FLUID MECHANICS

Sub Code	**: 15IM/IP 32**	**IA Marks**	**: 25**
Hrs/week	**: 04**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 50**	**Exam Marks**	**: 100**

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.

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

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 andTEL(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 π theorem, dimensionless numbers, similitude(theory and no problems)

Introduction to compressible flow : Velocity of sound in a fluid, Mach nuber, Mach cone, propogation of pressure waves in a compressible fluid.onplates.

10 Hours

TEXT BOOKS:

1. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004.
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. Cingel 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

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

Sub Code: 15IM/IP 33
Hrs/ Week : 04 **Total Hrs. : 50**
Exam Hours : 03 **Exam Marks : 100**

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. 1**0 HOURS**

MODULE-2

Displacementwork; 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 andwithout 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

I.C. Engine: Testing of two stroke and four stroke SI and CI engines for performance Related numerical problems, heat balance, Motoring Method, Willian's line method, swinging field dynamometer, Morse test.
Real Gases: Introduction. Van-der Waal's Equation of state, Van-derWaal's constants in terms of critical properties, Law of corresponding states,compressiblity factor; compressibility chart. **10 HOURS**

TEXT BOOKS:

1. **Basic Engineering Thermodynamics,** A.Venkatesh, Universities Press, 2008
2. **Basic and Applied Thermodynamics,** P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002
3. **Thermal Engineering,R.K**, Rajput, Laxmi Publication

REFERENCE BOOKS:

1. **Thermodynamics**, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2002
2. **Engineering Thermodynamics**, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
3. **Fundamentals of Classical Thermodynamics**, G.J.VanWylen and R.E.Sonntag, Wiley Eastern.
4. **An Introduction to Thermodynamcis**, 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	**: 15IM/IP 34**	**IA Marks**	**: 25**
Hrs/week	**: 04**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 50**	**Exam Marks:**	**100**

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

MODULE2:

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.

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.

12Hours

MODULE 3

Interferometer and screw thread, gear measurement: Interferometer, interferemetry, autocollimator. Optical flats. Terminology of screw threads, measurementof major diameter, minor diameter, pitch, angle and effective diameter of screw threadsby 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear.to,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, hysterisis, 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

Measurement of force, torque and pressure: Principle, analytical balance,platform balance, proving ring. Torque measurement, Prony brake, hydraulicdynamometer. Pressure measurements, principle, use of elastic merijbers, Bridgemangauge, Mcloed gauge, Pirani gauge.

I

Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermo couple, 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:

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.

Mechanics of Materials

Code: 15 IM/IP 35	**Hours / week: 04**	**Total Hours: 50**
Exam hours: 03	**IA Marks: 25**	**Exam Marks: 100**

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.

[10 hours]

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).
Torsion of Circular Shafts: Introduction, Torsion equation – assumptions and derivation, Torsional rigidity / Stiffness of shafts. Power transmitted by solid and hollow circular shafts, Simple numerical problems.
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.

[10 hours]

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.

[10 hours]

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).

[10 hours]

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.

[10 hours]

Texts:

1. Fundamentals of Strength of Materials – P N Chandramouli; PHI Learning Pvt. Ltd., 2013
2. Strength of Materials – R K Rajput; S. Chand and Company Pvt. Ltd. 2014

References:

1. Mechanics of Materials – R C Hibbeler; Pearson, Latest edition
2. Mechanics of Materials - James M Gere; Thomson Learning, Latest edition
3. Mechanics of Materials - Ferdinand Beer, Russell Johston, John Dewolf, David Mazurek; McGraw Hill Education (India) Pvt. Ltd., Latest edition

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 15IM/IP 36 **Hrs/ Week : 03**

Total Hrs. : 40

Exam Hours : 03 **Exam Marks : 100**

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

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 patternallowances 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.**(09Hrs)**

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.

MouldingMachines : Jolt type, Squeeze type, Jolt & Squeeze type and Sandslinger.

Special moulding Process: Study of important moulding processes, No bakemoulds, Flasklessmoulds, Sweep mould, CO2 mould, Shell mould,Investment mould.**(08 Hrs)**

MODULE 3

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

Melting Furnaces: Classification of furnaces. Constructional features &working principle of coke fired, oil fired and Gas fired pit furnace, Resistancefurnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.**(08Hrs)**

MODULE 4

WELDING

Welding process: Definition, Principles, Classification, Application,Advantages & limitations of welding.

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

Gas Welding: Principle, Oxy – Acetylene welding, Chemical Reaction inGas welding, Flame characteristics. Gas torch construction & working.Forward and backward welding.**(09Hrs)**

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.**(06Hrs)**

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:

1. **"Manufacturing Process-I",** Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.

2. **"Manufacturing & Technology**: Foundry Forming and Welding",P.N.Rao, 3rd Ed., Tata McGraw Hill, 2003.

REFERENCE BOOKS:

1. **"Process and Materials of Manufacturing**", Roy A Lindberg, 4th Ed.
Pearson Edu. 2006.

2. **"Manufacturing Technology**", SeropeKalpakjian, Steuen. R. Sechmid,
Pearson Education Asia, 5th Ed. 2006.

MACHINE SHOP

Sub Code	**: 15 IML/IPL 37A / 47B**	**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**

METALLOGRAPHY AND MATERIAL TESTING LABORATORY

Sub Code	**: 15 IML/IPL 38A/ 48A**	**IA Marks**	**: 25**
Hrs/week	**: 03**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 48**	**Exam Marks**	**: 50**

PART – A

1. Preparation of specimen for Metallograpic 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