SEMESTER-III

THEORY

BPE 201: BASIC MANUFACTURING PROCESSES (3-1-0)

Module – I

Manufacturing process: Definition, Classification of manufacturing process, Sand Casting : Pattern – materials, allowances, types, molding types, molding procedure , molding and properties, testing of molding sand, cores, core materials, properties of core making. Melting and founding of cast iron, degasification, design of casting and risering, pouring and feeding of casting, casting defects and inspection. [10]

Module II

Special casting: Shell mould casting, investment casting, permanent mould casting, Die casting, and centrifugal casting. [05]

Module – III

Fusion welding processes: Introduction, oxy-fuel gas welding, arc welding processes-I (consumable electrode): principle, equipment, power sources, principle of metal transfer, Electrodes, Submerged arc welding, Gas Metal Arc Welding, arc welding processes-II (non-consumable electrode): Gas Tungsten Arc Welding, Plasma Arc Welding, Other welding processes: Thermit welding, Brazing, soldering, Laser beam welding, Gas and Arc cutting, Defects in welding. [10]

Solid state welding process: Introduction, Cold welding, Ultrasonic welding, Friction welding, Resistance welding, [04]

Module – IV

Metal Removal Process:

Turning:	Turing Lathe, Capstan & Turret lathe, Tool layout	[02]
Milling:	Milling Process, Up and Down Milling, Indexing	[02]
Drilling:	Drilling Process	[01]
Grinding:	Types of Grinding, Wheels specification, Dressing, Centerless grinding	[02]
Shaping and Planning:	Processes, Quick Return mechanism	[02]
Super finishing Processes:	Lapping, Honing, Buffing	[02]

TEXT BOOK(S):

1. Manufacturing Technology (Foundation Forming & Welding)- P.N. Rao, Tata McGraw Hill.
2. Principles of manufacturing materials and processes- J.S.Campbell, Tata McGraw Hill.
3. Workshop Technology- Hazara and Chowdhury

REFERENCE(S):

1. Principles of manufacturing materials and processes- J.S.Campbell, Tata McGraw Hill.
2. Manufacturing Engineering and Technology, 4^{th} Edition- S.Kalpakjian and S.R. Scsimid, Pearson Education.
3. Materials and processes in manufacturing- DeGarmo, Black and Kohser, Prentice Hall of India.
4. Principle of Metal Casting- Heine, Loper and Rosenthal, Tata McGraw Hill.

SESSIONAL

BPE 291: PRODUCTION PRACTICE-I (0-0-3)

1. Turning Shop: Job on Centre Lathe with taper & thread cutting. Study of Turret lathe.
2. Machine Shop: Gear cutting using index head on milling machine and Gear hobbing machine.
3. Job on planner and slotting machine and surface grinding machine.

SEMESTER-IV

BPE 202: THEORY OF MACHINE (3-1-0)

Module-I

Mechanism: Basic Kinematic concepts and definitions, mechanism, link, kinematic pair, classification of kinematic pairs, degree of freedom, kinematic chain, binary ternary and quaternary joints and links, degrees of freedom for plane mechanism, grubler's equation, inversion of mechanism, four bar chains and their inversions, single slider crank chain, double slider crank chain and their inversion. [10]

Module-II

Friction of a screw and nut, square threaded crew, V-threaded screw, pivot and collar, friction circle, friction axis, friction clutches, transmission of power by single plate, multiplate and cone clutches. [06]

Gear trains: simple train, compound train, reverted train, epicyclic train and their application. [04]

Module-III

Toothed gears: Theory of shape and action of tooth properties methods of generation of standard Tooth profiles, Standard proportions, Interference and Under-cutting, methods of Eliminating Interference, Minimum numbers of teeth to avoid interference. [06]

Cams: Simple harmonic, constant velocity and constant acceleration types. Displacement, velocity and acceleration of follower. Cams with specified Contours. [04]

Module-IV

Governors: Centrifugal Governors-watt and Porter Governors, Spring loaded Governor-Hartnell Governor ,sensitiveness, stability, Isochronism ,Hunting, Governor effort and power, curves of controlling force. [06]

Balancing: Balancing of revolving masses in one plane and different planes, Partial balance of single cylinder engine. [04]

TEXT BOOK(S):

1. Theory of machines – SS Ratan, Tata McGraw Hill.
2. A Textbook of theory of machines (in S.I units) – R.K.Bansal, Laxmi Publication.

REFERENCE(S):

1. Mechanism and machine Theory- Rao and Dukkipati, Wiley Eastern Ltd.
2. Theory of Machines –Thomas Beven.
3. Mechanism and Machine Theory: Ambedkar, PHI Pvt. Ltd.

BPE 203: STRENGTH OF MATERIALS (3-1-0)

Module-I

Analysis of axially loaded members: Composite bars in tension and compression-temperature stresses in composite rods-statically indeterminate problem. [04]

2D Stress system, Principal Planes, Principal stress, Mohr's stress circle, Members in biaxial state of stress: Stresses in thin cylinders, thin spherical shells under internal pressure-wire winding of thin cylinders. [04]

Strain & deformation: Two dimensional state of strain, Principal Strains, Calculation of principal stresses from principal strains, Strain measurement. [04]

Module-II

Shear force and bending moment diagrams for simple beams: Support reactions for statically determinate beams, relationship between bending moment and shear force, shear force and bending moment diagrams. [06]

Simple bending of beams: Theory of simple bending of initially straight beams, distribution of normal and shear stress, composite beams. [04]

Module-III

Torsion in solid and hollow circular shafts, Twisting moment, strength of solid and hollow circular shafts, Strength of shafts in combined bending and twisting, Close-coiled helical springs. [06]

Deflection of Beams: Slope and deflection of beams by integration method and area-moment method. [04]

Module-IV

Buckling of columns: Euler's theory for initially straight columns with various end conditions. [04]

Theories of failure: maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, Maximum strain energy theory and maximum distortion energy theory. [04]

TEXT BOOK(S):

1. Strength of Materials- G.H.Ryder, Macmillan India.
2. Mechanics of Materials- J.M.Gere and S.Timoshenko.

REFERENCE(S):

1. Mechanics of Materials-I- E.J. Hern; Paragaman.
2. Introduction to Mechanics of Solids- Crandell, Dahl and Lardner, McGraw Hill.

SESSIONAL

BPE 292: DYNAMICS & PRODUCTION LAB. (0-0-3) *To conduct any six, three from each lab.*

Dynamics lab.

1. Determination of gyroscopic couple.
2. Performance characteristics of spring loaded governor.
3. Determination of critical speed of rotating shaft.
4. Experiment on static and dynamic balancing apparatus.
5. Determination of natural frequency under damped and un-damped vibration.
6. Study of interference and undercutting for gear.

Production lab.

1. Determination of green compressive strength of moulding sand.
2. Determination of grain fineness number of moulding sand.
3. Determination of clay content in moulding sand.
4. Determination of permeability of moulding sand.

BPE 293: PRODUCTION PRACTICE-II (0-0-3)

1. Welding: Study of basic principle of Arc (A.C and D.C) and Gas Welding. A welding joint will be prepared by each student.
2. Study advanced welding technique TIG and MIG.
3. Foundry Shop: Al-sand casting, study of melting furnace.
4. Study of Brazing and Soldering process.

SEMESTER-V

THEORY

BPE 301: THEORY OF METAL CUTTING (3-1-0)

Module-I

Basic shapes of machine tools. Wedge action, function of different angles of cutting tools, tool geometry, and Nomenclatures ASA, ORS systems. Conversion of angles, geometry of twist drill & slab milling cutter, grinding of single point cutting tool. Tool materials. [06]

Mechanism of chip formation: Mode of failure under stress- fracture & yielding mechanism. Types of chips, Factors involved in chip formation, shear plane, effect of cutting variable on chip reduction coefficient, chip formation in drilling and milling. [04]

Module-II

Force system in turning- Merchant circle diagram, velocity relationship .Stress in conventional shear plane, Energy of cutting process, Ernst & Merchant angle relationship, Forces in drilling and plane slab milling. Measurement of forces-dynamometer for measuring turning & drilling forces. [12]

Module-III

Thermodynamics of chip formation: The shear plane temperature-interface temperature from dimensional analysis-Experimental determination of chip tool interface temperature. Coolants-Theory of cutting fluid action at the chip tool interface, Techniques for application of cutting fluids. [10]

Module-IV

Tool wear: Criteria of wear. Machinability and tool life, Flank wear. Taylor's tool life equation, Crater wear, Causes and mechanism of tool failure. Vibration & chatter in machining. Economics of metal machining. [08]

TEXT BOOK(S):

1. Metal cutting Theory & Practice- A.Bhattacharya, C.B.Pub.
2. Production Technology- P.C Sharma.

REFERENCE(S):

1. Fundamentals of Metals machining & machine Tools- Boothroyd- International student Edition.
2. Theory of Metal cutting- Milton Shaw

BPE 302: MATERIALS ENGINEERING & METALLURGY (3-1-0)

Module-I

Introduction to materials- Metal and alloys, ceramics, polymers and semiconducting materials—introduction and application as engineering materials. Defects in solids- Point, line and surface defects. Diffusion in solids. Deformation of metals- Elastic and plastic deformation, slip, twin, dislocation theory, critical resolved shear stress, Bauschinger's effect, work hardening, recovery, recrystallization and grain growth. [10]

Module-II

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, Isomorphous alloy system, Types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, lever rule, coring, miscibility gaps – eutectic reactions. [08]

Module-III

Transformation in solid state, allotropy, order-disorder transformation, eutectoid, peritectoid reaction and complex phase diagrams, relation between equilibrium diagrams and physical properties of alloys. Study of important binary phase diagrams Fe-Fe3C. Phase transformations in steels pearlitic, martensitic and bainitic transformations cooling curves. Isothermal transformation diagrams, transformations on continuous cooling. [12]

Module-IV

Heat treatment- Iron-carbon system. Annealing, normalising, hardening, critical cooling rate, hardenability, age hardening, surface hardening, tempering, Thermal properties- High temperature materials, materials for cryogenic application, thermally insulating materials. (Specific heat, thermal conductivity, thermal expansion). Steels: High Speed Steel, Stainless Steel and Tool Steels. [10]

TEXT BOOK(S):

1. Introduction to Physical Metallurgy – S.H. Avner, TMH.
2. Material Science and Engineering- V.Raghavan, PHI.

REFERENCE(S):

1. Physical Metallurgy – Y.Lakhtyn, MIR.
2. Physical Metallurgy - V. Raghavan, PHI.
3. Elements of Material Science and Engineering- L .A. Vanblack. Addison-Wesley (Indian edition).
4. Material Science and Engineering: An Introduction- W.D.Callister, Wiley.

BPE 303: DESIGN OF MACHINE ELEMENTS (3-1-0)

Module-I

Morphology of design process, Basic requirements for machine, elements and machines, Design procedures, Engineering Materials, their properties and Manufacturing considerations in design.

Design of fastening elements: Riveted and welded joint for pressure vessels & structural joints, Design of bolted joint, cotter and knuckle joints. [14]

Module-II

Design of shaft, keys and couplings. Design of belt and rope drives, pulleys. [08]

Module-III

Design of springs: closed coil helical springs of circular section. Concentric springs, spiral springs and leaf springs. Theory of failure: Application to practical problems. [10]

Module-IV

Design of engine components, Clutches, Piston and Connecting rod [08]

TEXT BOOK(S):

1. Design of Machine Elements- V.B.Bhandari, TMH.
2. Machine Design- P.C.Sharma & D.K.Agarwal, S.K.Kataria and Sons.

REFERENCE(S):

1. Mechanical Engineering Design- Shigley, Mischke, Budnyas, McGraw Hill.
2. Design Data Handbook- K. Mahadeban & K. Balaveenath Reddy

BPE 304: INDUSTRIAL MANAGEMENT & OPERATION RESEARCH (3-1-0)

Module-I

Concepts of Management and Organization – Functions of Management, Evolution of Management Thought : Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Mayo's Hawthorne Experiments, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs, Systems Approach to Management. [08]

Module-II

Designing Organizational Structures : Basic concepts related to Organization - Departmentation and Decentralisation, Types of mechanistic and organic structures of organization (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundaryless organization, inverted pyramid structure, lean and flat organization structure) and their merits, demerits and suitability. [10]

Module-III

Linear Programming: Problem Formulation, Graphical solution, Simplex method, Transportation Problem: Formulation, Optimal solution, unbalanced transportation problem. Assignment problem: Formulation, Optimal solution, Variants of Assignment Problem- Traveling Salesman problem.

Theory of Games: Minimax (maximin) Criterion and optimal strategy, Solution of games with saddle points, Rectangular games without saddle points, 2x2 games, dominance principle.

[12]

Module-IV

Waiting Lines: Single Channel, Poisson arrivals, exponential service times, with infinite population and finite population models.

Inventory: Single item, Deterministic models, Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

[10]

TEXT BOOK(S):

1. Manufacturing Organization and Management- Amrine, Pearson.
2. Introduction to Operations Research- Taha, PHI.
3. Operations Research- R.Pannerselvam, PHI.

REFERENCE(S):

1. Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai & Sons.
2. Operations Research- S.D.Sharma-Kedarnath.
3. Introduction to Operations Research- Hiller & Libermann, TMH.

BPE 391: Production Engg.Lab.I (Metal Cutting)

1. To observe the variation of horizontal and vertical forces with variation in cutting speed, depth of cut and feed using a lathe tool dynamometer.
2. Study of chip formation in different speed and feeds.
3. Determination of cutting forces in drilling in drill tool dynamometer.
4. Study of vibration and tool chatter during cutting.

BPE 392: Optimization Lab. (0-0-3)

1. Solving LPP, Transportation and Assignment Problem and other Optimization problem with the help of Excel Add-In: Solver or with the Software LINDO/LINGO.
2. Sensitivity analysis of optimization problems
3. Writing simple codes for GA optimization problem.

BPE 393: Design of Machine Element Sessional (0-0-3) (Any six)

1. Design drawing of riveted joint
2. Design and drawing of cotter joint
3. Design and drawing of knuckle joint
4. Design of shafts subjected to combined loading
5. Design and drawing of flange coupling
6. Design of spring
7. Design of clutch
8. Design of connecting rod
9. Design of piston

SEMESTER-VI

BPE 305: PRODUCTION & OPERATION MANAGEMENT (3-1-0)

Module I

Operations function in an organization, Manufacturing vs. Service operation. Design in products, services & processes, new product design, Product life cycle, Process technology: project, job shop, batch, assembly line, continuous manufacturing, Process technology life cycle, Process technology trends, FMS, CIM, CAD, CAM, GT, Design for services, Services process technology. Value Engineering, Standardization, Make or buy Decision. [04]

Job Design & work Measurement, Method study: Techniques of analysis, recording, improvement & standardization. Work measurement: work measurement principles using stop watch time study, predetermined motion time standard & work sampling, standard time estimation. [04]

Module II

Forecasting: Principles & methods, moving average, double moving average exponential smoothing, double exponential smoothing, Forecasting error analysis. [04]

Facility location: Factor influencing plant & warehouse location, impact of location on cost & revenue. Facility location procedure & models; qualitative models, Breakeven analysis, Single facility location model, Multi facility location model, Minimax location, Total & partial covering model. [06]

Layout planning: layout types; Process layout, Product layout, Fixed position layout, Systematic layout planning, CRAFT. [04]

Module III

Manufacturing planning & control: Aggregate planning, Master production scheduling, Rough-cut capacity planning, Material requirement planning, Capacity requirement planning, Loading, scheduling & dispatching function, progress monitoring, & control. [04]

Sequencing and scheduling: Single machine scheduling: Basics and performance evaluation criteria, methods for minimizing mean flow time, parallel machines: minimization of makespan, flowshop sequencing: 2 and 3 machine cases: Johnson's rule and CDS heuristic. Jobshop scheduling: priority dispatching rules. [06]

Module IV

Project management: Project management through PERT/CPM. Network construction, CPM, Network Calculation, crashing of project network, project scheduling with limited resources, line of balance. [04]

Modern trends in manufacturing: Just in Time (JIT) system, shop floor control by Kanbans, Total Quality management, Total Productive Maintenance, ISO 9000, Quality Circle, Kaizen, Poka Yoke, Supply Chain Management. [04]

TEXT BOOK(S):

1. Production systems: planning analysis and control- J.L.Riggs, John Wiley.
2. Production and Operations Management- R.Panneerselvam, PHI.

REFERENCE(S):

1. Production and Operation Management- E.E.Adam and R.J.Ebert, PHI.
2. Production and Operations Management- S.N.Chary, Tata McGraw Hill.

BPE 306: INSPECTION AND METROLOGY (3-1-0)

Module-I

Metrology: Need of Inspection, Precision and accuracy, Accuracy and cost, Sources of error, Types of error, and Geometry of form on shape. Line standard, end standard, limits, fits, tolerances-Hole & shaft basis system, Interchangeability, selective assembly, ISO system for limits & fits, Limit gauges-Snap, plug, ring, taper, position gauges-Gauge design, Taylor's principle. Wear allowance, Screw allowance Screw thread gauge, Thread pitch gauge. [10]

Module-II

Comparators- Characteristics, Relative Advantages of various types of comparators-Mechanical, optical, Pneumatic, Fluid displacement type, Measurement by light wave Interference optical flat. [06]

Measurement of straightness- Autocollimator flatness testing measurement of circularity-types of irregularities. Angular measurement-Sine bar, Sine center,angle gauges, measurement of angle of tapered hole. [06]

Module-III

Surface Measurements- Roughness and waviness, Surface texture, cut off length, RMS & CLA values, Surface roughness measuring instruments, Principle of working. [04]

Metrology of screw thread- Errors in threads, measurement of element of threads, 2-wire &3-wire methods, Measurement & testing of gears-Measurement of error, rolling test, gear tooth calliper, base tangent comparator. [06]

Module-IV

Non destructive testing- X-ray examination, radiography, Ultrasonic inspection, magnetic test, machine vision system-principle, application, Laser inspection. [08]

TEXT BOOK(S):

1. Engineering Metrology- R.K. Jain
2. Production Technology- P.C. Sharma

REFERENCE(S):

1. Engineering Dimensional Metrology- Miller, Edward Arnold pub.
2. Precision Engineering in Metrology- R.L. Murty, New Age Int.

BPE 307: STATISTICAL METHODS & DESIGN OF EXPERIMENTS (3-1-0)

Module I

Sampling Distribution, Types, Random Sampling, Sample Size & Standard Error, Point Estimate, Hypothesis testing, Hypothesis testing of mean with different conditions, differences in mean, Chi squares as test of independence, test of goodness fit. [08]

Module II

Experiments with single factor, Analysis of variance, Fixed effect model, Estimation of model parameters, Comparison of individual treatment means, Orthogonal contrasts, Schaffer method of comparing contrasts, Comparing pairs of treatment means. Model adequacy checking, plot of residuals, Choice of sample size, OC curves, Method of CI estimation, Fitting response curves, regression approach orthogonal polynomials. [10]

Module III

Factorial Design, Two factor factorial design, Statistical analysis of fixed effect model, Estimation, Choice of sample size, Random & Mixed model, Fitting response curves and surface. General factorial design. [06]

2^k Factorial Design, single replicate, Addition of center points to 2^k design, Yates algorithm for 2^k design, 3^k design, Yates of Algorithm for 2^k design. [06]

Module IV

Response surface methods & design, Methods of steepest Ascent, Analysis of 2^{nd} order model. Fitting response surface, evolutionally operation. [06]

Taguchi contribution to experimental design; Quality engineering, Philosophy, Taguchi approach to parametric design. [04]

TEXT BOOK(S):

1. Statistics for Management- Richard I. Levin , PHI.
2. Design & Analysis of Experiments- D.C. Montgomery, John Wiley & Sons.

REFERENCE(S):

1. Design and Analysis of Experiments- J.Antony, Butterworth-Heinemann.
2. Statistics for Engineers: An introduction- J.Morrison, WileyBlackwell.

BPE 308: TOOL DESIGN (3-1-0)

Module I

Design of single point cutting tools, tool strength and rigidity calculation, selection of tool angles, chip breakers, carbide tipped tools, High production cutting tools. [06]

Form Tools; Method of determining the profile of circular and flat form tool, analytical and graphical method. [04]

Module II

Cutting process in broaching, Geometric elements of broach teeth, Design of internal & external surface broach, Calculation of no. of teeth, Rigidity, Cutting force, Power. [06]

Forging Design-Upset forging, Forging allowances, Forging die design, Drop forging dies and auxiliary tools. [04]

Module III

Design for sheet metal works, Press working shearing action center of pressure, clearance cutting force, die block design, punch design, punch support, stop, pilot stripper, knockout, blanking & piercing die design, progressive & compound die design, drawing dies, metal flow, Blank diameter, Drawing force. [10]

Module IV

Jigs & fixture design; Location & clamping, principles of location clamping devices, materials for locating & lamping elements, Design principles, Design of drilling jig, Milling fixture. [10]

TEXT BOOK(S):

1. Fundamental of tool Design- ASTME, PHI.
2. Metal cutting theory & cutting tool design- Arshinov.
3. A Text Book of Production Engineering- P.C. Sharma, S.Chand & Co.

REFERENCE(S):

1. Tool Design- Donaldson, Le Cain & Goold, TMH.
2. Fundamental of tool Engineering Design- Basu, Mukherjee & Mishra, Oxford & IBH.

BPE 309: THEORY OF METAL FORMING (3-1-0)

Module I

Review of two dimensional stress and strain, state of stress in three dimensions, Stress tensor, Invariants, Mohr's circle for 3-dimensional state of stress, strain at a point- Mohr's circle for strain, Hydrostatic & Deviatory components of stress, Elastic stress-strain relations. [08]

Module II

Elements of theory of plasticity; Flow curve, True stress & true strain, Yield criteria for ductile metals, Von Misses & Teresa yield criteria, combined stress tests. The yield locus, Anisotropy in yielding, Yield surface, levy-Misses, Prandtl-Reuss Stress-Strain relation, Classification of forming processes variables in metal forming and their optimization. [10]

Module III

Analysis of deformation processes- Method based on homogeneous compression slip line field theory, Upper bounds and lower bounds, Slab method of analysis. [06]

Flow stress determination, Hot working, Cold working, Strain rate effect, Friction and lubrication, Deformation zone geometry, Workability, Residual stress. [06]

Module IV

Analysis of metal forming processes(only limited portion), Forging: Load calculation in plane strain forging, Rolling: Forces & geometrical relationship in rolling, Rolling load and torque in cold rolling, Von-Karman work equation, Extrusion: Analysis of extrusion process, extrusion pressure, Drawing: Drawing load [10]

TEXT BOOK(S):

1. Mechanical Metallurgy: By- Dieter, Mc Graw Hill Book Co.
2. Plasticity- Chakraborty- McGraw Hill.

REFERENCE(S):

1. Engineering Plasticity: BY- Johson & Mellor, Van Nostrand.
2. Metal working –Avitzur, Mc Graw Hill
3. Industrial Metal working- G.W. Rowe

SESSIONAL

BPE 394: Production Engg .Lab.II (Metrology) **(0-0-3)**

1. To study the large tool maker's microscope and to measure the pitch, depth and angle of the thread of a given specimen.
2. Calibration of slip gauge using sine bar.
3. To study the gauge blocks or slip gauge to measure the diameter of holes and distance between their centres.
4. To measure displacement by means of LVDT transducer.
5. Gear measurement and inspection.

BPE 395: Production Engg. Lab.III (Simulation Lab.) **(0-0-3)**

1. Generation of Pseudo-random numbers
2. Chi-square test as test of independence.
3. Single factor ANOVA test for equality of means.
4. Hypothesis testing of means with different conditions.
5. Two factor factorial design.
6. Chi-square test as test of goodness of fit.

BPE 396: Production Engg. Lab.IV (Metal Forming) **(0-0-3)**

1. Bend Test.
2. Sheet Metal Forming
3. Deep Drawing.
4. Forward Extrusion and Backward Extrusion.
5. Wire drawing.

BPE 397: Tool Design Sessional (0-0-3)

1. Determination of tool geometry in ASA, ORS and NRS.
2. Design of single point cutting tool.
3. Design of form tool.
4. Design of internal and surface broach tool.
5. Design of progressive and compound die for sheet metal.
6. Design for Jig for 2D and 3D jobs.

SEMESTER-VII

THEORY

BPE 401: NON-TRADITIONAL MACHINING (3-1-0)

Module-I

Introduction: Need for Non-traditional Machining, Classification, process selection. Ultrasonic machining: Principle, Transducer, Magnetostrictive material, Analysis for Material Removal Rate by Shaw, Effect of process parameters, Application. [08]

Module-II

Abrasive Jet Machining: Principle, Application, Advantages and disadvantages, Variables in AJM, Water Jet Machining- Jet Cutting equipment, Principle, advantages, Practical Application. [06]

Electrochemical Machining: Principle, Faraday's law, Material Removal Rate, Dynamics of ECM process, Tool design, Advantages, Application, Limitation, Electro –chemical grinding, Deburring and Honing. [06]

Module-III

Electro Discharge Machining: mechanism of material removal, Basic EDM circuitry and principles of operation, Analysis of relaxation circuits, Concepts of critical resistance, Machining accuracy and surface finish, Tool Material, Dielectric fluid, Application limitation. [06]

Laser Beam Machining: Lasing process and principle, population inversion, Principle of Ruby laser, Nd: YAG Laser and CO2 Laser, Power control of laser output, Application. [06]

Module-IV

Electron Beam Machining: Basic principle, Controlling parameters and focal distance, Application. Ion Beam Machining: Principle and Mechanism, Application. [04]

Plasma Arc Machining: generation of Plasma, Equipments, Torch, Classification, Direct and indirect torches and applications, parameters effecting cutting, Advantages. [04]

TEXT BOOK(S):

1. Modern machines process- P.C.Pandey and H.S.Shan. TMH
2. Non Conventional Machining- P.K.Mishra,Narosa.

REFERENCE(S):

1. Manufacturing Processes- Amstead, Ostwald & Begeman, John Wiley & Sons.
2. Processes and Materials of Manufacturing- Lindberg, PHI.

BPE 402: AUTOMATION AND NUMERICAL CONTROL MACHINES (3-1-0)

Module-I

Introduction: Automation, types, Reasons for automation, Types of production, Functions in manufacturing, Automation Strategies, Costs in manufacturing. [02]

Flow Lines: Automated Flow lines, transfer mechanisms, Automation for machining operations, Line balancing- basic concepts, general procedure, rank positional weight method.computer aided line balancing (CALB), Manual & Flexible assembly line, Automated assembly systems-Types, Part feeding device. [08]

Module-II

Fundamentals of CAD: The design process, Application of computer for design, automated drafting, creating manufacturing data base, benefits of CAD, Design workstation – graphic terminal, operator input and output devices, Software of graphic system- graphic package, Data Base Structure, Wireframe Model and Solid Model, Graphics standards. [08]

Module-III

Numerical Control: Components of NC system, NC procedure, NC co-ordinate system, motion control, applications, NC part programming-manual part programming, computer assisted part programming, ATP language-macro statements, programming with interactive graphics, NC part programming using CAD/CAM. Writing simple part programme. [08]

Computer control in NC: Problems with conventional NC. Controller technology, CNC, DNC Adaptive Control. [04]

Module-IV

Automated material handling: Type of equipment, Principles of material handling, Conveyor system. [04]

Group Technology cell formation: Part classification & coding, Rank order clustering method for machine component assignment. Computer Aided Process Planning (CAPP) - Retrieval & Generative type process planning system. [06]

TEXT BOOK(S):

1. Automation, Production System and CIM- M.P.Groover, PHI.
2. CAD/CAM- Groover & Zimmers, PHI.

REFERENCE(S):

1. CAD/CAM/CIM- Radhakrishnan & Subramanyan, Wiley Eastern.
2. CAD/CAM Theory and Practice- I. Zeid, TMH.

BPE 403: PRINCIPLES OF MACHINE TOOLS (3-1-0)

Module-I

General classification of machine tools, working and auxiliary motions, hydraulics transmission and its elements, mechanical transmission and its elements, general requirement of machine tools. [02]

Kinematics of Machine Tools:- Stepped and stepless drive, basic consideration in the design of drives, variable speed range in machine tools, graphical representation of speed, structure diagram, selection of optimum ray diagram, design of speed and feed gearboxes, stepless regulation of speed and feed rates. [08]

Module-II

Machine Tool Structure: Design criteria, materials, static and dynamic stiffness, basic design procedure, design of beds and columns, model technique in design of machine structures. [08]

Module-III

Guide ways and Power Screw: Classification of guide ways, material and lubrication, design criteria and calculation of slide ways, design of guides under hydrostatic lubrication, aerostatic sideways, antifriction guide ways, combination guide ways, classification of power screws, design principle of power screw, recirculation power screw assemblies, elimination of backlash. [08]

Machine Tool Spindles and its bearings: Materials of spindles, effect of machine tool compliance on machining accuracy, design principles of spindles, antifriction and sliding bearings. [04]

Module-IV

Control system in Machine Tools: Classification, control, Changing speeds and feeds, ergonomic considerations applied to design of control members, principle of automatic and adaptive control. [06]

Vibration and chatter in Machine Tools: Forced vibration, Self-excited vibration, stick-slip vibration and its minimization, Vibration isolation. [04]

TEXT BOOK(S):

1. Machine Tool Design- N.K.Mheta,TMH

REFERENCE(S):

1. Design of Machine Tools- S.K.Basu and D.K.Pal, Oxford & IBH.
2. Principle of Machine Tools- G.C.Sen and A.Bhattacharya, New Central Book Agency

BPE 404: PE-I: PRODUCTION INVENTORY SYSTEM (3-1-0)

Module-I

Importance of Inventory in production distribution system, Purchasing- Functions, procedures-value analysis in purchasing-Vendor selection, Rating and development- Buying seasonal commodities, Purchasing under uncertainty, Purchasing capital equipments, Public buying. Stores Management- location & layout, Stores System, Scrap disposal. [06]

Inventory System: Concept, Function, Inventory Cost, Inventory models assuming certainty & risk, Quality discount, Economical order quantity, Economical manufacturing batch size, Safety stock, Joint ordering policy- Probabilistic Inventory system: (Q, R) and (R, S) policies. [06]

Module-II

Inventory Management: ABC analysis, VED analysis, perpetual inventory system, periodic inventory system, Japanese inventory system. [04]

Material Requirement Planning: Bill of material, Level coding, Master production scheduling, Gross requirement determination, Net requirements, Lot size determination techniques (Wagner-Whitin, Silver-Meal heuristic, Part-periodic balancing), Offsetting, Safety stock in MRP. [06]

Module-III

Manufacturing Resource Planning: MRP under certainty constraints, Capacity requirement planning, Just-in-time concept: pull & Push system, Essential conditions of JIT application, Practical Implementation of JIT through Kanban & other systems. [08]

Module-IV

Physical distribution of Materials: Finished product-Classification, Product features, Brand decisions, Packaging decisions, Labelling decisions, Product line decision, Distribution channel-nature, function, Channel behavior, physical distribution-warehousing, Transportation, Placing-products-retelling & wholesaling, Advertising-media selection, Sales promotion personal selling. [10]

TEXT BOOK(S):

1. Production System- J.LRiggs, John Wiley & Sons.
2. Material Management- P.Gopalkrishanan and M.Sundaresan, PHI.

REFERENCE(S):

1. Modern Production/ Operation Management- Buffa and Sarin, John Wiley & Sons.
2. Manufacturing Planning and Control- Vollman & Berry, Prentice Hall.
3. Decision System for Inventory Management and Production Planning- Peterson and Silver, John Wiley & Sons.

BPE 405: PE-I: ADVANCED CASTING AND WELDING (3-1-0)

Module-I

Casting processes: Classification, Metal mould casting processes, advanced casting processes, investment casting, Rheocasting, mould and core making materials and their characteristics. [04]

Technology of Selected casting Processes: Clay bonded, synthetic resin bonded, inorganic material bonded mould and core making, sand additives, mould coating, continuous casting process, centrifugal casting process. [06]

Module-II

Casting defects, inspection, diagnosis and rectification, mechanization and automation in foundries, use of robots, casting design, near net shape casting, pollution control, energy and waste management in foundries. [04]

Physics of welding arc, characteristics of arc, modes of metal transfer, welding fluxes, electrode coating, classification of electrode, characteristics of welding power source, pulsed and inverter type power source, power source for resistance welding, weldability, weldability tests, Weldability of cast iron, Plain carbon steel, Determination of preheating temperature, Stainless steel, use of Scheffler' s diagram. [10]

Module-III

Heat flow in welding, significance, theory of heat flow, cooling rate determination, selection of welding parameters based on heat flow analysis, residual stress and its measurement, types and control of distortion. [08]

Module-III

Analysis of fatigue of welded joint, fracture and toughness testing and its application on welded joint, automated welded joint, microprocessor based of control resistance and arc welding, quality assurance in welding, effects of welding fumes on environment. [08]

TEXT BOOK(S):

1. Principle of Metal Casting- Heine, R.W. Loper ,C. Philip and C.R.Rosenthal, McGraw Hill.
2. Principle of Metal Casting- P.L.Jain,TMH
3. Manufacturing Technology- P.N.Rao,TMH
4. Welding Engineering and Technology- R.S. Parmar Khanna publisher

REFERENCE(S):

1. Metallurgy of Welding Technology-D. Seferian, Chapman & Hall
2. Welding and Welding Technology- R.Little, TMH.

BPE 406: PE-II: COMPUTER INTEGRATED MANUFACTURING (3-1-0)

Module-I

Introduction: The meaning and origin of CIM, The changing manufacturing and management scenario, External communication, Islands of automation and software, Dedicated and open systems, Manufacturing automation protocol, Product related activities of a company, Marketing engineering, Production planning, Plant operations, Physical distribution, Business and financial management. [06]

Computer Aided Process planning: Role of process planning in CAD/CAM integration, Approaches to computer aided process planning- Variant approach and Generative approaches, CAPP and CMPP process planning systems. [04]

Module-II

Shop Floor Control and FMS: Shop floor control-phases, Factory data collection system, Automatic identification methods- Bar code technology, Automated data collection system, FMS-components of FMS - types -FMS workstation, Material handling and storage systems, FMS layout, Computer control systems-application and benefits. [10]

Module-IIII

CIM Implementation: CIM and company strategy, System modeling tools-IDEF models, Activity cycle diagram, CIM open system architecture (CIMOSA), Manufacturing enterprise wheel, CIM architecture, Product data management, CIM implementation software. [06]

Data Communication: Communication fundamentals, Local area networks, Topology, LAN implementations, Network management and installations. [04]

Module-IV

CIM System: Open System Open systems inter connection, Manufacturing automations protocol and technical office protocol (MAP /TOP). [04]

Database for CIM: Development of databases, Database terminology, Architecture of database systems, Data modeling and data associations, Relational data bases, Database operators, Advantages of data base. [06]

TEXT BOOK(S):

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.
2. Computer Integrated Manufacturing System- Y. Koren, McGraw-Hill.

REFERENCE(S):

1. CAD/CAM/CIM- P. Radhakrishnan, S. Subramanyan and V. Raju- New Age International.
2. Computer Integrated Manufacturing- Paul G. Ranky, Prentice Hall International.

BPE 407: PE-II: MECHATRONICS (3-1-0)

Module-I

Introduction: Introduction to Mechatronics: Mechatronic system, measurement systems, control systems and response of systems, Open and Closed loop System, Transfer Function, Sequential Controller, Microprocessor based controller. [04]

Basic System models: Mathematical models, Introduction to Mechanical, Electrical, Fluid and Thermal systems, Rotational and Transnational systems, Electro-Mechanical, Hydraulic-Mechanical systems. [04]

Module-II

Sensors and transducer: Desirable features, Displacement, position and proximity sensors, Velocity, motion and Force sensors, Time of flight sensors, Binary force sensor, temperature and Pressure measurement, Sensor selection. [04]

Actuation Systems: Actuation Systems, Pneumatic and Hydraulic systems, Directional control valves, Rotary actuator, Mechanical actuation systems- Mechanical Systems, Electrical Actuation Systems- Electrical Systems, Relays and Solenoids, DC brushed motors, DC brushless motors, DC servo motors, Stepper Motors. Drive selection. [06]

Module-III

Microcontrollers: 8051 Microcontroller, Microprocessor structure, Digital Interfacing, Analog Interfacing, Applications Programming- Assembly/ C (LED Blinking, Controlling a stepper motor). [06]

Interfacing: Interfacing microcontrollers with general purpose three-state transistors, interfacing relays, Interfacing solenoids, Interfacing stepper motor, Interfacing with sensors, Interfacing with RS 232 and RS485. [06]

Module-IV

Programmable Logic Controllers: Basic Structure, Programming- Ladder diagram, Timers, Internal Relays and Counters Shift Registers, Master and Jump Controls, Data Handling, Analog input / output, PLC Selection, Application. [10]

TEXT BOOK(S):

1. Mechatronics- W Bolton, Pearson Education.
2. Mechatronics Principles and Applications- G.C.Onwubolu, Elsevier Butterworth-Heinemann.

REFERENCE(S):

1. Mechatronics Source Book- Newton C Braga, Thomson Publications.
2. Introduction to Mechatronics and Measurement Systems- D.G.Alciatore and M.B.Histand, McGraw Hill.

BPE 408: PE-II: SURFACE ENGINEERING PRINCIPLES AND SYSTEMS (3-1-0)

Module-I

Mechanisms of Wear and Metal Cleaning: Basic Mechanisms of wear-abrasive, adhesive wear, contact fatigue, Fretting corrosion, Testing of wear resistance, practical diagnosis of wear, general cleaning process for ferrous and non ferrous metals and alloys selection of cleaning processes, alkaline cleaning, emulsion cleaning, ultrasonic cleaning, pickling salt bath descaling, abrasive bath cleaning, polishing and buffing shot peening. [10]

Module-II

Thermal Spraying Processes and Electrodeposited Coatings: Thermal spraying materials, characteristics of thermal spray processes, Design for thermally sprayed coatings coating production, spray fused coatings, Principles of electroplating, Technology and control-electroplating systems, Properties and applications of electrodeposits, Non aqueous and electroless deposition, plasma coating. [10]

Module-III

Hot Dip Coating and Diffusion Coating: Principles, Surface preparation, Batchcoating and continuous coating process, Coating properties and application, Principles of cementation, Cladding-vacuum deposition, Sprayed metal coating, Structure of diffusion coatings, Chemical vapour deposition (CVD), Physical vapour deposition (PVD). [06]

Non-Metallic Coating Oxide and Conversion Coatings: Plating coating, lacquers, rubbers and elastomers, viterous enamels, anodizing Chromating, application to aluminium, magnesium, tin, zinc, cadmium copper and silver, phosphating primers. [06]

Module-IV

Quality Assurance, Testing and Selection af Coatings: The quality plan, design, testing and inspection, thickness and porosity measurement, selection of coatings, industrial applications of engineering coatings. [08]

TEXT BOOK(S):

1. Engineering Coatings-design and application- S. Grainger, Jaico Publishing House.
2. Principles of Metals surface treatment and protection- D. R. Gabe, Pergamon.

REFERENCE(S):

1. Electroplating Handbooks- N.V.Parathasarathy, Prentice Hall.
2. Advances in surface treatment- Niku-Lavi, Pergamon.

SESSIONAL

BPE 491: Production Engg. Lab. V (NTM) **(0-0-3)**

(Any five)

1. Electro Discharge Machining.
2. Ultrasonic Machining.
3. Abrasive Jet Machining.
4. Laser Beam Machining.
5. Electrochemical Machining.

BPE 492: CAD/CAM/ROBOTICS LABORATORY (0-0-3)

(Any five)

Computer aided design of

1. Cutter joint assembly.
2. Flanged Coupling.
3. Universal Coupling.
4. Gears.
5. Piston.
6. Simulation of Numerical Control Machining.
7. Study of Robotics System

BPE 493: SEMINAR (0-0-3)

BPE 494: MINOR PROJECT (0-0-3)

SEMESTER-VIII
THEORY

BPE 409: ROBOTICS AND FLEXIBLE MANUFACTURING SYSTEMS (3-1-0)

Module-I

Robot Fundamentals: Definitions, History of robots, Laws of Robotics, Robot Specification, Anatomy of a Robot, Robot classifications, Function line diagram representation of robot arms, common types of arms, Robot end effectors- Types, Tools as end effectors, Considerations in gripper selection and design, Robot application in Manufacturing- Material Transfer- Material handling, loading and unloading, Processing - spot and continuous arc welding and spray painting, Assembly and Inspection. [04]

Manipulator Kinematics: Homogeneous coordinate transformation, matrix representations of coordinate transformation, D-H representation of kinematics linkages, Forward and Inverse Kinematics of manipulators, Euler's angle and fixed rotation for specifying position and orientation. Differential transformation and manipulators, Jacobians. [08]

Module-II

Robotics Dynamics: Velocity Kinematics, Acceleration of rigid body, Lagrange-Euler Formulation, Newton–Euler's formulation. [04]

Robot Actuators and Sensors: Internal and external sensors, Position- potentiometric, Optical sensors, Encoders - absolute, incremental, Touch and slip sensors, Velocity and acceleration sensors, Proximity sensors, Force and torque sensors. Actuators- Hydraulic, Pneumatic and Electrical, Comparison of actuating systems and their relative merits and demerits. [06]

Module-III

Robot Controllers: Open and close loop control, Manipulator control problem, Linear control, PD and PID control schemes, Force and torque control in robotic manipulators. [04]

Robot Programming: Methods of robot programming- Textual and Leadthrough, WAIT, SIGNAL and DELAY commands, Capabilities and limitations of leadthrough programming, Robot language structure, Motion, sensor and end effectors commands, Programming examples. [06]

Module-IV

Flexible Manufacturing Systems: Types of production, Characteristics, Applications, Flexibility in Machining systems, Need for FMS, Flexible Automation, Where to apply FMS technology, Components of FMS- FMS layout configurations, Planning the FMS, Workstations, Material Handling systems, Automatic Guided vehicle systems, Automated storage and retrieval systems, FMS Layout configurations, Applications and benefits of FMS, problems in implementing FMS. [08]

TEXT BOOK(S):

1. Industrial Robotics- Groover M P et al, Pearson Edu.
2. Robotics and Control- Mittal R K & Nagrath I J, TMH.

REFERENCE(S):

1. Robotics Technology and Flexible Automation- S.R.Deb, TMH.
2. Robotic Engineering- Richard D. Klafter, PHI.
3. Robotics- Fu K S et al., McGraw Hill.

BPE 410: QUALITY ASSURANCE AND RELIABILITY (3-1-0)

Module-I

Quality Control: Causes of variation, standard errors of mean, Process capability analysis, Natural tolerance limits, Specification Limits, Trial and Revised Control limits, Rational Subgroups, Control Charts for variables (X, R, S, CUSUM, EWMA), Control Charts for attributes.(P, np) [06]

Sampling Plans: Design of single sampling plan, double, multiple and sequential sampling plans, O.C. curve, AOQ, AOQL, ATI, AFI, ASN. [04]

Module-II

Quality Engineering: Taguchi's quadratic loss function, Off line & online quality control, importance of parameter selection design, experimental design principle for product and process design, two-level experimental for full factorial and fractional factorial design, S/N ratio, Inner and outer arrays. [10]

Module-III

Total Quality Control: Components of TQM, TQM Implementation, Quality function deployment, PDCA cycle, Quality Circle: Implementation, Training for QC, Kaizen and Poke Yoke Systems, Quality Cost, Concept of Zero defect, Quality assurance systems- ISO 9000, 14000, 18000. [10]

Module-IV

Reliability: System effectiveness, Mission reliability, Design adequacy, Operational readiness, serviceability, performance indices, their evaluation, uses and limitation, reliability models of maintained systems, relationship between reliability and maintainability, system with components in series, parallel and standby, Maintainability prediction. [10]

TEXT BOOK(S):

1. Fundamentals Of Quality Control & Improvement- A.Mitra, PHI
2. Introduction to Statistical Quality Control- D.C.Montogomery, John Wiley & Sons.
3. Total Quality Control- A.V.Feigenbaum, TMH.
4. Statistical ------PHI

REFERENCE(S):

1. Statistical Quality Control- E.L. Grant and R.S. Leavenworth, McGraw Hill.
2. Taguchi techniques for Quality Engineering- P.J.Ross, McGrawHill.
3. Quality Assurance through ISO 9000- H.D. Gupta, South Asia publication.

BPE 411: PE-III: TRIBOLOGY IN DESIGN AND MANUFACTURING (3-1-0)

Module-I

Surfaces, friction and wear- Topography of the surfaces - Surface features - Surface interaction - Theory of Friction - Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions - Wear, types of wear - Mechanism of wear - Wear resistance materials - Surface treatment - Surface modifications – Surface coatings. [10]

Module-II

Lubricants and their physical properties lubricants standards - Lubrication Regimes Hydrodynamic lubrication - Reynolds Equation, Thermal, inertia and turbulent effects - Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication - Hydro static lubrication - Gas lubrication. Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature rotating loads and dynamic loads in journal bearings - special bearings - Hydrostatic Bearing design. [12]

Module-III

Geometry and Kinamatics - Materials and manufacturing processes - contact stresses - Hertzian stress equation - Load divisions - Stresses and deflection - Axial loads and rotational effects, Bearing life capacity and variable loads - ISO standards - Oil films and their effects - Rolling Bearings Failures. [10]

Module-IV

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Instrumentaton - International standards - Bearings performance measurements - Bearing vibration measurement. [08]

TEXT BOOK(S):

1. Basic Lubricaton Theory- A.Cameron, Ellis Herward Ltd.
2. Introduction to Triboloty of Bearing- B.C. Majumdar, AH Wheeler.

REFERENCE(S):

1. Engineering Tribology- J.A.Williams, Oxford Univ. Press.
2. Tribology Hand Book- M.J.Neale, Butterworth Heinemann.

BPE 412: PE-III: MAINTENANCE ENGINEERING & MANAGEMENT (3-1-0)

Module-I

Importance of maintenance, Objectives of maintenance, Types of maintenance, Maintenance systems, Planned and unplanned maintenance, Breakdown maintenance, Corrective maintenance, Opportunistic maintenance, Routine maintenance, Preventive maintenance, Predictive maintenance, Condition based maintenance systems, Design-out maintenance, Selection of maintenance systems. [10]

Module-II

Maintenance planning and scheduling, establishing a maintenance plan, Safety precautions – Characteristics of items to be maintained, Classification of items, Maintenance procedure, Guidelines for matching procedures to items, Maintenance organization, Resource characteristics, Resources structure, Maintenance control, Administrative structure, Training of maintenance personnel. [10]

Module-III

System operations and documentation, Documenting maintenance operations, Record keeping, Data collection and analysis, Failure statistics, Planning and scheduling plant shutdowns, Depreciation and Machine Life, Replacement policies, Spares and types of spares, spares planning. [10]

Module-IV

Network techniques in maintenance activities, Evaluation of maintenance performance. Total productive maintenance – development and scope, Basic systems of TPM, Procedures and steps. Productivity circles, TPM as a part of TQM, benefits of TPM. [10]

TEXT BOOK(S):

1. Maintenance Planning and Control- A. Kelly, East West Press.
2. Mechanical Fault Diagnosis- R.A.Collacott, Chapman and Hall.
3. Maintenance Engineering and management…..PHI

REFERENCE(S):

1. Managing Maintenance Resources- A.Kelly, Butterworth-Heinemann.
2. Handbook of Maintenance Management- Levitt Joel, Industrial Press.

BPE 413: PE-III: MANUFACTURING INFORMATION SYSTEM (3-1-0)

Module-I

Introduction: The evolution of order policies, from MRP to MRP II, Role of Production Organization, Operations Control. Database: Terminologies, Entities and attributes, Data models, schema and subschema, Data Independence, ER Diagram, Trends in database. [10]

Module-II

Designing Database: Hierarchical model, Network approach, Relational Data model -concepts, principles, keys, Relational operations - functional dependence -Normalization, types - Query languages. [10]

Module-III

Manufacturing Considerations: The product and its structure, Inventory and process flow, Shop floor control - Data structure and procedure - various model - the order scheduling module, input/output analysis module the stock status database, the complete IOM database. [10]

Module-IV

Information System for Manufacturing: Parts oriented production information system - concepts and structure -computerized production scheduling, online production control systems, Computer based production management system, computerized manufacturing information system - case study. [10]

TEXT BOOK(S):

1. Manufacturing Information Systems- L.G. Sartori, Addison-Wesley Publishing Company.
2. An Introduction to Database Systems- C.J. Date.C.J., Narosa Publishing House.

REFERENCE(S):

1. Material Requirements Planning- G. Orlicky, McGraw-Hill.
2. Knowledge based Manufacturing Management- R. Kerr. Addison-Wesley.

BPE 414: PE-IV: INSTRUMENTATION AND CONTROL (3-1-0)

Module-I

Basic detector-transducer elements: Electrical transducer, sliding Contact devices, Variable-inductance transducer elements. The differential transformer, Variable-reluctance transducers, Capacitive transducers. The piezoelectric effect, photo-electric transducers, Electronic transducer element. [04]

Intermediate Modifying system: Electrical intermediate modifying devices, input circuitry. The simple current sensitive circuit, ballast circuit, voltage-dividing potentiometer circuit, voltage balancing potentiometer circuit, Resistance bridges. [04]

Terminating Devices and Methods; Introduction, CRO recording techniques. [02]

Module-II

Strain Measurement: The electrical resistance strain gauge. The metallic resistance strain gage, selection and installation factors for metallic strain gages, Circuitry, Metallic strain gage, the strain gage ballast circuit, the strain gage bridge circuit, Temperature compensation. [04]

Measurement of Pressure : Pressure measuring systems, Pressure measuring transducers, Gravitation transducers, Elastic transducers, Elastic diaphragms, Secondary transducers used with diaphragms, Strain gage pressure cells, Measurement of high pressures. Measurement of low pressures, Dynamic characteristic of pressure measuring systems, Calibration methods. [06]

Module-III

Temperature Measurement: Use of bimetals pressure thermometers. Thermocouples, Pyrometry. Calibration of temperature measuring devices. [04]

Vibration and shock: Measurement and test methods – Vibrometers and accelerometers, Elementary vibrometes and vibration detectors, Elementary accelerometers, the seismic instrument. [06]

Module-IV

Description of open and closed loop control systems and their block diagrams. Use of Block diagrams and signal flow graph to find overall transfer function. 1st and 2nd order systems and their response to step and sinusoidal input, Error analysis, static and dynamic error coefficients. [04]

Routh's stability criterion, The Root-Locus method. Bode plot and Nyquist plot, Gain margin and phase margin. [06]

TEXT BOOK(S):

1. Mechanical Measurements- T.G. Beckwith & N.Lewis Buck, Oxford and IBH.
2. Modern Control Engineering- K.K. Ogata, PHI.

REFERENCE(S):

1. Instrumentation, Measurement and Analysis- B.C.Nakra, TMH.
2. Control Systems Emgineering- I.J.nagrath and M.Gopal, New Age international.

BPE 415: PE-IV: PRECISION ENGINEERING (3-1-0)

Module-I

Precision Engineering: Micromilling and Microdrilling, MicroElectroMechanical Systems, Microelectronics fabrication methods, Principles of MEMS, mechanical MEMS, Thermal MEMS, Magnetic MEMS. [04]

Nanotechnology- Carbon nanotubes and Structures, Processing system of nanometre accuracies, mechanism of material processing, Nano Physical processing of atomic bit-units, Nano-chemical and electrochemical atomic-bit processing. [06]

Module-II

Nano-Measuring Systems of Sub-Nanometre Accuracy and Resolution: In process or in situ measurement of position of processing point, Post process and on machine measurement of dimensional features and surface, Mechanical measuring systems, Optical measuring systems, Electron beam measuring systems, Pattern recognition and inspection systems. [10]

Module-III

Nano-Positioning System of Nanometre Accuracy and Repeatability: Guide systems for moving elements, Servo control systems for tool positioning, Computer aided digital ultra precision position control, Future development of micro actuators. [10]

Module-IV

Applications of Nanotechnology: Nano-grating system, Nano lithography, Photolithography, Electron beam lithography, Machining of soft metal mirrors with diamond turning, Mirror grinding of ceramics, Ultra-precision block gauges, balls for rolling bearings, Fabrication CCD's, VCR head assemblies, Optical fibres. [10]

TEXT BOOK(S):

1. Nanotechnology- N. Taniguchi, Oxford University Press.
2. Micromanufacturing and Nanotechnology- N.P.Mahalik, Elsevier.

REFERENCE(S):

1. Foundation of MEMS- C.Liu, Prentice Hall.
2. Introduction to Nanotechnology- C.P.Poole and F.J.Owens, Wiley Interscience.

BPE 416: PE-IV: RAPID PROTOTYPING (3-1-0)

Module-I

Introduction: Definition of Prototype, Types of prototype, Need for the compression in product development, Survey of applications, Growth of RP industry, Classification of RP systems. [04]

Stereolithography Systems: Principle, Process parameter, process details, Data preparation, data files and machine details, Application. [04]

Module-II

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Fusion Deposition Modeling: Principle, Process parameter, Path generation, Applications. [06]

Solid Ground Curing: Principle of operation, Machine details, Applications, Aminated Object Manufacturing: Principle, of operation, LOM materials, process details, application. [06]

Module-III

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, object Quadra systems, Laser Engineering Net Shaping (LENS). [04]

Rapid Tooling: Indirect Rapid tooling -Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3D keltool, Direct Rapid Tooling- Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, ProMetal, Sand casting tooling, Laminate tooling, Soft Tooling vs. Hard tooling. [06]

Module-III

Software for RP: STL files, Overview of Solid view, magics, mimics, magic communicator, etc. Internet based software, Collaboration tools, Rapid Manufacturing Process Optimization: factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation. Surface digitizing, surface generation from point cloud, surface modification-data transfer to solid models. [10]

TEXT BOOK(S):

1. Stereolithography and other RP& M Technologies- Paul F. Jacobs, Society of Manufacturing Engineers, NY.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling- D.T. Fham and S.S.Dimov, Springer Verlag.

REFERENCE(S):

1. Rapid Prototyping: Principles and Applications in Manufacturing- C.C. Kai and L.K.Fai, World Scientific Co.
2. Rapid Prototyping & Manufacturing- Paul F. Jacobs, McGraw-Hill.