of Metals
Annealing and its types, normalizing, Hardening, tempering, Mar- tempering, Austempering, Hardenability, surface hardening methods like carburizing, cyaniding, Nitriding, Flame hardening and induction hardening. Age hardening of Aluminium –Copper alloys
Recovery, Recrystallization and Grain Growth Recrystallization temperature, Annealing temperature v/s cold-worked and recovered grains, Direction of grain boundary motion, time v/s grain diameter

MODULE- V
**Steels and cast irons** Ferrous alloys, steels – low medium and high carbon, AISI designation steels, Cast irons – types and properties **Composites and ceramics** Composite materials: definition, classification, Types of matrix materials & reinforcements, Application of composites, Ceramics: Glasses, Glass – ceramics, clay products, Refractories, abrasives and cements.

**Scheme of Examination:**
- Two full question (with a maximum of four sub question) of twenty marks each to be set from each module. Each question should cover all content of the respective module.
- Student has to answer five full question choosing one full question from the each module.

**Course outcomes:** The students should be able to
- Estimate the impact of imperfection on the property of the material
- Analyze steady and non-steady types of diffusion and solve related problems
- Construct the iron carbon diagram and TTT curves
- Estimate the hardness and other properties of metals obtained from different heat treatment processes
- Select the right iron-carbon alloy for any given application

**Text Books:**

**References:**
COMPUTER AIDED DESIGN AND MANUFACTURING (CAD / CAM)

Sub Code: 16IM/IP46
IA Marks: 20
Hrs / Week: 4Hrs
Exam: 3 Hrs
Total Hrs: 50
Marks: 80

MODULE 1

INTRODUCTION: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.

HARDWARE IN CAD: Basic Hardware structure, working principles, usage and types of hardware for CAD - input and output Devices, memory, CPU, hardcopy and Storage devices. 12Hrs

MODULE 2

COMPUTER GRAPHICS: Software configuration of a graphic system, function of a Graphics package, construction of geometry, wire frame and solid modelling, CAD/CAM integration. Describe modelling facilities. Introduction to exchange of modeling data – Basic features of IGES, STEP, DXF, DMIS.

NC, CNC, DNCTECHNOLOGY: NC, CNC, DNC< modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC. 12Hrs

MODULE 3

CNC TOOLING: Turning tools geometry, milling tooling systems, tool presetting, ATC work holding.

CAM PROGRAMMING: Overview of different CNC machining centers, CNC turning centers, high speed machine tools, MCE. 12 Hrs.

MODULE 4

CNC PROGRAMMING: Part program fundamentals – steps involved in development of a part program. Manual part programming, milling, turning center programming. 12 Hrs.

MODULE 5

INTRODUCTION TO ROBOTICS: Introduction, Robot Configuration, Robot Motions, Programming the Robots, Robot- Programming Languages, End effectors, Work Cell, Control and Interlock, Robot Sensor, Robot Applications. 12 Hrs

Text Books:
1. CAD / CAM Principles and Applications by P.N.Rao, TMH, New Delhi, 2002
2. CAD/CAM, Mikell P-groover, Emory W. ZimrnersJr Pearson Education inc, 2003

References:
6. CAD-CAM by Chris McMahon &Jimnie Browne -Pearson education Asia 2001
9. Introduction to FEM, T ChandraPattaAshokDBebgundu.

COURSE OBJECTIVES.

To provide the student to
1. know the fundamentals of CAD
2 information regarding various CAD hardware
3 understand the fundamentals of CAM
4 programming concepts in CNC
5 robotics and their applications

COURSE OUTCOMES

A student will be able to

1. understand the concepts of CAD and the required hardware
2 understand CAM and CNC machines
3 program CNC machines
4 Understand and program the robot
PART – A
1. Testing of Moulding sand and Core sand
Preparation of sand specimens and conduction of the following tests:
2. Permeability test
3. Core hardness & Mould hardness tests.
4. Sieve Analysis to find Grain Fineness 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: 20 marks
One question is to be set from either Part-B or Part-C: 40 marks
Calculation part in case of forging is made compulsory
Viva: 20 marks
MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY

Sub Code : 16IML/IPL 48A/ 47B  IA Marks : 20
Hrs/week : 03  Exam Hours : 03
Total Lecture Hrs : 48  Exam Marks : 80

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 SineCenter / 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 Part -A  30 Marks
ONE question from Instrumentation Part -B  30 Marks
Viva –Voce  20 Marks
Total  80 Marks