

## SEMESTER-III

### NUMERICAL ANALYSIS AND PROGRAMMING (MA 3103)

Numerical computation and error, solution of algebraic and transcendental equations-Bisection method, Regula-Falsi method and Newton-Raphson method and their order of convergence. Iterative methods for system of non-linear equations. Linear system of equations: Gauss elimination method, Crout's method, Jacobi's method, Gauss-Seidel method. Computer programming of above methods.

Finite differences, difference operators and symbolic relations, difference of a polynomial, Interpolation, error in interpolation, Newton's forward and backward formulae, Lagrange's interpolation formula, Newton general interpolation formula, Numerical differentiation, error in numerical differentiation. Numerical integration: Newton's cote's formula, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule and their error estimation. Computer programming of above methods.

**Ordinary differential equations:** Taylor's series method, Euler's method, Euler's modified method, Runge-Kutta method, Boundary value problem-linear and non-linear equations. Computer programming of above methods.

### MATERIAL SCIENCE (A) (ML 3101)

1. Atomic Bonding:- Classification of Engineering Materials, Ionic, Covalent, Metallic and Vander Walls Bonding. Effect of types of Bonding on properties of materials.
2. Structure of Solids:- Crystalline Solids, Crystal System, Unit Cells, Space Lattice, Miller Notations, Structure in Metallic Elements, Ionic and Molecular Crystals, Imperfection in Crystals.
3. Introduction to Iron Carbon Diagram and Principles of Heat Treatment. Annealing, Normalizing, Hardening, Tempering, T-T-T Diagram etc. recovery, recrystallisation and grain growth. White Cast Iron, Grey, Spheroidal Graphite, Malleable Cast Iron, their properties and applications.

4. Brief Introduction to Polymer, Ceramics, Composite Materials and Their Application as Engineering Materials.

### **MATHEMATICS – III (MA 3104)**

LAPLACE TRANSFORMATION :- Definition of Laplace transform and linearity and shifting property, Laplace transform of elementary functions, Inverse Laplace transform, Laplace transform of derivative and integration, convolution theorem, Solution of differential equation by Laplace transform, Unit Step function, Unit impulse function.

VECTOR CALCULUS :- Differentiation of vector function, gradient, divergence, curl and their geometrical or physical interpretation, Line, Surface and Volume integrals, Statement of Green's Theorem, divergence theorem and Stoke's theorem and their applications. Curvilinear co-ordinates.

FOURIER SERIES :- Fourier series, Dirichlet's conditions, Half Range series.

FOURIER TRANSFORM :- Definition of Fourier Transform, linearity, shifting, frequency theorem, Fourier transform of derivatives and Dirac-delta function, Inverse Fourier transform, Fourier Sine and Cosine transform, Solution of simple differential equation by Fourier transform method.

Z- TRANSFORMATION :- Definition, Z-transformation of standard sequences, linearity property, Shifting theorem, inverse of Z-transformations, Scaling property of Z-transformation, differentiation of Z-transformation, convolution of sequences, solution of difference equations by Z-transformation.

### **MECHANICS OF SOLIDS – I (ME 3103)**

Introduction and fundamental concepts: Introduction purpose and scope of the subject. Generalized procedure, Basic assumption, Types of forces (External and Internal forces), method of sections, constitutive laws, Elastic material, principle of superposition, St. Venant's Principle, Tensile test, Generalized Hook's law for isotropic and linear elastic material.

Simple stress and strain : Uniaxial tension or compression of a bar (prismatic and non prismatic) Cases of simple shear, shear strain components in terms of shear

stress. Bi-axial and tri-axial tension or compression. Thermal stress and strain. Statically determinate system of bars in tension (or compression), thin walled pressure vessels. Cylindrical and spherical shells.

Shearing force and Bending moment : Use of singularity functions in drawing B.M.D. and S.F.D.

Stress due to bending : Pure bending of beams. Normal stress and shear stress distribution in a beam subjected to both B.M. and S.F.

Deflection due to bending, Double integration method, Moment area method. Torsion : Torsion of solid and hollow circular shaft. Torsion of hollow thin walled shaft. Closed coiled spring Flanged coupling.

Two-dimensional stress analysis : Plane stress, stress components on a general plane at a point. Mohr's circle of stress.

Cases of combined loading : Bending with tension (or compression). Eccentrically loaded member ; Core of section, Torsion and shear. Torsion and bending. Cases of Transmission shafts subjected to bending tension or axial thrust.

Elastic strain energy and its application. Elastic strain energy of a rod under various kinds of loading. Elastic strain energy for various states of stress. Simple application. Castigliano's theorem.

## **THERMODYNAMICS (ME 3104)**

(1) IDEAL CYCLES: Otto, diesel, dual and joule cycles, comparison of cycle efficiencies.

(2) VAPOUR CYCLES: Carnot and Rankine cycle (use of Mollier chart). Rankine cycle efficiency improvement.

(3) NON-REACTING MIXTURES:  
Mixtures of ideal gases, Dalton's law, mixtures of ideal gases and vapour, psychrometry, adiabatic saturation temperature, DBT and WBT, humidity, degrees of saturation, use of psychrometry, processes including air-vapour mixtures, evaporative cooling.

(4) COMBUSTION\_:

Combustion processes, stoichiometric reaction equation, mass balance, complete and incomplete combustion analysis, enthalpy and internal energy of reaction equation, mass balance, complete and

incomplete combustion analysis, enthalpy and internal energy of reaction, enthalpy of formations, flue gas analysis, Orsat apparatus, higher and lower heating values of fuels.

(5) Fuel cells, solar cells and solar collectors, MHD converters.

## **KINEMATICS OF MACHINERY (ME 3105)**

### **BASIC KINEMATIC CONCEPTS:**

Links, kinematic pairs, kinematic chains, mechanism and inversions, single and double slider crank chains, straight line motion mechanism.

### **VELOCITY AND ACCELERATION IN MECHANISMS:**

Relative velocity methods, instantaneous centre of rotation, centroids, Kennedy theorem of three centres, acceleration diagram, acceleration centre, coriolis components.

### **FRICTION DEVICES**

Introduction to friction, belt, chain and rope drives. Transmission of power through friction clutch. Theory of shoe-brakes, band and block brakes.

### **FUNDAMENTAL LAW OF GEARING:**

Classification of gears and basic terminology, geometric and kinematic characteristics of involutes and cycloid tooth profiles, under cutting and interference in gears.

### **GEAR TRAINS:**

Simple, compound and planetary, tooth load and torque.

### **BALANCING:**

Balancing of revolving masses in the same plane by a single revolving mass, balancing of several revolving masses in different planes by two revolving masses in suitable planes.

### **GOVERNORS:**

Watt, Porter, Proell and Hartnell governors, effect of friction, controlling forces, governor effort and power, sensitivity and isochronism.

## **SEMESTER-IV**

### **MATHEMATICS – IV (MA 4105)**

**SPECIAL FUNCTIONS** :- Series solution of differential equations, Bessel and Legendre's equations and their series solution, elementary properties of Bessel's function and Legendre's polynomial.

**COMPLEX VARIABLE**:- Analytic function, Cauchy- Riemann equation. Complex Integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion. Poles and Residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations.

**PARTIAL DIFFERENTIAL EQUATION** :- Formulation of partial differential equation, Linear and non-linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems.

### **PROBABILITY AND STATISTICS (MA 4106)**

**Probability**: classical and axiomatic definitions, addition law, conditional probability, multiplication law, total probability, Baye's theorem and independence of events.

Random variables: Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions. Mathematical expectation, variance, moment and moment generating function, Chebyshev 's inequality.

Regression Analysis: Linear regression, principle of least square, non-linear regression, correlation, coefficient of correlation, Rank correlation.

Distributions: Binomial, Hypergeometric, Geometric, Poisson and Normal distributions.

Sampling Distribution: Population samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, Testing of hypothesis, the critical and acceptance region, two type of errors, Chi-square, t-student and F distributions.

Analysis of Variance: completely randomized design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart).

## **FLUID MECHANICS(ME 4107)**

### **INTRODUCTION:**

Concept of continuum, difference between fluid mechanics and solid mechanics, brief history of classical hydraulics, hydrodynamics and fluid mechanics.

Characteristic properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids viscosity, surface tension, capillarity, compressibility, fluid statics and buoyancy.

### **FLUID KINEMATICS:**

Streamlines, path lines, streak lines, velocity potential functions and stream functions, laminar and turbulent flows, steady and unsteady flow, rotational and irrotational motion, circulation, vorticity, velocity and acceleration.

### **FLUID DYNAMICS:**

Conservation of mass, principle of momentum and energy, moment of momentum, equation of motion, Euler's equation, and introduction to Navier-Stokes equation, energy equation, hydraulic and energy gradients.

LAMINAR FLOW:

Flow through pipes, frictional and other losses.

TURBULENT FLOW:

Fully developed flows, boundary layer theory, rough and smooth pipe flows.

DIMENSIONAL ANALYSIS:

Similitude of fluid flows, hydraulic modeling, non-dimensional parameters(Reynolds's, Froude's, Euler, Weber and Mach numbers)

FLOW MEASUREMENTS:

Piezometer, manometers, pressure gauges, pitot tube, orifices, notches and weirs, orifice meter, venturimeter.

FORCES ON IMMERSED BODIES:

Drag and lift, aerofoil section.

## **FLUID MACHINES (ME 4108)**

INTRODUCTION: application of the moment and moment of momentum equations to flow through hydraulic machinery. Euler's fundamental equation. Classification of machine.

WATER TURBINES: classification of turbines, impulse turbine. Constructional details. Velocity triangles. Power and efficiency calculations. Governing of pelton wheels. Reaction turbines: Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube. Cavitation. Thoma's cavitation factor.

PRINCIPLE OF SIMILARITY: unit and specific quantities, performance characteristics. Testing of models and selection of water turbines.

RECIPROCATING AIR COMPRESSORS: P-V diagram. Calculation of isothermal and adiabatic work. Free air delivery. Slippage. Volumetric efficiency. Effect of clearance. Multi-stage compression, inter-cooling.

ROTARY COMPRESSORS: Introduction, rotary positive displacement compressors, static and total head values. Centrifugal compressors and their performance. Axial flow compressors – polytropic efficiency. Surging, choking and stalling. Fans and blowers.

ROTODYNAMIC PUMPS: Classification, centrifugal pump. Vector diagram, specific speed. Head, power and efficiency calculation. Performance characteristics – special types of pumps.

**POSITIVE DISPLACEMENT PUMPS:** Reciprocating pump, theory, indicator diagram, slip. Effect of friction and acceleration. Theory of air vessels, gear, vane and screw pumps.

**OTHER MACHINES:** Hydraulic accumulator, intensifier, Ram and press.  
**HYDRAULIC POWER TRANSMISSION:** Theory of hydraulic couplings and torque converters, operating characteristics and common uses.

### **MANUFACTURING TECHNOLOGY – I (ME 4109)**

**FOUNDRY PROCESSES & CASTING:** Types of patterns, pattern allowances, types of moulds, sand preparation and sand test, preparation of moulds.  
Furnaces – electric furnaces, cupola.  
Cores – uses of cores, chills, chaplets.  
Gating design – aspiration effect and effect of friction and velocity distribution.  
Design of risers and gates. Dry sand mould casting, shell mould casting, investment casting, gravity die casting, metal mould casting, die casting, slush casting, centrifugal casting, CO<sub>2</sub> casting  
Casting defects, causes and remedies.  
Finishing of casting and inspection.

#### **MECHANICAL WORKING OF METALS:**

Hot working and cold working, its advantage, disadvantages and applications, rolling, forging, Wire drawing, extrusion, punching and blanking, piercing, spinning, coining, embossing, thread cutting and tube drawing.

#### **WELDING, BRAZING AND SOLDERING:**

Principles, process, parameters and application of gas welding, arc welding, TIG, MIG welding, Thermite welding, Electron beam welding, Laser beam welding, Submerged arc welding, Electro slag welding.  
Fluxes for gas welding and for arc welding. Electrode classification and selection, atomic hydrogen welding, selection of welding technique, filler metal, welding for the following metals – cast iron, aluminum, and copper, and their alloys, resistance welding, defect in welding, inspection – destructive and non-destructive test, equipment, application of soldering and brazing.

#### **HEAT TREATMENT OF METALS:**

Allotropic and non-allotropic alloys, heat treatment processes, heat treatment of carbon steel with reference to iron-carbon diagram and TTT ( Time Transformation and Temperature) curve. Defect in heat treatment and their remedies. Austempering and Martempering. Surface hardening of steel, heat treatment of high speed steel.



#### **POWDER METALLURGY:**

Principles, method of producing powder, pressing, sintering and finishing operations, applications.

#### **CAD G (ME 4110)**

##### **INTRODUCTION:**

CAD/CAM, Product cycle and CAD/CAM, Automation & CAD/CAM.  
Fundamental of CAD : The design process, Application of computers for design, creating a manufacturing data base, benefits of Computer Aided Design.

##### **HARDWARE IN COMPUTER AIDED DESIGN:**

Introduction, The Design work station, The graphics terminal, Operator Input Devices, Plotters and other output Devices. The central processing unit, secondary storage.

##### **COMPUTER GRAPHICS SOFTWARE AND DATA BASE:**

Software configuration of graphic system, Functions of a graphic package, Construction the geometry, Transformations, Data Base structure and content, wire-frame and solid modeling.

## **SEMESTER-V**

#### **HEAT AND MASS TRANSFER (ME 5112)**

**INTRODUCTION:** Modes of heat transfer – conduction, convection and radiation.

**CONDUCTION:** Fourier law, thermal conductivity of solids, liquids and gases, factors influencing thermal conductivity, general three dimensional heat

conduction equations in Cartesian and cylindrical co-ordinates.

ONE DIMENSIONAL STEADY: state conduction through plane walls, cylinder and spheres, flow through composite walls, cylinders and spheres, critical thickness of insulation. Heat conduction with internal heat source through plane walls and cylinders, different types of fins, heat transfer from fins of uniform cross-section.

TWO DIMENSIONAL STEADY : state conduction through plane walls, one dimensional unsteady state heat conduction, heat capacity systems, heat flow in a semi-infinite solid with sudden change of surface temperature, periodic changes of surface temperature.

CONVECTION: free and forced convection – basic concept of hydrodynamic and thermal boundary layers – laminar and turbulent boundary layer over a flat plate – equation of motion and energy. Heat transfer through tubes, constant wall temperature and constant heat flux (empirical relations) similarity conditions of heat transfer, Reynolds analogy. Application of dimensional analysis – empirical relations of convective heat transfer (free and forced).

FUNDAMENTALS OF BOILING HEAT TRANSFER: pool, nucleate and film boiling. Heat transfer in condensations drop wise and flow wise (empirical equations).

RADIATION: thermal radiations – monochromatic and total emissive power , absorptivity, reflectivity, transmissivity, black and grey bodies, Planck's law, Wien's law, Stefan-boltzman's law, Kirchoff's law, heat transfer by radiation between black and grey surfaces, electric network methods of solving radiation problems, radiation shields, shape factor.  
Heat Exchanger – Counter and parallel types, LMTD, NTU effectiveness, efficiency.

MASS TRANSFER: introduction – Fick's law of diffusion- diffusion coefficient, analogy between heat and mass transfer, elementary problems.

## **MECHANICS OF SOLIDS –II (ME 5113)**

STRAIN ENERGY: strain energy due to bending and shear. Castigliano's theorem, application to the deflection and rotation of the beam, deflection of

simply supported beam and cantilever beam due to shear.

**THICK CYLINDERS AND SPHERES:** thick cylinders, radial and hoop stresses, application of compound stress theories, compound cylinders, thick spherical shells – radial and circumferential stress.

**ROTATION OF RINGS AND DISCS:** thin disc of uniform thickness. Radial and hoop stresses. Disc with central holes, disc of uniform strength.

**THEORIES OF YIELDING:** different theories of failure, comparison of theories of failure.

**UNSYMMETRICAL BENDING :**

Flexural stresses due to unsymmetric bending of beam.

**SHEAR CENTRE :**

Shear centre for thin walled open cross section, shear flow.

**BEAM WITH LARGE ORIGINAL CURVATURE:**

Stress in crane hooks, ring and links.

**ANALYSIS OF STRAIN:**

Principal strain, mohr's circle of strain.

**FATIGUE:**

The fatigue of metals, Bauehinger's experiment, strain method of obtaining fatigue range's formulae connecting stress range, maximum stress and ultimate strength, S-N curve, Gerber's formula, Goodman's law.

**CREEP:**

Creep of metals, mechanism of creep, equicohesive temperature, creep curve, creep rate, prediction of long time properties from short duration test.

## **APPLIED THERMODYNAMICS (ME 5114)**

**BOILERS:**

Classification, boiler mounting and accessories, draft system, calculation of chimney height, induced and forced draft fans, equivalent evaporation, boiler efficiency and heat balance, high pressure boilers, Steam Calorimeter.

#### STEAM ENGINE:

Construction and working of simple steam engines, ideal and actual indicator diagram, diagram factor, mechanical efficiency and estimation of cylinder dimension, missing quantities, governing and performance, William's line.

#### STEAM NOZZLE:

Flow through nozzles, shape and flow area, effect of friction, wet and supersaturated flow, estimation of flow area.

#### STEAM CONDENSER:

Type, cooling water requirement, air leakage and air pump capacity, vacuum and condenser efficiency, steam injector, spray pond and cooling tower.

#### STEAM TURBINE:

Construction and working of steam turbines, impulse and reaction turbines, inlet and outlet velocity diagrams – work output and efficiency, pressure and velocity compounding, regenerative and reheat cycles, back pressure and pass-out turbines.

#### REFRIGERATION:

Refrigeration machine, heat pump, COP, unit of refrigeration, ideal refrigeration cycles, bell-colemon air refrigeration systems.

#### VAPOUR REFRIGERATION SYSTEMS:

Simple vapour compression refrigeration cycles, wet and dry compression, sub-cooling and superheating, actual vapour compression cycles, flash chamber and accumulator, vapour absorption refrigeration cycles, electro lux refrigerator.

### **ENGINEERING ECONOMICS AND MANAGEMENT (ME 5115)**

#### ENGINEERING ECONOMY:

(a) Simple and compound interest, annuities (b) depreciation: cause and methods (c) comparison of alternative and replacement studies: (i) equivalent annual cost method, (ii) present worth method, (iii) rate of return method.

#### ACCOUNTING :

(a) Double entry book keeping, (b) journal, (c) ledgers, (d) manufacturing account: profit and loss accounts, (e) balance sheet.

#### COSTING:

(a) cost and cost accounting, elements, (b) break even analysis, determining selling price and profitability, (c) over-head cost allocation, (d) costing system, job costing, unit costing, process costing, operating cost, departmental cost, (e) cost

control : actual and standard cost, budget and budgetary control.

#### ENTREPRENEURSHIP DEVELOPMENT :

(a)Introduction to entrepreneurship, (b) motivation, (c) psychological factors, risk taking behavior, (d) rural entrepreneurship, (e) self employment.

#### MANAGEMENT AND ORGANIZATION :

(a)Principle of management, (b) elements of management, planning, organizing direction and control, (c) organization structure and charts, line, staff functional and committee organization.

#### INDUSTRIAL MANAGEMENT :

(a)Industrial ownership LP proprietorship, partnership, Joint Stock Company and cooperative societies, (b) site selection, (c) plant layout: process oriented product oriented layouts, line balancing.

#### PRODUCTION MATERIALS MANAGEMENT :

(a)Production types: job order, batch and mass production, (b) inspection and quality control, (c) inventory control, economic order quality.

#### OPTIMIZATION TECHNIQUES :

(a)Linear programming: graphical method, analytical method of solution (two variables), (b) CPM & PERT.

#### PERSONAL MANAGEMENT :

(a)Functions: manpower planning, recruitment, selection, training, promotion, discipline, welfare, (b) job evaluation, (c) merit rating, (d) wages and incentives

#### MARKETING MANAGEMENT :

(a) Market research and sales forecasting, (b) sales management, (c) advertisement and sales promotion

### **MANUFACTURING TECHNOLOGY-II (ME 5116)**

MACHINE TOOLS : Principles of copying, forming and generating, speeds and feeds for machine tools .classification, specification and operation of machine, machine like lathe, shaper , drilling machines , milling machines , their accessories and tools, estimation of machining time .boring machine, broaching machine, capstan and turret lathes , single and multispindle automatic lathes. Abrasive machining –types, selection of grinding wheels, grinding machine-types and operation. Special purpose machine tools, and operation of special purpose machine tools, transfer type machine tools, numerically controlled machine tools.

NEWER MACHINING TECHNIQUE: abrasive jet machining, ultra sonic machining, electro discharge machining, electro chemical machining and grinding, chemical milling, plasma arc machining.

METAL CUTTING\_:Mechanics of metals cutting, Merchant's analysis , tool life, Taylor's equation, Tool angles and shapes , tool materials, composition, properties and applications. Effects of work and machine variables on cutting force, power consumption.

JIGS AND FIXTURES:\_Locating elements, clamping devices, principles of jigs and fixture design.

METROLOGY: Tolerance and allowance, limit system, limit gauge, measurements of surface roughness. Inspection of gears and screw threads.

## **SEMESTER-VI**

### **DYNAMICS OF MACHINERY (ME 6118)**

#### **FORCE ANALYSIS OF MECHANISMS:**

Dynamics of plane motion of a rigid body, equivalent mass systems, forces in mechanisms and machines, friction in link mechanism.

#### **DYNAMICS OF DIRECT ACTING ENGINE MECHANISM:**

Displacement, velocity and acceleration of the piston, turning moment diagrams, fluctuation of crank shaft speed and energy, flywheels.

#### **CAMS:**

Classification of cams and followers, radial cam, nomenclature, types of follower motion – uniform simple harmonic, parallel, cycloidal, generation of cam profile by graphical method, analytical cam design, pressure angle, cams with specified contours.

#### **GYROSCOPIC MOTION:**

Principles of gyroscope, gyroscopic acceleration, gyroscopic couple and reaction.

#### **BALANCING OF INERTIAL FORCES AND MOMENTS IN MACHINES:**

Balancing of reciprocating masses, primary and secondary forces and couples, concept of direct and reverse cranks, balancing of multicylinder engines.

#### **VIBRATIONS:**

Basic Concepts – simple harmonic motion, degree of freedom, types of damping, equivalent systems, free and forced vibrations, linear and angular of single degree freedom, systems with and without damping, whirling of shaft vibration, isolation and absorbers elementary treatment of systems with two degree of freedom.

### **MACHINE DESIGN (ME 6119)**

Introduction to the methodology of engineering designs.

Principle of machine design: form and functional design, product simplification and standardization, material selection, design consideration process.

Working stress: selection of suitable factor of safety and design stress taking into account the influence of shape, size, type of loading, condition of service, quality of material and manufacturing process.

Fatigue, creep, wear: impact and vibration consideration in design for the selection of material and design stress.

Design of fastening devices: screw fastening, key, pin and cotter, cotter and knuckle joints, riveted joints with special reference to pressure vessels, power transmission elements, rope, belt, shaft, axle and couplings.

Power screw, screw jack, spur and helical gears, lever, bearings – journal, ball and roller.

Design of helical and leaf springs.

Design of clutches and brakes.

## **REFRIGERATION AND AIR CONDITIONING (ME 6120)**

AIR CYCLE:- simple system, boot strap system, boot strap with evaporation, cooling, regenerative system, reduced ambient system, application to aircraft, and effect of discharge pressure.

VAPOUR COMPRESSION CYCLE:-Simple system, wet and dry compression, maximum cop, Ewing construction, effect of variation of evaporator and condenser pressures, superheating of suction vapour and sub cooling of liquid, flash chambers.

MULTI PRESSURE SYSTEM:- Purpose and applications, thermodynamic analysis of systems using multi evaporators with individual and multiple expansion valves, individual and compound compressor, dual effect.

LOW TEMPERATURE REFRIGERATION:-Different method-salt ice mixture, expansion of gases, joule-Thomson expansion , evaporation of liquid, magnetic cooling , cascade .

REFRIGERATION:-thermodynamic properties of important primary refrigerants, international nomenclature, comparative study, binary mixture, Roul't's law, Entropy-concentration diagram.



VAPOUR ABSORPTION SYSTEM:- simple cycle, maximum cop, Electrolux system, actual cycle ( $\text{NH}_3+\text{H}_2\text{O}$ ) and its thermodynamic analysis, lithium bromide-water system.

EJECTOR COMPRESSION SYSTEM:-Working principle, thermodynamic analysis, exact and approximate methods of analysis, Fanno and Rayleigh line solution.

VAPOUR COMPRESSION SYSTEM EQUIPMENTS:-Compressors-Types, reciprocating and centrifugal, effect of variation of condenser and evaporation and weirs, Forces on immersed bodies-drag, lift, aerofoil section.

CONDENSER:- Types, heat transfer in air cooled and water condenser, evaporative condenser, Wilson's plot.

EVAPORATOR:- Types, heat transfer mechanism and calculation of areas.

EXPANSION DEVICES;- types, thermostatic expansion, solenoid valve, capillary tube, control devices.

AIR CONDITIONING:-Applied psychrometric (advance topics):- psychrometric processes and their applications in summer and winter air conditioning.

Cooling and heating load calculations and their applications in A.C. load calculations, heat transfer through glass surfaces, human comfort, air distribution systems and layouts. A.C. equipments, their installations and control.

Applications of refrigeration and air conditioning.

## **AUTOMATION (CAM) (ME 6121)**

AUTOMATION:Introduction: Industrial Automation, Types, Hard and flexible automation, Role of computer in automation, Transfer mechanism

CAM (COMPUTER AIDED MANUFACTURING): Conventional NC, Component of NC system, NC procedure, NC-Co-ordinate system and motion control, Part Programming, Programming Language, NC Programming and Interactive graphics.

APT Language, Advantages of CAD/CAM in NC Programming, CNC and DNC Control, Adaptive control(AC), Graphics display devices, input and output devices, Graphics system and standard graphical user interface

FMS (FLEXIBLE MANUFACTURING SYSTEM): Intrduction to FMS, Various components of FMS Cell, AGV introduction to CIM & Robotics, Role of Robots in FMS.Advantages and Limitations of CIM.

COMPUTER AIDED QUALITY CONTROL: Contact and Non- contact inspection method, Role of computers in quality control,Computer Aided Testing

## **AUTOMOBILE ENGINEERING (ME 6122)**

Power units:-Arrangement of cylinders, fuel supply system, air cleaner, silencer, engine lubrication, cooling system.

Transmission system :- Transmission requirements , mechanical transmission, tractive resistance, performance of vehicles, gear ratio, gear box, fluid transmission, hydromantic transmission, propeller shaft, universal joint, differential, rear axle, wheel and tyre.

Steering system:-Front axle, center point, steering, caster action, steering mechanism, power steering, wheel alignment.

Braking system: - General braking requirements, elementary theory of shoe brake, weight transfer, mean lining pressure and heat generation during braking, mechanical and hydraulic brakes, weight distribution, stability of vehicle on slope, braking of vehicles.

Chassis and suspension: - Chassis spring, engine suspension system, shock absorber.

Electrical system:- Ignition, starting, lighting and generating system, cutout, regulators, sparking plug, electrical petrol gauge, trafficator, horn, wind screen wiper.

Vehicle maintenance:-Trouble shooting, service station and its equipment.

## **SEMESTER-VII**

### **ELECTIVE – I**

#### **MECHATRONICS (ME 7124)**

1. Manufacturing Process and Automation.
2. Integrated Product Design.
3. Application of Software Engineering in Industries.
4. Fundamental of Microprocessor and its Application.
5. Artificial Intelligence and Expert Systems in Design and Manufacturing.
6. Simulation, Modelling and Integration.
7. Mechatronics Engineering and its Application
8. Concurrent Engineering / Reverse Engineering.

### **ELECTIVE – I**

## **OPERATIONS RESEARCH (ME 7125)**

Origin and development of O.R. Areas of Application, Allocation problems, Transportation problem and Assignment problem.

Linear programming, Graphical and simplex technique Degeneracy Duality.

- Stepping stone method.
- MODI method
- Vogel's Approximation method
- Introduction to simulation and Monte-carls technique
- Queuing theory
- Introduction nonlinear programming
- Project management by PERT and CPM, Crashing of network, Decompression of activity-updating
- Dynamic programming.

## **ELECTIVE – I RELIABILITY & MAINTAINABILITY(7126)**

Reliability : Hazard Rate, Mean Time to Failure.

Hazard Models. Constant Hazard, Weibull Model.

System reliability : Series, Parallel and Mixed Configurations, K ou of n structure. Economic of Introducing a stand by or Redundancy into a Production System, Optimum Design Configuration of Series / Parallel System.

Maintainability : Maintenance Increment. Equipment and mission availability. Defination and basic concept. Relationship between reliability, availability and maintainability.

Corrective maintenance time distributions, maintainability demonstration, prediction of corrective maintenance time.

Introduction to life testing.

## **ELECTIVE – II**

### **GAS DYNAMICS (ME 7127)**

1. Basic concepts and definitions:-Compressibility, Lagrangian and Eulerian and relationship, steady irrotational flow.
2. Basic laws and energy equation:-conservation of mass, thermodynamic laws, momentum equations for perfect and non-viscous fluids.
3. Steady flow energy equations, isentropic flow, acoustic velocity, velocity of propagation due to pressure pulse, mach no., mach line and mach angle, steady flow through constant and variable areas, duct nozzles.
4. Flow with friction:-Friction losses, Fanning equation, Darcy equation, friction factors, friction parameter, fennoline.
5. Diabatic equation:-stagnation temperature, Rayleigh equation, Rayleigh line, pressure ratio, temperature ratio, entropy consideration.
6. Wave phenomena: - Formation of shock wave properties changes, plane stationary, normal shock, introduction to oblique shock.
7. Propulsion:-Introduction to ramjets, rockets and jet planes, rocket propulsion, classification of rocket motors, propellant.
8. Boundary layer control: boundary layer control by suction and injection.
9. Incompressible turbulent boundary layer on a flat plate, boundary layer in favorable and adverse pressure gradient. calculation of flow resistance.

## **ELECTIVE – II**

### **COMPOSITE MATERIALS (ME 7128)**

1. Classification and characteristics of composite materials –Mechanical behavior, current and potential advantage of fiber –reinforced composite materials.
2. Macro- mechanical behavior of laminar-stress-strain relations for isotropic materials orthotropic materials, plane stress and plane strain relations. Invariant, properties of an orthotropic lamina, strength of orthotropic lamina, biaxial strength theory.

3. Micro-mechanical behavior of lamina:-mechanics of materials and elasticity approaches to stiffness, their comparison, mechanics of material approach to strength.
4. Macro-mechanical behavior of laminate- classical lamination theory, special cores of laminate stiffness, comparison of theoretical and experimental laminate stiffness, strength of laminates, inter-laminar stresses.
5. Design of laminates:-invariant laminate, stiffness concepts, special results for invariant laminate stiffness, use of invariant laminates, stiffness in design, laminate joints.
6. Bending of laminated under distributed lateral load- specially orthotropic laminates, symmetric angle-ply lamintes, antisymmetric cross ply laminates, anty angle ply laminates.
7. Buckling of laminated plates- specially orthotropic laminates, symmetric angle ply laminates, antisymmetric cross laminates and antisymmetric angle- plylamintes.
8. Vibration of laminated:-specially orthotropic laminates, symmetric ply laminates, antisymmetric cross ply laminates, antisymmetric angle-ply laminates.

**ELECTIVE – II**  
**MECHANICAL VIBRATION (ME7129)**

1. Single degree of freedom- Equation of motion, undamped free vibration , torsional vibration , free damped vibration , forced damped vibration , rotating and reciprocating unbalanced , vibration isolation, transmissibility , logarithmic decrement , self excited vibration , equivalent viscous damping, coulomb damping, critical speed of shaft.
2. Vibration isolation –Vibration isolation and transmissibility, materials used as isolators and their properties.
3. Two degree of freedom-Principal modes, dynamic absorber, Lagrange's equation, influence coefficient.

4. Method of determining natural frequency-Rayleigh's method, Dunker ley's method, Stodola's method, matrix method, matrix iteration method, Holzer's method.
5. Vibration of continuous beam-Longitudinal vibration of bars, transverse vibration of bars, torsional vibration, vibration of strings.
6. Laplace transformation and control system-Control system block diagram, control systems applied to vibrations.

### **CONTROL SYSTEMS AND MEASUREMENT(ME 7130)**

1. INTRODUCTION: concept of automatic controls open loop and closed loop systems , servo mechanism-block diagram , transformer functions
2. REPRESENTATION OF CONTROL COMPONENTS AND SYSTEMS: translations and\_\_rotational mechanical components, electrical components, series and parallel combinations , comparators for rotational and linear motions integrating devices- hydraulic servo motor temperature control systems, speed control systems
3. SYSTEM RESPONSE: first and second order system response to step, pulse, ramp and sinusoidal input systems with distance velocity lag.
4. CONTROLLER MECHANISM: pneumatic hydraulic and electric controller's general principles and circuits for generating various control actions.
5. CONTROL SYSTEM ANALYSIS: transient response of simple control systems, stability of control systems, Routh's criterion.
6. BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS:
7. PRESSURES: Use of manometers, Bourdon gauge, bellows type gauge. Measurement of vacuum and pressure. Transducers, static and dynamic, response of pressure measuring instruments.
8. FLOW: Use of obstruction type meters. Variable area meters, probes. Positive displacement type meters, Hot wire Anemometry.
9. TEMPERATURE: Use of thermocouples, resistance thermometers, pyrometer, thermisters, static and dynamic response of temperature measuring instruments. Thermocouple errors and compensation. Heat flux measurement and meters.
10. STRAIN:\_\_Use of strain gauge, static and dynamic response. Displacement, Velocity, Acceleration. Jerk linear and angular. Piezoelectric pick/ups, Inductive type pick/up. Force, torque, time Frequency and phase angle: use of CRO, Electric counters, density and viscosity of gases and liquids, calorific value of solid, liquid and gaseous fuels. Noise. Humidity flow visualization. Demonstration of shadow and schlieren techniques, introduction to metrology.

## **MECHANICAL SYSTEMS AND DESIGN (ME 7131)**

1. DESIGN OF SUB ASSEMBLES AND MACHINE ELEMENTS:
  - i. Design of brackets and pipe joints,
  - ii. Design of gear boxes,
  - iii. Design of welded joints,
  - iv. Design of chain drive.
2. DESIGN OF FLYWHEEL AND HYDRAULIC PRESS.
3. DESIGN OF I.C. ENGINE PARTS:  
Cylinders, truck pistons, connecting rods,  
crank and crankshaft and valve gear.
4. Design of centrifugal pump.

## **INDUSTRIAL ENGINEERING AND MANAGEMENT (ME 7132)**

1. MATERIAL MANAGEMENT: Inventory function model (Deterministic), Inventory analysis and control.
2. WORK STUDY : (a) Motion study-Flow process charts , Motion economy, Therbligs, (b)Time study: Work management techniques, equipments, Performance rating , Standard time. (c)Work sampling principles, Procedure and application Ergonomics, Fatigue.
3. PRODUCTION PLANNING AND CONTROL: (a) Production batch size. Buffer stock, production range, minimum cost batch size, (b) Machine loading, progressing feed back, control charts.
4. QUALITY MANAGEMENT: (a) statistical methods : probability and probability distribution functions, confidence limit, estimation, analysis of variance; (b) Statistical quality control: sampling inspection, acceptance sampling plans, control charts for variables (c) Operating characteristic (O.C) curve : average outgoing quality (A.O.Q.) curve and limits, producer's risk, consumer's risk(L.T.P.D.), acceptable quality level (A.Q.L.). (d) Quality circles : quality organization, quality education, problem solving techniques, brain storming. (e) Quality standards : bureau of Indian standards, I.S.I., I.S.O.-9000
5. ELEMENTARY OPERATION RESEARCH: (a) Transportation problems,(b)Assignment problems, Linear programming problems, Simplex methods, Duality (d) Queuing theory(Single channel).



6. PROJECT MANAGEMENT: (a) Network technique: PERT and CPM, crashing the network, application, cantt chart, Small scale industry; Feasibility study, Financing the project.. Government incentives, industrial policy, Preparation of project report.

7. INDUSTRIAL SAFETY: (a) Industrial accidents, causes and costs, (b) Process risks, mechanical, chemical and electrical, (c) Accident prevention safety education, preventive measures, protective equipments machine safe guarding (d) First aid.

8. POLLUTION CONTROL: (a) Industrial hygiene: fatigue causes, fatigue reduction, (b) Clean environment, (c) Land pollution and waste control, (d) Water pollution, water treatment and sewage disposal, (e) Air pollution, control of fumes, smoke, toxic material, noise, temperature.

## **SEMESTER-VIII**

### **I.C. ENGINE AND GAS TURBINE(ME 8133)**

1. INTRODUCTION: Engine classifications; two strokes, four strokes (S.I. and C.I.).Engines, engine parts engine's working principles in general and valve timing diagrams.
2. REVIEW OF THE THERMODYNAMIC CYCLES: Their comparison, fuel air cycles, Real cycles.

- 3 ENGINE PERFORMANCE TEST: Purpose and types, measurements of power (IHP, BHP, and FHP), Air-Fuel ratio, and plot of different performance curves (engine speed vs. BHP, IHP, thermal efficiency torque, air fuel ratio).
4. THEORY OF COMBUSTION: principles of combustion, chemical equilibrium and dissociation, adiabatic flame temperature. Thermodynamic charts- Unburned and Burned mixture charts, Transition from unburned to burned mixture charts. Combustion processes in S.I. and C.I. engines. Effect of engine variables on combustion process, Knock in S.I. and C.I. engines, combustion chambers for S.I. and C.I. engines.
5. FUELS: Petroleum base fuels, gasoline and its properties, alcohols (fuels for S.I. engines), Blending, diesel fuel and properties, knock rating of S.I... and C.I. fuels.
6. (a) CARBURATION: Working principles, chemically correct air fuel ratio and load variation, Governing and compensating devices (accelerating pumps, idling jets, economizer, chokes etc.), Venturi and jet diameter calculation.  
(b) INJECTION SYSTEM: Types, elements of atomizer and pumps, types of nozzles and governing system.
7. (a) SUPERCHARGING: Principle of supercharging, superchargers, Turbo superchargers.  
(b) ENGINE LUBRICATION AND COOLING: Purpose, principles of lubrication and cooling. Types of lubricants.
8. GAS TURBINE: principle, principles of gas turbine, simple open gas turbine cycle, effect of operating variables on thermal efficiency. Regenerative and reheat cycles, multistage efficiency, multistage gas turbine cycle, closed cycle gas turbine, gas turbine application.
9. JET PROPULSION: Working principle, thrust power, propulsive force and propulsive efficiency.
10. ROCKET ENGINES: Basic theory of operation, solid propellant rockets, application of rocket engines.

### **POWER PLANT ENGINEERING (ME 8134)**

1. INTRODUCTION: A brief survey of power and energy of availability of power and energy in India, fuels, gas oil, coal and their characteristics, ash and refuse analysis.
2. BOILERS: Circulation Principles (Natural and Forced), types of boilers Furnace design and heat transfer characteristics, Boilers rating and characteristics, modern boilers.

3. BOILER GAS LOOP: Coal storage, conveyers, pulverizers, Oil and Gas supply system. Fuel bed mixing, stokers and Burners, Ash and handling methods of dust collection, air preheater, Draught system Control equipments.
4. BOILER WATER LOOP: Water treatment plant , feed water heating contact and surface heaters, Evaporators, Feed water pumps, Economizers and Super heaters, Condensers, Cooling water requirement.
5. PIPING SYSTEM AND ELEMENTS: Pipe size determination, calculation of losses in pipe, pipe insulation, High temperature effects on piping, piping supports.
6. CONTROLS AND INSTRUMENTATION: Temperature, pressure, flow measuring devices, circular and strip chart recorders.
7. NUCLEAR POWER STATION: Elementary concept, Nuclear Reactors, Moderators. Shield Reflectors, control rod, nuclear fuels. Breeder and gas cooled reactors.
8. MODERN POWER PLANT AND POWER PLANT ECONOMICS: The variable load, ideal and realized load curves, Terms and factors, effects of variable load on power plant operation, method of meeting the load, Source of income, effect of plant types and costs. Economic survey and site suitability of different plants.

### **ELECTIVE - III**

#### **WORK STUDY & MEASUREMENT (ME 8135)**

Introduction : Purpose and Scope of Work Study and its Historical Development. Work Study as a Tool for Productivity Enhancement.

Method Study : Objectives and Scopes, General Procedure to Tackle Method Study Problems (Steps, Select, Record, Critical, Examination, Develop, Install, and Maintain Improved Method)., recording Techniques and their Applications ( Operation Process Chart; Flow Process Chart, Two Handed Process Chart, Multiple Activity Chart, Flow Diagram, string Diagram, Photographic Aids and Models.

Micromotion Study : Preparation of Motion Films and Analysis with the help of thrbligs and SIMO Charts, Memomotion Study, Cycle Graph and Chrno Cycle graph and Principles of Motion Economy.

Work Measurement : Concept, Scope and Objectives, Various Work Management Techniques, Stop Watch Study Procedure in Detail, Performance rating and Determination of Normal Allowances in time study and determination of Standard Time.

Work Sampling, Concept and Uses, sampling Study Procedure and Presentation of Results, establishing Time Standard by Work Sampling, Practical Applications.

PMTS : Establishment and Uses of Elemental Time Data, Predetermined Motion Time Systems, Major Systems, Uses and Applications.

Wage & Incentive : Principle and Methods of Job Evaluation and Merit Rating, Principles of Wage & Incentive Payment, Comparative Study of Incentive Schemes.

Ergonomics : Concept, Scope and Objectives of Human Factors in Engineering and Man-Environment Interaction, Causes and Prevention of Fatigue, Design of Man Environment Systems and Methodology.

### **ELECTIVE - III**

#### **ADVANCE ENGINEERING MATHEMATICS (ME 8136)**

1. Vector calculus-Integral transformation, theorem of Gauss, Stokes and Green, curvilinear coordinates transformation from one system to another.
2. Integral calculus-Double and triple integral, change in order of integration, differentiation under integral sign, change of variables, improper integral, convergence of improper integral, general and principle value of infinite integral.
3. Matrices-Solvability of sets of linear equations, characteristics, value problems, properties of symmetric matrices, numerical method for finding out the characteristic value of vector.
4. Classical methods of optimization of a function of several variables with constants. Introduction to calculus of variation.
5. Series expansion of arbitrary function-Orthogonalisation of functions, generalized Fourier series, Bessel equalities, discussion on closures, completeness and convergence in the mean, Sturm-Liouville problem and eigen function expansion.
6. Cartesian tensor-Multiple suffix sets, summation convention, dummy suffixes, special symbols like  $\epsilon_{ij}$  and  $\epsilon_{ijk}$ , coordinate transformation, algebraic operation on tensors, sum, product, contraction and quotient law.
7. Partial differential equation-Characteristics of linear first and second order partial differential equation, classification of second order equation, use of Green function and integral transformation for their solution.

### **ELECTIVE - III**

#### **MATERIALS MANAGEMENT (ME 8137)**

Introduction, Relevance of Materials Management, Need for Integrated approach, Deterministic models; EOO, EPO, Discount, backloging, multi-item models etc., sensitivity analysis, basic systems of inventory management, inventory costing, Aggressive inventory models, Stochastic inventory models, service level, single period model, etc. Role of uncertainty, selective inventory controls, material planning, forecasting, warehousing, storage etc. Documentation for purchasing etc. MRP concepts, logic, computerized models, implementation issues, case studies. JIT philosophy, logic applications, implementation, vendor selection & evaluation. Vendor relation, consolidation of vendor base, single sourcing. Information systems for materials, documentation. Procurement & internal based purchasing, e-commerce & materials management. Organizational issues & evaluation of materials function.

### **ELECTIVE – IV**

#### **APPLIED STRESS ANALYSIS (ME 8138)**

1. Analysis of Strain-Stress at a point, invariant of stress, stress equations of equilibrium, laws of stress transformation, principle stresses and planes, principal stresses in two- dimensional system, special state of stresses (dilatation and distortion).
2. Analysis of strain-Definition of displacement and strain, strain invariants, strain equations of transformation, principal strains, generalized stress-strain relations, compatibility equation.
3. Plane problems-Plane stress, plane strain, Airy's stress function to Cartesian coordinates and polar coordinates applications to simply supported beams with V.D. loads, stresses and displacements subjected to internal and external pressure , stress distribution in a thin infinite plate with circular hole, subjected to uniaxial load.
4. Strain measurement methods-Basic characteristics of strain gauge, type of strain gauges-mechanical, optical and electrical.
5. Electrical resistance strain gauge:-Factors producing strain- sensitivity in metallic alloys. Gauge construction, types of strain gauges-unbounded, bounded wire strain gauge, metal foil strain gauges.
6. Factors affecting gauge selection, gauge sensitivity and gauge factor, correction for transverse strain effects.
7. Rosette analysis-Three element, rectangular, delta rosette. An element rectangular rosette.
8. Circuitry for strain measuring bridge, Wheatstone bridge, temperature compensation, application to tension, compression, bending, torsion and combined stresses.

**ELECTIVE – IV**  
**ROBOTICS (ME 8139)**

**BASIC CONCEPT IN ROBOTICS:** Introduction, Definition, Basic structure of robot, Resolution. Accuracy, repeatability, Work envelope, pays load and degrees of freedom.

**CLASSIFICATION OF ROBOT SYSTEM:**Point-to-point and continuous path systems, loops of robotic system, robot anatomy, Basic configurations- Cartesian, cylindrical, polar and jointed- arm configuration. SCARA robot and spatial configuration.

**DRIVE AND CONTROL SYSTEM:** Types of drive systems, Dynamic performance, Actuators-Pneumatic and hydraulic actuators, controls approaches of robot, open loop and closed –loop control system.

**ROBOT KINEMATICS:** Direct kinematics problems in robotics, geometry based direct kinematics analysis, co-ordinate transformation and Wrist motion.

**ROBOT AND EFFECTORS:** Robot gripper and gripping mechanism, types of gripper, Grasping requirements for the gripper.

**SENSOR SYSTEM IN ROBOTICS:** Sensor and Transducer, Desirable features, tactile and non-tactile sensors-Touch sensor, Force and Torque Sensor, Proximity Sensor, Range Sensors; Machine vision and Artificial Intelligence.

**ROBOT PROGRAMMING:** Programming methods- Manual teaching and lead through teaching, Programming through Textual robot languages.

**ROBOT APPLICATION AND SAFETY:** General application of robot in material handling Machine loading and unloading, welding, spray painting and Assembly, Safety measures in robotic area.

**ELECTIVE – IV**  
**INDUSTRIAL STATISTICS (ME 8140)**

Sampling Theory :

Sampling and distribution of Statistics, Central limit theorem, point and interval estimation of parameters. Hypothesis testing, OC Curve, Chi Square, Goodness of fit curves. Application to Industrial problems.

Statistical Quality Control : Shewhart Control Charts for measurement and attributes, acceptance sampling, single and multiple OC curves, AOQ and

AOQL for single sampling plans. Introduction to sequential sampling.

Regression and Correlation Analysis :

Two dimensional variables and related distributions, Regression of the mean, Covariance and correlation of Bivariate, Normal distribution. Simple linear regression and correlation problems and estimation of parameters. Introduction to curvi-linear and multiple regression.

Variance Analysis and Design of Experiments :

Analysis of Variance and Covariance. One Way, Two Way, and Random Classifications, Latin square design GRAEO latin square design, Two factor experiments.

## **ELECTIVE – V**

### **INSTRUMENTATION AND CONTROL (ME 8141)**

Measurements: Definition, importance and requirements for static and dynamic measurements, mechanical and electrical measuring system, Measurement of displacement and strain.

Dial gauges, Electrical strain gauge : inductive type strain gauges, resistance strain gauges, wire and foil types, photo cells.

Measurement of force, torque and power. Measurement of load using elastic transducers and electrical resistance strain gauges.

Use of load cells and providing thins for calibrations of force measuring devices. Measurement of torque by brakes dynamometer and electrical strain gauges, Measurements of speed by tachometers and stereoscopes, measurement of mechanical of mechanical power using hydraulic and electrical dynamometers.

Pressure Measurement : Gravitational and elastic types of pressure measuring devices, manometers, micro manometers, Bourdon pressure gauge and their defects, Diaphragm type pressure pick ups used in conjunction with secondary transducers, pressure cells, static and dynamic calibration of pressure measuring devices.

Flow Measurement : Primary methods, meters, flow nozzle and orifice meters, basic principles of magnetic and ultrasonic flow meters, Vibration measurements, Method of vibration measurements based on sensory perception, Mechanical methods, Measurement of relative motion and of absolute motion, Vibration pick ups, Methods of excitation for vibration measurement.

Dynamometry : Fundamental principles and design aspects of dynamometers used on machine tools.

Automatic control, Concept of automatic controls, simple open loop and closed loop systems, concept of feed back, block diagram and transfer functions.

Modes of Control : Characteristics of proportional control, integral control, proportional plus integral control, derivative control, proportional plus derivative control and two position control system, stability criterion, Rouths criteria. Traffer and program controlled automatic lathes and other machine tools.

## **ELECTIVE – V**

### **FINANCIAL MANAGEMENT AND ACCOUNTING (ME 8142)**

Goals and Functions of Finance:

Evolution of Finance, objective of the firm, functions of finance, concept of time & value of money.

Principles of Capital Budgeting:

Kinds of Capital Budgeting decisions, evaluation of proposals, capital discounting & non-discounting based method.

Working Capital Management:

Definition and importance of working capital- working capital operating cycle, factors affecting working capital, inventory management, introduction to cash & receivable management.

Sources of Finance:

Working capital financing, long-term finance, financial instruments, financing institutions, schemes, IDBI re-finance lease financing.

Financing & Dividend Policies:

Capital structure of a firm, operating & financial leverage, EBIT, EPS analysis.

Cost Accounting:

Cost classification, cost grid, fixed & variable costs, marginal costing, significance of overhead cost, machine hour rate method, variance analysis.

Financial Accounting:

Book keeping-single, double entry, journal & ledger, financial statement-profit & loss accounts, balance sheet

Financial Ratio Analysis:

Uses & nature, liquidity coverage ratios.

## **ELECTIVE – V**

### **METROLOGY (ME 8143)**



1. Standard of Measurements :

- ( ) Principles of Measurements : Line Standard, Imperial Standard Yard, Standard Meter, Wave Length Standards and Bars, Effect of Environment on Measuring Accuracy. ISI Code of Practice
- ( ) Constructional Details of Measuring Instruments, Abbe Principles, Pivots and Bearings, Sources of Error, Temperature Variations, Parallax, Sine and Cosine Errors, Elastic Deformations etc.
- ( ) Measuring Accuracy : Dimensional and Geometrical accuracy.

2. Tolerance and Limit Systems : Systems of Tolerance and Fits, ISA and ISI System of Tolerance and Fits, The Economics of Wide and Close Tolerance, Principles of Limit, Gauging of Plain Work, Design and Manufacture of Gauges.

3. Measuring Instruments : Linear Measurement : Direct Measuring Tools, Comparators – Types, Relative Merit and Limitations, Optical Instruments, Projectors and Microscopes, Angular Measurements, Clinometer, Taper Gauges, Sine Bar, Angle Blocks and Auto Collimators, Circular Division Testers, Optical Dividing Head.

4. Geometrical Form of Surfaces : Concepts and Measurements of Flatness, Straightness, Parallelism, Perpendicularity, Roundness, Cylindricity, Runout and Concentricity, Errors in Positioning, Uses of Interference Methods, Measurements of Surface Texture.

5. Screw Thread Measurements : Systems of Screw Threads, Principles of Limit Gauging of Threaded Work, Measurements of Screw Threads, External and Internal Threads and Measuring Instruments.

6. Spur Gear Measurements : Geometrical Definitions of Spur Gears, Basic Parameters of Spur Gears, Measurements of Spur Gear Parameters, Individual and Accumulative Error Measurements.

7. Alignment and Large Scale Measurements : Machine Tool Alignments, Instruments and Method for Testing Straightness, Flatness & Squareness, Alignment Charts, Dynamic Testing of Machine Tools.