

## 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. Biaxial 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 status of stress. Simple application. Castiglians 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 saturations, 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.

### **FRICITION 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, Prowell 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.

**PARATIAL 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 commutative 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 randomize design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart).

## **FLUID MECHANICS(ME 4108)**

### **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 MACHINE (ME 4109)**

**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.

### **COMPUTER AIDED DESIGN (PE 4101)**

Basic concepts : Introduction, Integrated CAD/CAM, Designer Vs computer as a Design medium, system software's comparison of languages. Benefits and applications of CAD. Computer Graphics and Geometric Modeling : Introduction, point plotting techniques, line drawing displays, two and three dimensional transformations, Clipping And windowing, Segmentations. Wire frame modeling, surface modeling, Solid modeling and their applications. Three dimensional graphics, Curves and surfaces, hidden surface elimination, shading. Graphic input devices, Graphic input techniques, Input functions, Raster graphics fundamentals, Interactive raster graphics, Raster graphic Systems.

Computer Aided Drafting : Introduction, Drafting packages. Arrows and pointers, dimensioning, Text, Cross hatching, Drafting examples.

Computer Aided Design: Computer Aided Design, Optimizations and drafting of following machine elements: Shaft, coupling, gear, springs, etc. and kinematics analysis of four bar mechanism. Introduction to CAD Packages.

## **MANUFACTURING PROCESS – I (PE 4102)**

Machine tool classification, spectrum of machining operation performed on machine tools, Types of cutting tools, tool signature, cutting speed, feed, depth of cut. Cutting tool material. Use of coolants. Constructional features, specification, operations and drives of basic machine tools such as lathe, shaper, planer, slotter, drilling machine, boring and milling machine. Indexing in milling operations. Working principles of Capstan and turret lathes. Tool layout and operation of Capstan and turret lathes. Grinding and finishing operations : Cylindrical, surface and centerless grinding. Broaching, lapping, honing and buffing. Gear cutting by forming and generating methods.

## **SEMESTER-V**

### **PRODUCTION TOOLING & DESIGN I (PE 5103)**

Stress in elementary machine members. Design stress and factor of safety. Interchangeable parts. Design of rivets, welded joints, keys, cutters, knuckle joints, Power screw and springs.

Introduction to Jigs and Fixtures. Basic principle followed in the design of Jigs and Fixtures. Jig classification and drill bushes and its types. Typical Jigs for components requiring drilling, reaming, tapping, counter boring and spot facing. Job holding and clamping devices used in mass production of identical jobs.

Fixtures characteristics and setting-piece, Milling fixtures, turning Fixtures, grinding fixtures, Assembly and inspection of fixtures. Universal assembled fixtures.

Design of tools for making holes, Deep drilling tools, Cutting forces in drilling, milling Cutter's types, design parameters and its calculation. Design and construction of form tool and relieving cutters. Design of Reamers and thread cutting tools.

### **METROLOGY (PE 5104)**

#### Standard of Measurements :

- a) Principles of measurements : Line standard: Imperial standard yard, standard meter, wave length standards, end bars, effect of environment on measuring Accuracy.
- b) Constructional details of measuring instruments, Abbe principles, pivots and Bearings, sources of error, temperature variations, parallel, sine and cosine errors, elastic deformations etc.
- c) Measuring accuracy : Dimensional and geometrical accuracy.

Tolerance and Limit Systems: System of tolerance and fits, ISA and BIS system of tolerances and fits, the economics of wide and close tolerance, principles of limit gauging of plain work, Design and manufacture of gauge.

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.

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.

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.

Spur Gear Measurements : Geometrical definitions of spur gears, basic parameters of spur gears, measurements of spur gear parameters, individual and accumulative error measurements.

Alignment and large scale measurements : Machine tool alignments, instruments and methods for testing straightness, flatness & squariness, alignments charts, dynamic testing of machine tools. Concept of on-line inspection.

### **ENGINEERING ECONOMY (PE 5105)**

Fundamental economic concepts and basic economic laws relating to market and prices. Selection in present terms economy. The time element in economy study, interest and interest formulas. Nominal and effective interest rates, calculation of equivalent interest. Present worth, properties, capitalized costs and capitalized values.

Comparison of alternatives, Selection and replacement of equipment from amongst multiple alternatives.

Uncertainty in economy studies, decision making under known probabilities, decision trees in evaluation of alternatives.

Promotion of a company and its legal aspects. Raising of capital, equity capital and borrowed capital. General accounting and double entry, book keeping, journals and ledgers, income statement, balance sheet and their analysis.

Cost accounting, cost elements and cost structure, Methods of allocating factory overhead, various classification of cost and use of cost data in economy studies.

Depreciation and depreciation accounting, classification and types of depreciation and accounting for the recovery of cost of capital assets. Value time function, common methods of depreciation, accounting and their selection.

Economy of operation and minimum cost analysis for purchase, production order, maintenance tooling etc. Break even analysis, effect of price on profit. Income taxes, inflation.

## **MANUFACTURING PROCESS – II (PE 5106)**

Foundry : Patterns, Pattern materials, types of patterns, Pattern allowances. Mould and core making, properties of molding and core sands, Sand testing, Machine Molding. Gating, Riser and solidification of casting. Special casting processes: Centrifugal casting, investment casting, Die casting, Continuous casting and shell molding. Working principle and operation of cupola. Cleaning of casting, inspection of casting, casting defects.

Welding and Allied Process: gas welding and gas cutting processes.

Electric Arc Welding : Carbon Arc welding, Shielded-Metal Arc Welding, Submerged Arc Welding, TIG (or GTAW) welding, MIG(or GMAW) welding, Electroslag welding, Plasma Arc welding.

Resistance welding : Spot, Seam, Projections, Butt welding etc.

Thermit welding, atomic hydrogen welding, Ultrasonic Welding, explosive welding, electron beam welding, Laser beam welding, Soldering, Brazing and Braze-welding.

Design of welded joints. Weldability and weldability testing. Inspection (Destructive and non-destructive testing).

## **INDUSTRIAL ORGANIZATION AND MANAGEMENT (PE 5107)**

Business Organization : Legal forms of Business organization – single ownership, partnership and joint stock company and their formation. Share and their classes, rights and privileges. Borrowing of capital through mortgages, Debentures, unsecured notes and Bonds. Ownership and operation of a joint stock company through Board of Directors. Principles of Management: The element of managerial functions-planning organizing, staffing, Direction and control. Authority and responsibility, leadership and principles of co-ordination. Uses of committee as a management tool, span of control. Organization structure : Line and staff, Functional Lateral(Fayol's Bridge) and metric organization structures. Organization chart and organization manual. Departmentation. Budget and Budgetary control: Functions, types and preparation of budgets, working of budgetary control. Marketing Management: Function of sales and marketing, Channels of distribution, Sales promotion, Advertising and publicity, Product packaging and product printing. Human Resource Development : Main functions of personnel department, Morale, motivation and behavior, Handling of Industrial grievance through joint consultation and collective bargaining. Workers participation in management. Industrial legislation: Factories Act, Trade unions, Trade dispute Act, Workmen's compensation Act, Payment of wages Act.

## **SEMESTER-VI**

### **PRODUCTION TOOLING & DESIGN II (PE 6108)**

Kinematics of machine tool drive, types of machine tool drive, standard series used for selection of spindle speed between maximum and minimum. Determination of speed Structures and layout for a drive. Design of main spindle and feed drive system.

Design of spindle, bearings, slides and slide ways with consideration of fundamental idea, friction and lubrication. Theory of solid friction, extreme pressure lubrication, the function of cutting fluid, types of friction in machine tools. Design of spindle bearings for general machine tools, basic method of stick slip phenomenon. Hydrodynamic theory of lubrication. High pressure lubrication.

Vibration in machine tools and dynamic rigidity, sources of vibration, effect of vibration, Forced vibration, Single degree of freedom. Chatter theory.

Press tools, classification and operation of press, design for safety, design of press tools, Progressive and compound tools.

Broaching, types, construction and design features in general and regrinding of tools.

Gear cutting tools for spur, helical and worm gear. types and construction concept of generation and forming, hob for spur and worm. Gear shapers, slotters, bevel gear cutters, design features and design of fly cutters.

### **WORKSTUDY & ERGONOMICS (PE 6109)**

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).

Micro-motion Study : Preparation of motion films and analysis with the help of therbligs and SIMO charts, memomotion study, cycle graph and chronocyclegraph, Principles of motion economy.

Work Measurements : Concept, scope and objectives. Various work measurement techniques. Stop watch study, procedure in detail. Performance rating and determination of normal time. Allowances in time study and determination of Standard time.

Work Sampling : Concept and uses. Sampling study procedure and presentation of results. Establishing time standards by work sampling, practical applications.

Pmts : Establishment and uses of elemental time data, predetermined motion time systems, major systems, uses and applications.

Wage & Incentive: Principles 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.

## **MODERN MANUFACTURING PROCESSES (PE 6110)**

Introduction to New Technology :

Abrasive Jet Machining (AJM) : Mechanics of AJM, Process parameters, Abrasive Jet Machines.

Ultrasonic Machining(USM) : Mechanics of USM, Process parameters, Abrasive slurry, Ultrasonic Machining Unit.

Electro Chemical Machining(ECM): Electrochemistry of ECM process, Kinematics and Dynamics of ECM, Design of electrolyte flow, ECM plant. Applications of ECM, Electro-chemical grinding(ECG), Electrochemical Honing. Chemical Machining. Introduction to neutral particle etching.

Electric Discharge Machining(EDM): Mechanics of EDM, EDM circuits and operating principles, Tool Electrodes and Dielectric fluids.

Electron Beam Machining(EBM)

Laser Beam Machining (LBM)

Plasma Arc Machining (PAM)

Hot Machining.

High Energy Rate Forming Processes: Explosive forming processes, Electro-hydraulic forming, Electro-magnetic forming.

Introduction to Nano-manufacturing.

## **OPERATIONS RESEARCH (PE 6111)**

Introduction to Operations research and its application, Basic Methodology(Introduction).

Linear Programming: Linear programming model and solution by simplex method. Duality and its economic interpretation and practical application, post optimality analysis, sensitivity analysis.

Transportation Problems: L.P. Formulation, Transportation Tableau, Determination of initial basic feasible solution and optimal basic solution, degeneracy, Modi method, Assignment problems; sequencing.

Queuing Models :Basic structure of queuing models, examples of real queuing system, queuing formula for single and multi channel problems(for poisson arrivals and exponential service time).

Dynamic Programming: Characterisations of dynamic programming problem, Deterministic dynamic programming problem (description and computational procedure for solution).

Application to industrial problems particularly on material and production management aspects.

## **MANUFACTURING PROCESS – III (PE 6112)**

Powder Metallurgy:

Definition and scope of powder Metallurgy in Industry, Merits and demerits. Types of powders and their manufacturing. Fundamental properties of powders. Mech. Pulverisation, Electrolytic process, chemical reduction, Automization. Process of powder Metallurgy: Mixing, Compaction, Sintering infiltration, sieving, coining, Machining etc. Heat Treatment of products. Tooling for powder metallurgy, Use of metal powder performs for producing industrial products. Industrial Application of powder metallurgy.

Metal Forming Processes:

Principle of plastic flow of metals during hot and cold working. Hot and cold working processes: Forging, Rotary swaging, Rolling, Thread rolling, extrusion, wire drawing, Tube drawing, Sheet metal operations.

## **SEMESTER-VII**

### **ELECTIVE I**

#### **PROJECT ENGINEERING (PE 7113)**

The scope of project, characteristics of a project, stages of a project, Project constraints, Project Management structures, Responsibilities of project manager, Project productivity. The anatomy of a project. Environmental considerations in project evaluation. Main issues and secondary issues in feasibility study, Social cost benefit analysis, Commissioning, Evaluation of competing projects. Budgetary aspects and considerations of a project. Industrial/Engineering projects, R & D Projects, Turnkey projects, Network Modeling of a project, Deterministic & probabilistic activity networks, Line of Balance, Time-cost trade-off in a project, Mega projects. Project scheduling techniques, PERT, CPM Models.

Project monitoring techniques, Performance and Cost Evaluation (PACE), Project Staffing Requirements, Resource leveling. Project Documentation, Computer Application in Project Engineering.

#### **ENTERPRISES RESOURCE PLANNING(PE 7114)**

Basic issues, Approach and database implementation, ERP modules: Production planning, Sales and Distribution, Materials Management, Plant Maintenance, Quality Management, Project Management, Financial Management and Costing, and Human Resources, ERP implementation : Strategies and Steps. Case study in ERP implementation.

#### **HUMAN FACTORS IN ENGG. & DESIGN (PE 7115)**

Introduction : History and scope of Ergonomics/human factors and its interdisciplinary concepts. Human beings in Man-Made world. Data base of human factors.

Information Input and Mediation Processes : Information input and processing. Visual display. Auditory and Tactual Displays. Speech communication.

Human Output and Control Processes

Human activities : Their nature and effects. Human control of systems. Control, Tools and related devices.

Workspace and Arrangement : Applied Anthpometry and work space and arrangement.

Environment : Illumination, Atmospheric conditions. Noise, Man in motion, The living environment the physical features, Services and Related facilities.

Overview : Application of human factor data.

## **ELECTIVE II**

### **MECHATRONICS (PE 7116)**

Fundamental of mechatronics : Definition and concepts of Mechatronics. Conventional System Vs. Mechatronics System, Need Role of Mechatronics in Design, Manufacturing and Factory Automation. Hardware components for Mechatronics. Number Systems in Mechatronics. Binary Logic, Karnaugh Map, Minimization Transducer Signal conditioning And Devices for Data conversion programmable controllers. An introduction to sensors and Transducers, use of sensor and transducer for specific purpose in Mechatronic. Signal Systems and Actuating Devices. Introduction to signals systems and controls system Representation. Linearization of Nonlinear systems. Time Delays. Measures of system Performance. Types of actuating devices selection. Real time Interfacing : Introduction Element of a Data Acquisition and control system. Overview of the I/O process, installation of the I/O card and software. Application of software in Mechatronics. Advanced Application in Mechatronics Sensors for conditioning monitoring. Mechatronics Control in Automated manufacturing. Micro sensors in Mechatronics. Case studies and examples in Data Acquisition and control Automated Manufacturing.

### **VALUE ENGINEERING (PE 7117)**

Introduction & Value Orientation : Reasons for unnecessary costs, VE-versatile technique, definition, beginning and the Spread. Value orientation, customer and cost, internal customers, value defined, Increasing value.

The Orientation Phase : Training, Selection of projects, impact of VE application, ABC analysis, Problematic areas, production problems, maintenance problems, vendor development problems, design problems, old designs, specifications and standards. Selection of leader, team members, workshop.

The Information Phase

Decision and costs, use of work book, human relations.

The Function Phase : Importance of functions, types of functions, functions defined, levels of functions, Function-cost, concept of worth, value potential, function Analysis System Technique (FAST), scope lines.

The Creation Phase : Brainstorming, split-brain theory, brainstorming process, Gordon technique, checklists, Morphological analysis technique, word association technique.

The Evaluation Phase : Filters, ranking, feasibility rankings, weighted evaluation, factor comparison, Decision matrix.

The Recommendation Phase : Conducting trails, assessing management's needs, preempting, making the presentation.

The Implementation Phase : Action plan, record progress, report progress, organizing review meetings, problems in implementation, incorrect project selection, human factors.

The Audit Phase : Technical audit, cost audit, case study, timing of audit, problems in audit, audit personnel, documentation, frequency of audit, benefits.

Managing the VE Programme : The need, management support, VE organization, VE group, VE manager, tasks, VE workshops, selection of projects, follow-up, Publicity, VE Budgets, action plan, Select a simple project, Management Presentation, Audit of savings.

### **COMPETITIVE MANUFACTURING STRATEGIES (PE 7118)**

The competitive environment in the market. The WTO agreement and its effect on Indian Industries. Manufacturing as a competitive strategy, Product variety, Vendor Development, MRP, J.I.T., Kanban, Reengineering, TQM, Modular design, Design for manufacturability, Networking, ERP and simulation as tools for competitive manufacturing. Pool Manufacturing, Island Manufacturing, Agile Manufacturing, Intelligent Manufacturing, Cognitive Manufacturing, Competitive Advantages and disadvantages, Selection for manufacturing technologies. Concept of CIM, FOF and Manufacturing on Internet.

### **THEORY OF METAL CUTTING AND FORMING (PE 7119)**

Principles of Metal Machining: Metal Machining, Elements of machining, Classical metal machining process; Mechanism of chip formation; types of chips. Geometry of chip formation, Forces on chips, Velocity relationships; stress and strain in chips; Theories on Mechanics of metal cutting for orthogonal cutting(Merchant, Lee and (Shaffer); Power and energy relationship; Thermal aspects of metal machining; Measurement of chip-Tool interface temperature, Friction in metal cutting.

Mechanics of Multi-Point Cutting Tools: Milling cutters; Forces in Milling, specific cutting pressure.

Measurement of Cutting Forces: Tool Dynamometer.

Theory of Machinability: Evaluation of machinability , Tool life, Tool life Plots, Types of tool failure, Flank wear, crater wear, variable influencing tool failure and tool life, Economics of metal machining.

Stress: Concept of stress, two dimensional and three dimensional components, Mohrs circle, concept of incremental strain components, direct strain and shear strain.

Stress –strain relation; Hooks' law, Prandtl-Reuss equation, Levy Mises equation; Flow rules, Yield criteria, Experimental evidence for yield criteria.

Theory of Metal Forming: Introduction of plasticity theories.

Application of slab theory in the analysis of metal forming

Processes (forging, wiredrawing, rolling, Extrusion, Deep drawing).

Introduction to slip line concept and its application to simple plain strain problems.

Application of upper bound technique in metal forming processes.

## **PLANT ENGINEERING (PE 7120)**

Objectives and Principles of facility design, facility design process, facility design problems and their analysis. Factors affecting the location and site selection, techno economic analysis, multi-plant location, concept of location theory and models-design and types of building. Plant layout, types of layout problems, objectives of good plant layout, factor's affecting plant layout, types of plant layout, techniques and tools of layout, Types of flow patterns, Material handling, types of load, objectives and principles of material handling, Diagnosis and analysis of handling problems, Material handling equipment and their selection. Industrial applications, Interrelationship between material handling and plant layout, Design of an integrated plant/facility layout. Life cycle costing, plant maintenance, importance of maintenance in plant, types of maintenance, evaluation of maintenance policy, Fero-technology.

## **MANUFACTURING AUTOMATION AND ROBOTICS (PE 7121)**

Basic concepts: Evaluation of manufacturing components and type of automation, Automation scenario and development of factory automation. High volume production systems : Principle and conceptual frame work of transfer machines and automates. Numerical control machine tools: Basic ideas, Classification and structure of NC Systems, NC-coordinate system, absolute and incremental positioning. Fixed and floating zero points, Constructional features and feedback devices for CNC machine tools such as machining center and turning center, CNC retrofitting, Direct Numerical Control(DNC) and adapative control, part programming and related languages.

Basic concept in Robotics :

Introduction, Basic structure of robots, Resolution, Accuracy, and Repeatability Position representation.

Classification and Structure of Robotic System:

Point to point and continuous path Robotic systems: Trajectory planning, control loops of Robotic systems; The manipulator-cartesian, Cylindrical, Spherical and articulated robots; Direct and indirect drives; Wrist, motions and grippers;

Drive and Control Systems:

Hydraulic systems; direct current servo motors control approaches of Robots.

**Kinematics Analysis and Co-ordinate Transformation:**

Direct kinematics problem in Robotics; Geometry based direct kinematics analysis.  
Homogeneous transformation.

**Trajectory Interpolators:**

The necessity of interpolators; The generation of motion commands; Trajectory planning.  
Basic structure of interpolators(absolute interpolators and incremental interpolators).

**Programming of Robots:**

Manual teaching; lead-through teaching, programming languages, programming with graphics; storing and operating tasks programmes.

**Sensors and Intelligent Robots:**

Introduction to robotic sensors; vision systems, Range defectors: Assembly Aid Devices;  
force and torque sensors: artificial intelligence.

**Applicant of robots.**

Flexible manufacturing systems, Computer-Integrated Manufacturing Systems. Concept  
of group Technology.

## **SEMESTER-VIII**

### **ELECTIVE III**

#### **MANAGEMENT INFORMATION SYSTEM (PE 8122)**

The Meaning and Role of Management Information System :  
Decision support system, System Approach, The system view of Business, MIS organization within the company.

Management Organizational Theory and the System Approach :  
Development of organizational theory, Management and organizational behavior, Management, Information, and the system approach.

Computer System and M I S :  
Data processing and the computer, operation of a manual information system, component of computer system/conversion of Manual to computer-based systems, The data bank concept, Computer-based applications.

Data Base Management :  
The Business setting, Data base management system, Objective of a DBMS, Computer, Data base Technical overview.

Information System for Decision Making :  
Evaluation of an information system, Basic information systems, Decision making and MIS, MIS as a technique for making programmed decisions, Decision Assisting Information Systems.

Strategic and Project Planning for M I S :  
General Business planning, Appropriate MIS response, General MIS planning, Detailed MIS planning.

Conceptual System Design :  
System objectives, Constraints, Information needs, Information sources, Alternative conceptual designs and selection, Documentation of the system concept, Conceptual design report.

Detailed System Design :  
Aim of detailed design, Project management of MIS detailed design, Dominant and Trade-off criteria, Subsystem, Detailed operating subsystems and information flows, Degree of automation of operations; Inputs outputs and processing; system testing Software, hardware and tools; Documentation of detailed design.

Implementation Evaluation and Maintenance of MIS :  
Implementation planning, Organize for implementation; Training of operating personnel, Development of forms for data collection and information, testing of system, cutover,

Documentation of the system, Evaluation of MIS, Control and maintenance of the system.

### **COMPUTER INTEGRATED MANUFACTURING (PE 8123)**

Introduction : Evaluation of CIM, Scope of CIM, Nature & role of the elements of CIM system. Segments of generic CIM, Computers and workstations, an overview of CIM Software & hardware development of CIM, Design aspect of CIM system, Approach to CIM, CIM common data base.

Introduction to product development through CAD and CAE

Automated Process Planning : Process planning, general methodology of group technology, code structures variant and generative process planning methods, AI in Process planning, Process software.

CNC Technology : Integration of CNC machines in CIM environment, DNC-Flexible Manufacturing systems.

Manufacturing System Software : MRP-II software, production control software, Forecasting, Master production schedule, Materials requirements planning, capacity Requirements planning, shop floor control, shop floor data collection techniques, Inventory management, purchase orders and receiving, financial control, bill of materials, standard product, rating job costing, marketing applications.

Robotics and Automated Quality Control: Application of robots in manufacture and assembly in CIM environment. Selecting assembly machines. Feeding and transfer of arts.

Data Communications and Technology Management : Technology issues, configurations management , database systems, management of technology, networking concepts. Manufacturing Automation Protocol(MAP) and Technical and off protocol(TOP).

Factory of future.

### **EXPERT AND DECISION SUPPORT SYSTEMS (PE 8124)**

Introduction to expert system ; History, Motivation, State of the art. Propositional Calculus, Predicate Calculus (first order), Horn clauses, Fuzzy expert systems: Fuzzy sets, Fuzzy logic. Expert system development tools(VP EXPERT) Decision theory, Individual decision making, Organizational Decision making, Concept of decision support Systems(DSS). Group and organizational DSSs, Executive DSSs, Data collection, Modeling support. System Analysis, Tools for determining systems requirements, Fact finding Techniques, Decision trees, Decision table, Structural analysis, Data flow analysis,

Data Flow diagrams, Data dictionary, system development life Cycle, Preliminary analysis, Feasibility study, systems design, conversion and maintenance.

## **ELECTIVE IV**

### **RAPID PROTOTYPING (PE 8125)**

Introduction : Engineering Manufacturing, Manufacturing Processes, Recent development.

Current Trends in Design and Manufacturing : Automation, Robotics, FMS and CAD/CAM. Computer Integrated Manufacturing and Concurrent Engineering. Rapid prototyping.

Generative Manufacturing Processes(GMP) for Rapid prototyping: General features and classification. Issues related to CAD and GMP software.

Overview of the Generative Manufacturing processes. Two dimensional layer by layer techniques : Stereo lithography(SL) with photo polymerization, Stereo lithography with liquid thermal polymerization, Solid Foil polymerization (SFP), Selective Laser Sintering(SLS), Selective Powder Binding(SPB), ballistic particle Manufacturing(BPM), Fused Deposition Modeling(FDM), laminated object Manufacturing (LOM), Solid Ground Curing(SGC), and Repetitive Masking and Depositing.

Direct Three-Dimensional techniques for R P : Beam Interference Solidification (BIS), Ballistic particle Manufacturing, Holographic Interference Solidification and programmable Moulding. High energy rate forming processes : Explosive forming processes, Electro hydraulic forming, Electro-magnetic forming.

Issue related to GMP's and Rapid Prototyping : Comparison of GMP characteristics, Building Metallic object by Generative Manufacturing processes. Advantages of GMP's. considerations for adopting R P. Technology.

### **MATERIALS MANAGEMENT (PE 8126)**

Nature, Scope and importance of materials management, materials cycle and The materials system.

Materials requirement – planning (Demand, Aggregate)

Management and organization of purchase function.

Make or buy decisions

Inventory control models

A B C analysis

Classification and codification

Standardisation, simplification and variety reduction  
Waste and Scrap disposal surplus management

Store keeping

Stores accounting

Stock verification

Stores layout and location system

Stores equipment and storage methods

Spare parts management

### **MAINTENANCE TECHNOLOGY AND SAFETY ENGINEERING (PE 8127)**

Definition, Importance, Purpose and results of maintainability efforts, Maintainability in product life cycle, maintainability tools : Failure mode, effect and critical analysis, fault tree analysis, Cause and effect diagram, total quality management, Reliability and maintainability, bath-tub curve, concept of repairability. Principle: Relative advantage, limitation and application of various maintenance strategies like, Preventive maintenance, predictive maintenance, Reliability based maintenance, Computer integrated maintenance etc. Concept and strategies for zero-technology and condition based maintenance. Maintainability testing, Costing, budgeting and control index for maintenance system. Industrial safety : Concept and relevance, Occupational diseases, Electrical and Mechanical Hazards, Personal Protective Equipment and clothing, Safety Responsibility and function of various functionaries and departments, employee training and safety.

### **ELECTIVE V**

#### **CONCURRENT ENGINEERING (PE 8128)**

Concurrent Engineering. Meaning and need. Review of Engineering Problem Solving methods. Description of methods of Analysis. Decision Making, Creativity and Information processing and their role in engineering. Discussion of Emerging engineering strategies of Total Design, Design for Manufacturing and Assembly, Quality Function Development, and Constraint networks.

Integration concurrent approaches with those of conventional. Implementation of current engineering in industrial environment especially those of IT and high speed computation.

## **PRODUCTIVITY ENGINEERING AND MANAGEMENT (PE 8129)**

Definitions and Basic concepts of Productivity : Introduction, Importance and factors affecting productivity. Productivity Engineering and Management.

Productivity Measurement at International, National and Industrial levels.

Productivity Measurement in companies / organizations: The need for productivity measurement in companies. Total productivity model.

Productivity Evaluation and planning in companies and organizations. Short term productivity planning models. Long term productivity planning models.

Productivity Improvement in companies and organizations :-

Productivity improvement concepts.

Technology-based productivity improvement techniques.

Material-based productivity improvement techniques.

Employee-based productivity improvement techniques.

Product-based productivity improvement techniques.

Task-based productivity improvement techniques.

Setting up a formal productivity improvement programme.

## **SYSTEM DYNAMICS (PE 8130)**

Introduction to System Dynamics and its application to industrial systems. Systems and systems enquiry: need for systems methods, methodologies for system enquiry. Elements of System Dynamics: structure, behavior, behavior of simple and complex structures. Flow diagrams, Influence Diagrams, Exercises in Flow and Influence diagramming. Equation Formulation and Familiarisation with DYMOSIM, DYSMAP and DYNAMO packages. Running programs to study dynamic behavior. Model validation, Policy design, testing and Analysis. Developing computer models for and understanding policy implications for Production – inventory systems, capacity acquisition, employment, and manpower planning, etc.

## **PRODUCTION PLANNING & CONTROL (PE 8131)**

Production Control: Production system, Types of manufacturing systems and their characteristics. Objective and functions of production planning and control. Demand forecasting, common techniques of demand forecasting, Production planning, Estimating factors of production, routing, product mix and batch size decisions. Loading and scheduling, loading and scheduling techniques. Application of transportation model and assignment model in loading and scheduling, Dispatching, progress report and corrective measures.

Inventory Control : Field and scope of Inventory control, Inventory types and classification. Inventory control models, Static model, Dynamic model both deterministic and stochastic, Economic lot size, reorder point and their applications, ABC analysis and value analysis, Modern practice in purchasing and store keeping. Material requirement planning(MRP) – Manufacturing Resource planning(MRP II). Japanese approach to inventory management : JIT, KANBAN.

Value Engineering : Introduction, Different phase of value Engineering.  
Concept of productivity.

Aggregate Planning : Introduction, Nature of Aggregate planning, Costs, problem structure, Methods of Aggregate planning.

Introduction to Capacity planning.

## **QUALITY AND RELIABILITY ENGG. (PE 8132)**

Control chart : Introduction to quality control, objectives, applications and cost consideration. Control charts, general theory of control charts, Control charts for variables and attributes, Theory and application of control charts for averages, ranges, standard deviation, fraction defective and number of defects, Process capability study, Interpretation of control chart. Acceptance sampling : Elementary concepts, sampling by attributes, single, double and multiple sampling plans, construction and use of o.c. curves, Sequential sampling techniques. Concept of quality circle. ISO -9000 Quality systems. Total quality control-quality and competitiveness in a Global Market place, Establishing a customer focus. Employee involvement. Six sigma, Introduction to Taguchi methods.

Reliability concept, Failure-statistics: Failure density, Failure rate, Probability of failure, Mean failure rate, mean time to failure(MTTF), mean time between failure(MTBF).Graphical plots.

Hazard Models :

Introduction, Constant Hazard, Linearly increasing Hazard, The weibull model.

Distribution functions and Reliability analysis.

Hazard Rate as Conditional Probability.

System Reliability :

Introduction, Series configuration, Parallel configuration, Mixed configuration.

Application to specific Hazard Models.

Reliability analysis of (i) Complex systems and (ii) Systems not reducible to mixed Configuration. Mean time to failure of systems. Logic diagrams, Markov Models.

Reliability Improvement :

Improvement of components, Redundancy (Element redundancy, Unit redundancy, Stand by redundancy), Optimization, Reliability Cost Trade-off.

Calculation of Reliability from :

(i) Fault tree analysis (ii) Tie set and Cut-set methods (iii) by use of Boolean Algebra.

Maintainability and Availability :

Introduction, Maintainability, System downtime, Availability, Inherent Availability, Achieved Availability, Operational Availability, Reliability and Maintainability Trade-off.