

## MECHANICAL MEASUREMENTS AND METROLOGY

**Sub Code** : 15IM/IP 32/42  
**Hrs/week** : 04  
**Total Lecture Hrs** : 50

**IA Marks** : 25  
**Exam Hours** : 03  
**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, 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**

**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 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, 6<sup>th</sup> 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

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. **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 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 at constant pressure.

**10 HOURS**

### MODULE-3

**APPLICATION OF FIRST LAW OF THERMODYNAMICS:** Extension of the First law to control volume; 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**

**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, compressibility 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, Yunus A. Cengel 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 Thermodynamics**, Y.V.C.Rao, Wiley Eastern, 1993,

5. **B.K Venkanna, Swati B. Wadavadagi "Basic Thermodynamics**, PHI, New Delhi, 201

## Mechanics of Materials

Code: 15 IM/IP 34  
Exam hours: 03

Hours / week: 04  
IA Marks: 25

Total Hours: 50  
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 - Lamé'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 Johnston, 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 35**

**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 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. **(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.

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

**Special moulding Process:** Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO<sub>2</sub> 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 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. **(08Hrs)**

#### **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**)

**Gas Welding:** Principle, Oxy – Acetylene welding, Chemical Reaction in Gas 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. (**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:**

1. **“Manufacturing Process-I”**, Dr.K.Radhakrishna, Sapna Book House, 5<sup>th</sup> Revised Edition 2009.
2. **“Manufacturing & Technology: Foundry Forming and Welding”**, P.N.Rao, 3<sup>rd</sup> Ed., Tata McGraw Hill, 2003.

**REFERENCE BOOKS:**

1. **“Process and Materials of Manufacturing”**, Roy A Lindberg, 4<sup>th</sup> Ed. Pearson Edu. 2006.
2. **“Manufacturing Technology”**, SeropeKalpakjian, Steuen. R. Sechmid, Pearson Education Asia, 5<sup>th</sup> Ed. 2006.

## Materials Science and Metallurgy

Sub Code: 15IM/IP 361

Hrs/ Week : 04

Total Hrs. : 54

Exam Hours : 03

Exam Marks : 100

### 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 Rothery 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, Martempering, 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:**

1. William D Callister, “An Introduction -Material’s Science and Engineering”, John Wiley and Sons India Pvt Ltd., 6th Edition, 2006 New Delhi.
2. Smith -Foundation of Material Science and Engineering, 3rd Edition, Mc Graw Hill, 1997.
3. Donald R Asklund, Pradeep.p.phule -Essentials of Materials for Science and Engineering, Thomson Engineering, 4th edition 2003.

### **References :**

1. V Raghavan -Physical Metallurgy, Principles and Practices, PHI, 2nd Edition 2006, New Delhi.
2. H. Van Black and Addison -Elements of Material Science and Engineering, Wesley Edition,1998.
3. James F Shackelford -Introduction to Material Science for Engineering, 6th edition
4. Pearson Prentice hall, New Jersey,2006.

## ENERGY ENGINEERING

Subject Code : 15IM/IP 362  
Hours/Week : 03  
Total Hours : 38

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

### MODULE - 1

**Steam Power Plant:** Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures. **08 Hours**

### MODULE - 2

**Hydro-Electric Plants:** Hydrographs, flow duration and mass curves, unit hydrograph and numericals. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants. **06 Hours**

### MODULE - 3

**Nuclear Power Plant:** Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio active waste disposal. **08 Hours**

### MODULE - 4

**Solar Energy:** Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion (Numerical Examples).

**Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor (Numerical Examples). **08 Hours**

### MODULE - 5

**Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

**Ocean Thermal Energy Conversion:** Principle of working, Rankine cycle, problems associated with OTEC.

**Geothermal Energy Conversion:** Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy. **08 Hours**

### TEXT BOOKS:

1. **Power Plant Engineering**, P. K. Nag Tata McGraw Hill 2nd edn 2001.
2. **Power Plant Engineering**, Domakundawar, Dhanpath Rai sons. 2003

**REFERENCE BOOKS:**

1. **Power Plant Engineering**, R. K. Rajput, Laxmi publication, New Delhi.
2. **Principles of Energy conversion**, A. W. Culp Jr., McGraw Hill. 1996
3. **Non conventional Energy sources**, G D Rai Khanna Publishers.
4. **Non conventional resources**, B H Khan TMH – 2007.

**Course Objectives**

To provide the student

- 1 with understanding of hydel power plants and steam power plants
- 2 an understanding of nuclear power plants and various parameters
- 3 to understand non-renewable sources like solar and wind power plants
- 4 to understand further non-renewable sources like tidal and geo thermal plants

**Course Outcomes**

A student will

- 1 understand the working of steam power plants
- 2 examine the possibility of a Hydel power plant and the working of it.
- 3 understand the working of a nuclear plant and the various factors affecting it.
- 4 understand the working of renewable energy plants

## NON DESTRUCTIVE TESTING

**Sub Code: 15IM/IP 363**

**Hrs/ Week : 04**

**Exam Hours : 03**

**Total Hrs. : 40**

**Exam Marks : 100**

**Course objectives:** Students will get an insight on different non-destructive testing techniques and application in various industries

### MODULE 1

**Introduction to ND testing:** selection of ND methods, leak testing, Liquid penetration inspection, its advantages and limitation. **8 Hrs**

### MODULE 2

**Magnetic particle inspection:** Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection

**Optical Holography:** Basics of Holography, recording and reconstruction - Acoustical Holography: systems and techniques applications. **8 Hrs**

### MODULE 3

**Eddy current inspection:** Principles, operation variables, procedure, inspection coils, and detectable discontinuities by the method. **8Hrs**

### MODULE 4

**Ultrasonic inspection:** Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplants, search units, contact types and immersion types inspection standards **8 Hrs**

### MODULE 5

**Radiography inspection:** Principles, Radiation sources- X-rays and gamma rays, X-ray tube, radiographic films, neutron radiography, equipment inspection methods applications. **8 Hrs**

### Course Outcome:

**Upon completing this course, the students should be able to:**

1. Know the basic concepts of NDT.
2. Detect discontinuities using magnetic particle inspection techniques.
3. Use the principles of eddy current inspection for the detection of discontinuities.
4. Learn the concepts of ultrasonic inspection by different methods for the detection of defects.
5. Evaluate the defects using radiography and its techniques
6. Understand the concepts of optical holography for the detection of defects by using different methods.

### 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.**

**Books:**

1. Mc Gonnagle JJ” Non Destructive testing” – Garden and reach New York
2. Non destructive Evolution and quality control” volume 17 of metals hand book 9 edition 1989
3. Davis H.E Troxel G.E wiskovil C.T the Testing instruction of Engineering materials” Mc graw hill.





- **Student has to answer five full question choosing one full question from the each module.**

**Course Outcome:**

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

- Identify & use the correct material for relevant industrial application.
- Know the various types of composites with fibers and fillers
- Manufacture different composites using techniques
- Test composites used non-destructive testing
- Manufacture metal matrix composites and characterize
- Characterize composites using sophisticated instruments

**Books:**

1. Chawla K K “Science and Engineering” Composite Materials 2nd edition, Springer- 1988.
2. William D Callister, R Balasubramaniam, Materials Science and Engineering Wiley India (Pvt) Ltd., 2007
3. Raymond and Higgins, Engineering Metallurgy, ELBS/EA
4. James.F.shackleford – Introduction to Material Science and Engineering, Mc Millan, NY
5. Powder Metallurgy-Metals Hand Book, Vol.7, ASM,USA,1997
6. Chawla K.K., ‘Composite Materials’ – Science and Engineering’ — verlag, Newyork
7. P.K. Rohagti “Cast Metal matrix composites, ASM Metals Hand Book, V15.
8. Van Vlack L.H. “Elements of Material science and Engineering, Addison Wesley, NY

## FOUNDRY AND FORGING LABORATORY

<b>Sub Code</b>	<b>: 15 IML/IPL 37 / 47</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Lecture Hrs</b>	<b>: 48</b>	<b>Exam Marks</b>	<b>: 50</b>

### 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 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: 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 + Foundry = 05 + 25 = 30 Marks

(Forging) Model

Calculation + Forging = 05 + 25 = 30 Marks

(Forging) Model

## METALLOGRAPHY AND MATERIAL TESTING LABORATORY

**Sub Code** : 10 IML/IPL 38 / 48  
**Hrs/week** : 03  
**Total Lecture Hrs** : 48

**IA Marks** : 25  
**Exam Hours** : 03  
**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
<b>ONE question from part -B:</b>	<b>20 Marks</b>
Viva -Voice:	10 Marks
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Total:	50 Marks

## FLUID MECHANICS

<b>Sub Code</b>	<b>: 10IM/IP 32/ 42</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Lecture Hrs</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 100</b>

### 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. Darcy'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:**

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. 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, 5<sup>th</sup> 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.

## COMPUTER AIDED MACHINE DRAWING

<b>Sub Code</b>	<b>: 15IM/IP 43</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Lecture Hrs</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 100</b>

### MODULE 1

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.

**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

**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**

### 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:**

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', GoutamPohit&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.



## KINEMATICS OF MACHINES

**Sub Code** : 10IM/IP 44  
**Hrs/week** : 04  
**Total Lecture Hrs** : 50

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

### 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.

**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.

**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:**

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

**CODE 15IM/IP 45**

**Hrs/ Week : 03**

**Total Hrs. : 43**

**Exam Hours : 03**

**Exam Marks : 100**

## **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**

Classification of metal removal process and machines: Concept of orthogonal and oblique cutting Geometry of single point cutting tool and tool angles, tool nomenclature. Mechanism of Chip Formation: Type of chips. Mechanics of metal cutting, Merchant's circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. (09Hrs)

### **Module 2**

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

### **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. **(09Hrs)**

#### **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).

**Broaching process** - Principle of broaching. Details of a broach. Types of broaching machines - constructional details. Applications. Advantages and Limitations. **(08Hrs)**

#### **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. **(09Hrs)**

#### **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 the each module.**

**Text Books:**

1. Elements of Workshop Technology: Machine Tools (Volume – 2) by S. K. HajraChoudhary, A. K. HajraChoudhary, Nirjhar Roy, Media promoters (2010).
2. Manufacturing Processes for Engineering Materials, 4th Edition by Serope Kalpakjian, Steven R. Schmid, published by Pearson (2007).
3. Fundamentals of Metal Machining and Machine Tools by G. Boothroyd, McGraw Hill, 2000.

**Suggested Readings**

1. Lal G.K., Introduction to Machining Science, New Age international Publishers.
2. Ghosh, A., & Mallik, A. K. , Manufacturing Science, East West Press Private Limited.
3. Pandey & Singh, Production Engineering Science, Standard Publishers Distributer, Delhi.
4. Karl H. Heller, All About Machine Tools, Wiley Eastern Ltd., New Delhi
5. Sen, G. C., & Bhattacharyya, A. Principles of Machine Tools: New Central Book Agency
6. Bhattacharyya A, Theory & Practice of Metal Cutting, New Central Book Agency
7. Trent, E. M. Metal cutting: Butterworth Heinemann
8. Stephenson, D. A., & Agapiou, J. S. Metal cutting theory and practice: CRC Taylor & Francis.
9. Milton C. Shaw, Metal Cutting Principles, CBS Publishers.

# ADVANCES IN JOINING OF MATERIALS

**Sub Code: 15IM/IP 461**

**Hrs/ Week : 03**

**Total Hrs. : 40**

**Exam Hours : 03**

**Exam Marks : 100**

## **Course objective:**

This course will help students to get the advances in the area of metal joining process and the engineering materials used considering both destructive and non-destructive test under various conditions.

### **MODULE 1**

**Thermal Effects of Welding:** Grain size Control, Micro structure control, Internal Stresses, control, Distortion, methods to avoid distortion. Stresses in Joint Design.

**Welding and Cladding of dissimilar materials,** overlaying and surfacing different methods and applications, thermal –Spray coating or metalizing. **08hrs**

### **MODULE 2**

**Types of Welding:** Forge welding, Electro Slag Welding, Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding. **8 hrs**

### **MODULE 3**

**Weldability of metals** like stainless steel, Cast iron, Copper, and Aluminium.

Advanced soldering and brazing processes-different types. Welding of plastics- different methods. **08 hrs**

### **MODULE 4**

**Welding design-** principles of sound welding design, welding joint design, welding positions, Allowable strength of welds under steady loads, allowable fatigue strength of welds, Design of welds subjected to combined stresses. **08 hrs**

### **MODULE 5**

**Welding symbols-**Need for representing the welds, Basic weld symbols, location of weld, supplementary symbols, dimensions of weld, examples

**Adhesive bonding:** adhesive materials and properties, non-structural and special adhesives, surface preparation and joint design considerations .

**. 08 Hrs**

## **Course Outcome:**

**Upon completing this course, the students should be able to:**

- Understand the importance of grain size control, methods to avoid destruction and residual stresses. Also know the techniques of surfacing and cladding of surface
- Interpret and understand the advantages and limitations of different advanced welding process knowing fully the characteristic features, identify research topics in the wear of welding and related processes
- Explain the weld ability of engineering materials and the advanced soldering and brazing processes
- Know the different techniques of welding of plastics

- Inspect to welds in accordance with ASTM standards employing both destructive and non-destructive methods represent the weldment with standard symbols
- Design welds for various conditions or loads and explain the method of adhesive bonding

**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.**

**Books:**

1. Welding Engineering Handbook by A.W.S. Ninth Edition
2. Advanced Welding processes – G.Nikolaev&N.Olshansky, MIR Publications 1977.
3. Welding Technology by O.P. Khanna, Dhanpat Rai Publication 2008
4. Welding and welding Technology by Richard Little Tata Mc Graw hill 2005.
5. ASM handbook on welding, brazing and soldering, vol 6, 2005.

## COMPUTER AIDED DESIGN AND MANUFACTURING ( CAD / CAM )

Sub Code: 15IM/IP 461

IA

Marks: 25

Hrs / Week: 3 Hrs

Exam: 3 Hrs

Total Hrs: 40

Marks: 100

### 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. **10 Hrs**

### 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, DNC TECHNOLOGY :** NC, CNC, DNC modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC. **10 Hrs**

### 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. **10 Hrs.**

### MODULE 4

**CNC PROGRAMMING:** Part program fundamentals – steps involved in development of a part program. Manual part programming, milling, turning center programming. **10 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. **10 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. Zimmermann Jr Pearson Education inc, 2003

#### References :



1. Introduction to the Design and Analysis of Algorithms -S.E.Goodman, S.T. Headetmiemi, McGraw Hill Book Company -1988
2. Principles of Interactive Computer Graphics by Newman and Sproull, Tata McGraw Hill, 1995
3. NC Machine programming & software Design -Chno-Hwachang, Michel.A. Melkanoff, Prentice Hall, 1989.
4. Numerical control and CAM, Pressman RS and WilliamsJE, JohnWiley.
5. Computer Graphics by Steven Harrington, McGraw Hill Book Co.
6. CAD-CAM by Chris McMahan & Jimrnie Browne -Pearson education Asia 2001
7. CAD/CAM -IbrahimZeid, Tat McGraw Hill, 1999
8. Computer Aided Manufacturing by P.N.Rao, N.K.Tewari and T.K. Kundra Tata McGraw Hill 1999.
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

# **Mechatronics**

**Sub Code: 15IM/IP 463**

**Hrs/ Week : 03**

**Exam Hours : 03**

**Total Hrs. : 40**

**Exam Marks : 100**

**Credits: 3:0:0**

## **Module 1:**

**Introduction to Mechatronics:** Introduction to mechatronics systems, Measurement system, control systems, microprocessor based controllers, need for mechatronics in industries, scope of mechatronics. Introduction to manufacturing systems: Total quality management, just in time techniques, cellular manufacturing, group technology, computer integrate manufacturing and flexible manufacturing systems. 8 Hrs

## **Module 2**

**Basic electronics, mechanical and electrical systems:** Electron, voltage, current, resistance, alternating current, direct current, inductance, capacitance, transformer, semiconductors, transistors, junction diodes. Force, moment, couple, friction, rolling friction, inertia, stress, strain, bending, theory of metal cutting, chip formation and cutting forces. Resistors, inductors, capacitors, Reactance and impedance 8 Hrs

## **Module 3:**

**Sensors & Transducers:** Introduction to sensors & transducers, performance terminology, Displacement, position & proximity LVDT light sensors, half effect sensors selection

**Electrical actuation systems:** Electrical systems, Mechanical switches, solid state switches, solenoids DC & AC motors, stepper motors and their merits and demerits

8 Hrs

## **Module 4**

**Signal conditioning:** Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, digital signals Multiplexers, data acquisition, Introduction to Digital system processing pulse modulation, Numerical problems

8 Hrs

## **Module 5**

**CAD/CAM/Robotics:** definition of cad and its importance, design process, classification of geometric modelling, hardware in CAD, numerical control process, advantages and disadvantages of NC, application of NC, NC motion control system, definition of robots, necessity of robots, robot physical configuration, application of industrial robots.

8 Hrs

## **TEXT BOOKS:**

1. **Mechatronics**, W.Bolton, Longman, 2Ed, Pearson Publications,2007.

2. **Mechatronics**, G S Mahajanshettar, H Pakirappa, Sudha publications.

**Reference books**

1. **Mechatronics and Microprocessors**, K.P.Ramchandran,.G.K.Vijayraghavan, M.S.Balasundran, Wiley, 1st Ed, 2009
2. **Mechatronics - Principles, Concepts and applications** – Nitaigour andPremchandMahilik - Tata McGraw Hill- 2003.
3. **Mechatronics Principles & applications**, Godfrey C. Onwubolu, Elsevier.

## Modern Machining Methods

**Sub Code: 15IM/IP 464**

**Hrs/ Week : 04**

**Exam Hours : 03**

**Total Hrs. : 54**

**Exam Marks : 100**

**Course objectives:** The student will be able  
To understand the classification of nontraditional machining methods.  
To learn the effect of parameters and principle of Nontraditional machining.  
To study the applications of nontraditional machining processes.

### MODULE-I

**Modern machining processes:** Need of modern machining processes, Classification of modern machining processes, physical parameters, process capabilities. **Ultrasonic Machining:** Introduction, ultrasonic machining process, Elements of process, Effects of parameters, Applications.

### MODULE-II

**Abrasive Jet Machining:** Introduction, Abrasive Jet machining process, Variable in AJM, Advantages, Disadvantages and Applications. (no problems) **Chemical Machining:** Introduction, elements of process, material removal, types of chemical machining, maskant, etchant- cut and peel, screen printing and photo resist etchants.

### MODULE-III

**Electrochemical machining:** Introduction, Principle, Element of ECM process, electrolyte, the process and metal removal rate, Tool design, Advantages, Applications and limitations. (no problems).

### MODULE-IV

**Electric discharge Machining:** Introduction, Principle, Mechanism of metal removal, Electrode feed control, Metal removal using relaxation circuit, Electrical parameters in R C circuits, Dielectric fluid, Flushing, Selection of electrode materials, surface finish, characteristics of spark eroded surfaces, applications. ( no problems).

### MODULE-V

**Plasma arc machining:** working principle, cutting systems, parameter of PAM, Air plasma torch, water injected, oxygen injection torch, dual gas plasma torch, Applications. **Laser Beam Machining:** Introduction, Principle, Apparatus, Material removal, advantages and limitations, Applications.

**Course outcomes:** The students should be able to,  
Apply knowledge of basic science and engineering fundamentals, in depth technical competence in at least one engineering discipline.  
Utilize a systems approach to design and operational performance.  
Design and implement the digital control techniques in microcontroller and microprocessors.  
Select and integrate appropriate sensors, actuators and control hardware through an understanding of electro-mechanical systems and processes in CNC machines.  
Apply the concept of actuators and to design.

**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.**

## MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY

<b>Sub Code</b>	<b>: 15IML/IPL 37 / 47</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Lecture Hrs</b>	<b>: 48</b>	<b>Exam Marks</b>	<b>: 50</b>

### 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 Metrology (part -A)	20 Marks
ONE question from Instrumentation (part -B)	20 Marks
Viva –Voce	10 Marks
<b>Total</b>	<b>50 Marks</b>

## MACHINE SHOP

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

### 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
<b>Total</b>	<b>50 marks</b>

