DIVISION

OF

PRODUCTION ENGINEERING

Code No.	Subject Name	Credit
PE101	Computer Aided Graphics (ME103)	1:0:2
PE102	Workshop Practice (ME104)	0:0:2
PE201	Welding Technology	4:0:0
PE202	Foundry, Smithy, Welding & Sheet Metal Lab	0:0:2
PE203	Material Science & Engineering	4:0:0
PE204	Metallurgy Lab	0:0:1
PE205	Machining Technology	4:0:0
PE206	Lathe Shop	0:0:2
PE207	Theory of Metal Cutting and Tool Design	4:0:0
PE208	Statistical Quality Control & Reliability Engineering	4:0:0
PE209	Fluid Power Control System	4:0:0
PE210	Production Planning and Control	4:0:0
PE211	Computer Integrated Manufacturing	4:0:0
PE212	Computer Aided Design and Analysis	4:0:0
PE213	CAD/CAM Laboratory	0:0:2
PE214	Principles of Management and Industrial Psychology	4:0:0
PE215	Production Drawing	4:0:0
PE216	Design and Optimization of Products	4:0:0
PE217	Theory of Machines	3:1:0
PE218	Workshop Technology	4:0:0
PE219	Manufacturing and Drawing lab	0:0:1
PE220	Principles of Management and Industrial Psychology	3:0:0
PE221	Machining Technology	4:0:0
PE222	Machining Lab - I	0:0:1
PE223	CAD/CAM Laboratory	0:0:2
PE224	Metal Forming and Casting Engineering	4:0:0
PE225	Machine Tools and CNC Machines	4:0:0
PE301	Fracture Mechanics & Applied Materials Engineering	4:0:0
PE302	Advanced Strength of Materials	3:1:0
PE303	Advanced Mechanism Design	3:1:0
PE304	Finite Element Analysis	3:1:0
PE305	Industrial Robotics	4:0:0
PE306	Product Design and Development Strategies	4:0:0
PE307	Computer Graphics	4:0:0
PE308	Computer Applications in Design & Manufacturing	4:0:0
PE309	Design for Manufacturing and Assembly	4:0:0
PE310	Flexible Manufacturing Systems	4:0:0
PE311	Manufacturing Information & Decision Support Systems	4:0:0
PE312	Advanced Modeling Lab	0:0:2
PE313	Advanced Manufacturing lab	0:0:2
PE314	Advanced Analysis Lab	0:0:2

Code No.	Subject Name	Credit
PE315	Computer Graphics	3:1:0
PE316	Design for Manufacturing and Assembly	3:1:0
PE317	Design of Fluid Power Control Systems	3:1:0
PE318	Design of CNC Machine Tools	4:1:0
PE319	Rapid Prototyping	4:0:0
PE320	Product Design and Development Strategies	4:0:0

PE101 (ME103) COMPUTER AIDED GRAPHICS

Credit: 1:0:2
Marks: 50+50

Unit I
Introduction to Computers and Computer Aided Graphics – Workstations Display Technology – Input and Output Devices – Graphics standards.

Unit II
Introduction to Computer Aided Design and Drafting – Applications – Various CAD Packages – Study of AUTOCAD 2000 Software – Hardware requirements.

Unit III
Simple Exercise using various Drawing and Editing commands of AUTOCAD 2000.

Unit IV
Simple Exercise using various Formating commands – Basic Dimensioning practice using AUTOCAD 2000.

Unit V
Simple exercises using Layers and Blocks – Introduction to Isometric Drawings – Basic Plotting practice.

Text Book

1. Ajeet Singh, 'AUTOCAD 2000' TMH Publications, New Delhi, 2001.

Reference Books

1. Shyam Tickoo, 'AUTOCAD 2000 Bible' BPP Publications, New Delhi, 2000
2. K.V. Natarajan, 'Engineering Drawings and Graphics', 15th Edition 2001

PE102 (ME104) WORKSHOP PRACTICE

Credit: 0:0:2
Marks: 50+50

Unit I

A. Carpentry

Handling of carpentry tools: Practice in marking, sawing, plaining and chiselling to size – making simple joints such as half-lap, dovetail, mortise joints.

Use of modern materials such as plywood, chip board, novapan, laminated sheets etc. (demonstration only).

B. Fitting:

Use of fitting tools: practice in marking, fitting to size and drilling, making of simple mating profiles such as vee, square, dovetail, half round joints.

C. Smithy:

Demonstration of hand forging of round rod into square.

D. Miscellaneous

Demonstration of metal joining processes like welding, brazing soldering and operation of Lathe, Milling machine and CNC machines.

PE 201-WELDING TECHNOLOGY

Credit 4:0:0
Marks: 40+60

UNIT I : Basic Joining Processes & Equipment

Types of welding-gas welding-arc welding-shielded metal arc welding , GTAW, GMAW, SAW –Resistance welding (spot, seam, projection, percussion, flash types)-thermit welding - soldering, brazing and braze welding- Welding power sources and characteristics-welding electrodes- safety aspects in welding

UNIT II : Design of Weldments

Welding symbols-Positions of welding-joint and groove design-weld stress-calculations-design of weld size-estimation of weld dilution , preheat and post heat temperature- brief introduction to welding codes & standards (ASME / ASTM / AWS)

UNIT III : Welding Metallurgy

Weldability of cast iron , steel, stainless steel, aluminium alloys , dissimilar metals-effect of gases in welding-residual stresses-distortion-relieving of stresses

UNIT IV : Inspection and Testing

Defects in welding-causes and remedies-destructive testing methods –non destructive testing (visual inspection , liquid penetrant inspection, radiographic inspection, magnetic particle inspection, ultrasonic inspection & pressure and leak testing)- case studies -testing of pipe, plate, boiler drum, tank- introduction to WPS/PQR/WPQ

UNITS V : Special welding Processes

Electron beam and Laser beam welding-plasma arc welding-stud welding-friction welding-explosive welding-ultrasonic welding-underwater welding-welding of plastics - automation of welding, seam tracking, vision and arc sensing-welding robots

Text Books

1. Khanna, O.P., "A Text book on Welding Technology", Dhanpet Rai & sons, Delhi, 1999
2. Little, R.L, "Welding and Welding Technology", TMH, Delhi, 1999.

Reference Books

1. Rao, P.N. "Manufacturing Technology", 2 nd edition ,TMH Publications, New Delhi, 1998
2. Houldcraft, P.T., "Welding process Technology" ,Cambridge University press, 1990.
3. Parmar, R.S., "Welding Process and Technology", Khanna Publishers, Delhi,. 1992.
4. AWS. "Welding Hand book", Vol I & II, 1996.

PE 202 FOUNDRY, SMITHY, WELDING & SHEET METAL LAB

Credit: 0:0:2
Marks: 25+25

Foundry:

Study of molding tools, equipments and furnaces. Preparation for molding. Exercises for flange, gland, bush, straight-pipe, bend pipe, tee-pipe, and grooved pulley involving 2 boxes. Study of cores, safety precautions, and study of casting defects.

Smithy:

Study of tools and forges. Making a square from a round rod. Making an L-bend. Making a hook, Making a square headed bolt. Making a hexagonal headed bolt. Making a U-clamp. Fusion welding of a ring (demonstration only).

Welding:

Study of welding hand tools and equipments, safety precautions. Exercises in arc welding and gas welding like butt joint, lap joint, fillet, and tee joints. Demonstration of gas cutting.

Sheet metal working:

Study of presses, dies and tools. Sheet metal layout, development of lateral surfaces. Simple exercises involving blanking, forming, bending and flanging.

PE203 MATERIAL SCIENCE AND ENGINEERING

Credit: 4:0:0
Marks: 40+60

UNIT I : Structure of materials and alloys:
Crystal systems, space lattices, miller indices of atomic planes and directions, allotropy. Crystal defects – point, line and surface defects, X-ray diffraction – Bragg's law. Metallography – preparation of specimen, micro and macro examination, metallurgical and electron microscopes.

UNIT II : Mechanical behaviors of materials:
Stress – strain curve, elastic deformation, characteristic of elastic deformations,. Anelastic deformation, strain-time curves, damping capacity, Viscous deformation, Plastic deformation, mechanism of plastic deformation – slip and twinning. Strengthening mechanism – work hardening.

UNIT III : Mechanical testing and fracture of materials
Tensile test – stress strain curves for ductile and brittle materials – mild steel, copper, concrete, cast iron, proof stress, yield point phenomenon, Luder's bands. Compression test, Hardness test – various hardness tests. Impact test – fatigue – stress cycles for fatigue testing, endurance limit, fatigue limit S-N curve, Creep – creep curve, primary creep, secondary creep, tertiary creep. Fracture – ideal fracture stress, brittle fracture – Griffith's theory – ductile failure, cup and cone type fracture. Fatigue failure.

UNIT IV : Phase diagram
Solid solution, inter metallic compound, cooling curves, non-equilibrium cooling, phase rule, Ferrous and non-ferrous alloys – Fe-C diagram, effect of alloying elements on properties of steel, tool steel, heat resisting and die steel, Grey CI, White CI, Malleable iron and SG iron. Bearing materials, brazing and soldering alloys.

UNIT V : Heat treatment of steel
Critical temperature on heating, annealing, spheroidizing, normalizing, hardening, isothermal transformation – TTT diagram, tempering, martempering and ausforming. Hardenability and its testing. Surface hardening processes.

Text Books

1. Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 1995.

Reference Books

1. Anderson, J.C., Leaver. K.D., Rawlings, R.D., Alexander, J.M., "Material Science", ELBS, 1985.
2. Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.
3. Shanthakumar, S.R.J. , " Metallurgy & Materials Science", Anuradha agencies, Kumbakonam., 1999.

PE 204 METALLURGY LAB

Credit: 0:0:1
Marks: 25+25

List of experiments

1. Study and use of metallurgical microscope.
2. Identification of plain and high carbon steels.
3. Identification of stainless steels, HSS and alloys steels.
4. Identification of Grey cast iron, white cast-iron, malleable iron, SG iron.
5. Identification of cold worked and re-crystallised specimen.
6. Identification of annealed, spherodized specimen.
7. Identification of Cu alloys, Mg alloys, Al alloys, Ni alloys, and Bearing metals.
8. Heat treatment practice: annealing, normalizing, hardening and tempering
9. Measurement of Hardenability – Jomny End Quench test.
10. Sieve analysis and grain finenesss number
11. Strength of foundry sand
12. Permeability of foundry sand.
13. In- situ Metallography by replication technique.

PE205 MACHINING TECHNOLOGY

Credit: 4:0:0
Marks: 40+60

Unit I : Theory of Metal Cutting

Introduction, orthogonal and oblique cutting, shear plane, stress and cutting forces-Merchant's circle, chip formation. Cutting force calculations.. Tool materials, Machining time calculation. Machinability -evaluating and rating, Problems-Merchant's circle, tool life machining time.

Unit II : Lathe and Cutting Tool

Lathes-introduction, types, specification, construction, mechanism and attachments for various operations, nomenclature of single point cutting tool and its specifications and cutting parameters, capstan and turret lathes, tooling.

Unit III : Special machines and Tools

Shaper, planer and slotter: Introduction, types, specification, mechanism, holding devices,. Difference between shaper and planer, Milling process, introduction, types, specification, mechanisms, holding devices, types of milling operations. Milling tool nomenclature Broaching: introduction, types, mechanism, nomenclature of broaching tool and its specifications.

Unit IV : Abrasive Machining

Abrasive machining-grinding process, types, work holding devices, grinding wheel and specifications and fine finishing process-honing, lapping, super finishing, polishing, buffing, metal spraying, galvanizing and Electro-plating.

Unit V : Machining for special Design

Drilling & Boring: Introduction, specification, cutting parameters, mechanism, nomenclature of drilling and reaming tools. Deep hole drilling, miro boring, jig boring, Gear milling, gear shaping, gear hobbing, gear broaching for various types of gears., gear finishing-gear shaving, gear grinding.,bevel gear generation.

Text books

1. S. K. Hajra Choudhruy, S. K.Bose, Elements of work shop Technology, Vol II Machine tools, media Promoters & Publishers (P) Ltd., Bombay 10th Edition, 2000.
2. HMT, 'Production Technology", TMH(India), 1996.

Reference Books.

1. ASM, "Hand book on metals", Vol 3, McGraw Hill book co, 1990.
2. Sharma. P.C., " Production Engineering", S. Chand & Co,1993.
3. Roy, A. Lindberg, " Process and materials of manufacture", Allied publishers, 4th Ed., 1999

PE206 LATHE SHOP

Credit: 0:0:2
Marks: 50+50

LIST OF EXPERIMENTS

1. Study of different types of lathe – center, Capstan, Turret and Automatic and accessories.
2. Exercise on plain, step and taper turning.Thread cutting, external and internal threads.
3. Exercise on drilling, boring and tapping.
4. Exercise on knurling, Counter boring, counter sinking
5. Effect of tool angles on performance of lathe.
6. Tool grinding exercises.

PE207 THEORY OF METAL CUTTING AND TOOL DESIGN

Credit: 4:0:0
Marks: 40+60

Unit I : Metal Cutting

Theory of metal cutting, chip formation - specific cutting energy - shear angle - theory of merchant. Lee and shaffer - friction in metal cutting - temperatures in metal cutting - measurement of cutting temperature.cutting fluids,

Unit II : Cutting Tool
Cutting tool material, properities, insert and coated tools, tool wear , tool life.Single point tools-nomenclature, type and styles, design and manufacture of tools- HSS and Carbides-brazed and clamped insert tools for turning, boring, shaping, operations.

Unit III : Multipoint Cutting Tools
Multi point cutters- nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, taps, milling cutters, milling cutters, grinding wheel specification, lapping, -dressing-truing.

Unit IV : Jigs & Fixtures
Jigs-Degrees of freedom-principles of location and clamping- principles of jig design, elements of jigs, classification of jigs, design of jigs for drilling. Fixtures- principles of fixture design, locators and different types of clamps, elements of fixture, design of fixtures for milling, turning, boring and grinding operations.

Unit V : Tool Design
Press tools-design and manufacture for die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operation, selection of presses and tools.

Text Books

1. Sen B.C., Battacharya. A., 'Principles of Metal Cutting', New central Book Agency, 1982.
2. Donaldson. C., Lecain , G.H. and Goold, V.C., 'Tool Design', Tata McGraw Hill of India Pvt Ltd., 1978.
3. Arshinov, V. Alekseev, G.,"Metal cutting Theory and Cutting Tool Design", MIR Publishers, Moscow. 1976.

Reference Books

1. Geoffrey Boothroyd., 'Fundamentals of Metal machining and Machine tools', McGraw Hill International, 1985.
2. Hoffman. G., 'Fundamentals of Tool Design', SMF Publications, 1980
3. SME ," Manufacturing Engineers Hand Book",1984.
4. Kempster, " Principles of Jigs and Tools Design", ELBS, 1978.
5. Rodin, P. "Design and Production of Metal cutting Tools" MIR Publishers, Moscow,1968.

PE208 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING

Credit: 4:0:0
Marks: 40+60

UNIT I: Statistics and Quality
Introduction, definition of quality, method of control, chance, causes, assignable causes, SQC benefits and limitations. Quality assurance, quality management, total quality control, quality

circles, fundamental concepts, introduction to TQM, normal curve, measure of dispersions. Distributions - Binomial, Poisson, Hypergeometric, Gamma distribution. Poisson as an approximations to the Binomial, Review of Probability theorems. Introduction to design of experiments.

UNIT II : Statistical Process Control

Theory of control charts, sample as an estimate of universe process control, control charts for variables -x bar and R charts, standard deviation charts, run up and run down, process capability studies, control charts for attributes, fraction defective and number of defectives charts. Chart sensitivity, control charts for non conformities - C and U charts, Process Capability- Definition and Analysis.

UNIT III: Acceptance Sampling:

Fundamental concepts and terms, OC curves, AQL, LTPD, AOQL sampling plans, simple, double, Dodge Romig sampling plans, problem using Dodge Romig Plan, ISO-9000 QS 14000, QS 9000- a simple case study in an industry.

UNIT IV : Introduction to Reliability and life testing

Reliability: Definition, Mean failure rate, Mean time to failure, Mean time between failure, hazard rate, hazard models. Constant hazard, linearly increasing hazard, Weibull model. System reliability, series, parallel and mixed configuration - simple problems, Failure Mode Effect Analysis, Quality Function Deployment. Life testing – Objective, classifications.

UNIT V Reliability Improvement

Reliability improvement redundancy, element, unit and stand by redundancy, reliability allocation for a series system. Maintainability and availability. System downtime, reliability and maintainability. Trade-off, simple problems. Product design, product analysis, product development, product life cycle.

Text Books

1. Grantt, "Statistical Quality Control" McGraw Hill, ISE 1990.
2. Srinath.L.S, "Reliability Engineering" Affiliated East West Press, New Delhi, 1973.

Reference Books

1. Jerry Banks, "Principles of Quality Control", John Wiley, 1990.
2. Douglas C.Montgomery, "Principles of Quality control", John Wiley, 1991.

PE209 FLUID POWER CONTROL SYSTEM

Credit: 4:0:0
Marks: 40+60

UNIT I : Fluid power Automation

Need for and development of automation, principles of automation, basic concepts, feasibility of automation, economic considerations. Symbols used for various hydraulic circuit components, Boolean algebra, truth tables.

UNIT II : Elements Of Hydraulic System.
Air and Hydraulic cylinders, pressure accumulators, fluid reservoirs, checkvalve, flow control valves, directional control valves, restrictors, relief valve, hydraulic servo systems, Fluid power symbols, electrical devices for hydraulic circles.

UNIT III : Transmission Of Hydraulic Drives
Constant and Variable delivery types, gears, vane and piston pumps, design and construction, linear motor cylinder and piston drives, design and construction**.**

UNIT IV : Hydraulic Circuits
Reciprocation, quick return, sequencing, synchronizing clamping and accumulator circuits, press circuits, hydraulic copying machine circuit, fluidic elements.

UNIT V : Pneumatic And Lowcost Automation
Pneumatic circuits, components simple circuit and application, low cost automation circuits for product handling and operation and machine tools and presses. Application of pneumatics and Hydraulics in CNC machining centres.

Text Book

1. Anthony Esposito, " Fluid power with applications", Prentice Hall, 1980.
2. Ramakrishnan M. " Industrial Automation", Swathi Publications, 1999.

Reference Books

1. Hary C. Steward, " Practical guide to fluid power", D.B. Tarapovevala sons & Co Pvt Ltd. Bombay 1987.
2. Steward H.L. " Hydraulic and pneumatic power for production, Industrial press", New York, 1987.
3. Andrew par, " Hydraulic and pneumatic", 1993.
4. Shearer J. L. " Fluid power control", John wiley, 1989.
5. "Electro Hydraulics" FESTO didactic KG D- 73734 Esslingen1994.

PE210 PRODUCTION PLANNING AND CONTROL

Credit:4:0:0
Marks: 40+60

UNIT I : Introduction To PPC
Objectives and benefits of production control, function of production control. Types of production: Job, batch and continuous production. Product development and design, marketing aspect, functional products, operational aspects, durability and dependability, standardisation, simplification and specialisation. Break even analysis, economics of a new design.

UNIT II : Forecasting
Sales forecasting: Need and its use, making the forecast, market share, sales trend analysis, forecasting in seasonal demand, use of indicators and correlation analysis, effects of forecast on production orders, accuracy of forecasts.

UNIT III : Product planning
Extending the original product information, value analysis, problems created by lack of product planning. Process planning and routing, prerequisite information needed for process planning, steps in process planning. Product data management (PDM), Entreprise application integration. (EAI)

UNIT IV : Inventory Control
Material and tool control: Physical control, record keeping, two-bin material control system, the super market concept, procurement and control of tools, inventory control, determination of economic order quantity and economic lot size, ABC analysis, reorder point and lead time. MRP I&II Introduction to JIT and KANBAN

UNIT V : Scheduling and Dispatching
Loading and scheduling information rearranging for loading and scheduling: Master scheduling, perceptual loading, order scheduling devices. Dispatching: Progress reporting and expediting.

Text book
1. Samuel Eilon, "Elements of production planning and control", Macmillan and co., 1971.

Reference books
1. Jain K .C and Aggarwal L .N, "Production planning control and Industrial Management", Khanna Publishers, 1997.
2. Buffa E .S, "Morden Production management", Eastern Pvt Ltd., 1983.

PE211 COMPUTER INTEGRATED MANUFACTURING

Credit: 4:0:0
Marks: 40+60

UNIT I : Introduction
Evolution of CIM, scope of CIM, segments of generic CIM, Automated Process Planning – Process planning, group technology, variant and generative process planning methods, Al in process planning, process planning software. CNC technology – Principles of numerical control, features of CNC systems, programming techniques, capabilities of a typical NC CAM software, integration of CNC machines in CIM environment, DNC – Flexible manufacturing systems- Architecture, work stations.

UNIT II : Manufacturing Systems
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, bill of materials, standard product routing, job costing, marketing applications**.**

UNIT III : Robotics, Automated Assembly and Inspection
Types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, selecting assembly machines, feeding and transfer of arts, applications of robots in manufacture and assembly, sensors. Automated quality control types of CMM, non-contact inspection methods, in process and post process metrology, flexible inspection systems. Computer Aided Inspection and on line quality monitoring.

UNIT IV : Data Communications and Technology Management
Technology issues, configuration management, database systems, management of technology, networking concepts, Local area Network (LAN), SQL fundamentals, Manufacturing Automation protocols (MAP) and Technical and office protocols
(TOP)fundamentals.– CIM models, economics of CIM, implementation of CIM.

UNIT V : Recent trends in manufacturing
Collabarative Engineering:- Introduction,Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering , supply chain management (SCM), customer relations management(CRM) Virtual Reality and Factory simulation, Agile and lean manufacturing, reverse engineering , Rapid prototyping.

Text Books
1. David Bedworth Etal., "Computer Integrated Design and Manufacturing", McGraw Hill Book Co., 1991
2. Radhakrishnan P., "CAD/CAM/CIM" , New age International Publishers, 2000.

Reference Books
1. Eric Teicholz and Joel Orr., "Computer Integrated Manufacturing Hand Book", Mc Graw Hill Book co., 1989.
2. Paul G Ranky., "Computer Integrated Manufacturing", 1985.

PE212 COMPUTER AIDED DESIGN AND ANALYSIS

Credit 4 :0:0
Marks 40 +60

Unit I : Fundamentals of CAD
Benefits of CAD, CAD hardware, input devices- keyboards, lightpaus. Digitizing tablets, Mouse systems joysticks, trackballs thumbwheels, output devices-Graphics displays, hardlopy printers and plotters, CAD software- Graphics standards, database, DBMS, database coordinate system, working coordinate system screen coordinate system, operating systems. Applications of CAD.

Unit II : Geometrical Modeling
Representations of curves-introduction to wire frame entities models, curve representation, representations of solids solid models solid entities solid representation fundamentals of solid modeling B-rep- Constructive solid Geometry (CSG) sweep representation.

Unit III Geometric transformations
Transformation of Geometric models- Translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations. Graphics aids- Geometric modifiers, dragging and clipping.

Unit IV : Fundamentals of FEA
Introduction, types of analysis general procedure the FEM. Boundry and initial value problem, function variational calculus, variational formulation of boundry value problem. weighed residual method Ritz method, Element types and characterstics- basic element shapes, aspect ratio, element shape function gneralised coordinates and nodal shape function, 1D spar and beam elements, 2D rectangular and triangular elements, axisymemtric elements.

Unit V : Stress Analysis
Concept of element assembly, global and local coordinate systems, band width and its effects, banded and skyline assembly, boundary conditions, solution of simultaneous equations, gaussian elimination and cholesky decomposition methods. Higher order and isoparametric elements 1D quadratic and and cubic elements. Use of natural coordinate systems area coordinate system continuous and convergence requirement, static analysis, analysis of trusses and frames

Text Books
1. Rao S. S. " The Finite Element method in Engineering IInd Edition pergamon press Oxford 1989.
2. Ibrahim Zeid " CAD/CAM Theory and practice", Mcgraw hill 2000.

Reference Books
1. Belakuntu, 'Finite Element Methods in Engineering', DHI 2002
2. Donald J. Frieth " Introduction to CAD", Tata Mcgraw Hill 1988.

PE213 CAD/CAM LABORATORY

Credit:0:0:2
Marks: 50+50

CAD LABORATORY

1. Three dimensional geometry creation and modification using standard modeling package.
2. Detailing and documentation of a typical production drawing .
3. Attributes and Data extraction from a drawing.
4. Creation of Simple Solid Models using CSG and B-Rep Approach.
5. Creation of surface models.
6. Interfacing a programming language with a typical drafting package.
7. Interfacing database package with a typical drafting package.
8. Object modeling and Mesh generation using simple elements.
9. Surface/solid modeling using Pro-Engineer.
10. Analysis of typical machine elements.

11. Kinematic Analysis of simple mechanisms.
12. Study of reverse engineering component drawings.

CAM LABORATORY

1. Study Of CNC Machine Tool Length offset measurement , tool nose radius, head stock, tail stock, Feed, controls, tool life process chart preparation.
2. Introduction to NC Manual Part Programming and Computer Assisted part programming- Exercise.
3. Production of Various Contour Shapes using CNC Lathes.
4. NC Programming Using CAD Models.
5. Generation of CNC programming using ProE
6. Simulation of CNC programme using standard packages.
7. Study of pick and place Robot- basic components, configuration, work volume.
8. Programming of pick and place Robot.

PE214 PRINCIPLES OF MANAGEMENT AND INDUSTRIAL PSYCHOLOGY

Credit: 4:0:0
Marks: 40+60

Unit : I

Nature of Management and its process - Functions - Fayol's Principles - Contribution of Taylor to Scientific Management - Schools of Management - Types of organisations - Organisation charts and manuals - Industrial ownership - Types, formation, merits and demerits - Management by objective, Management by exception and Management information system.

Unit : II

Plant location - Factors - Decision - Plant layout - Types, procedure and techniques - Material handling - principles, equipments and selection - plant maintenance - Objective, types and techniques.

Unit : III

Production, productivity, Economic growth and standard of living - Factors affecting productivity - Role of work study - Human factors - Method study - Objective and procedure - Charting and photographic techniques - SIMO Chart -principles of motion economy - work measurement - Stop watch time study - Rating concept and systems - Allowances - work sampling.

Unit : IV

Introduction - Nature and Scope of Industrial psychology - Hawthorne studies - Individual behavior and group behaviors - formal and informal organisations - Importance of informal organisations. Fatigue and accidents - causes and remedial measures - Accident proneness.

Unit : V

Employees needs and satisfaction - Job Satisfaction - Attitude - Morale - Motivation - Theories of Motivation - Importance and methods of training the employees - Role of Supervisor, Importance of Supervision - Leadership Styles - Communication and its importance, Methods and barriers.

Text Books

1. Khanna.O.P, "Industrial Engineering and Management" , McGraw Hill Pub, 1990.
2. Blum.M.L, Naylor.J.C, "Industrial Psychology", CBS 1984.

Reference Books

1. McCormick.E.J, Daniel Ilgen "Industrial Psychology", PHI, 1931
2. Harrell.T.W , "Industrial Psychology", Oxford India, New Delhi.
3. Monks.E.S, "Modern Production/Operations Management", McGraw Hill, ISE.
4. Elwood.S.Buffa,"Modern Production/Operations Management", Wiley Eastern, 1991.

PE215 PRODUCTION DRAWING

Credits : 4:0:0
Marks: 40+60

Unit I : Standard Codes And Conventions

Indian standard code of practice for engineering drawing - general principles of presentation. Conventional representations of threaded parts, springs, gear and common features Abbreviations and symbols for use in technical drawings. Conventions for sectioning and dimensioning.

Unit II : Parts Drawing

Tolerances - types - representation of tolerances on drawing, fits - types - selection of fits - allowance. Geometric tolerances - datum, datum features. Maximum material principle - symbols and methods of indicating it on drawing - surface finish symbols - welding symbols and methods of indicating it on drawing.

Unit III: Working Drawing

Preparation for working drawing for given machine components like:
Fastening - nuts, bolts - screws, key and key ways, joints – cotter joint and knuckle joint.

Unit IV: Assembly Drawing

Preparation of Assembly drawing of Connecting rod, plumber block, screw jack, swivel bearing, machine vice, lathe tail stock, tool head of the shaper, Lathe tool post, safety valve, relief valve,

Unit V : Study of Industrial Drawing (Not for exam)

Lathe gear box, grinding spindle assembly, Study and practice of 3 D modeling using Auto CAD package.

Text Book

1. Gopalakrishnan, "Machine Drawing" , Subash Publishers,1995 .

2. Donald Hean and M. Pauline Baker, “Computer Graphics”, Printice Hall Inc., 1992

Reference Books

1. Bhatt, N.D. “Machine Drawing”, Charotar Publishing House, Anand, 1990.
2. Siddheswar, N. P.Kanniah, and V.V.S. Satry, “Machine Drawing”, Tata McGraw Hill, 1980.
3. Revised IS codes; 10711, 10713, 10714,9609, 1165, 10712, 10715, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

PE216 DESIGN OPTIMIZATION OF PRODUCTS

Credits : 4:0:0
Marks: 40+60

Unit I: Classical Optimization Techniques

Engineering Applications, statement of an optimization problem, classification.
Classical Optimization Techniques-Single, variable optimization algorithms with and without constraints, Fibonacci search, Newton, Raphson of Prualty function methods, Multivariable optimization algorithms with and without constraints, simplex search, Cauchy’s steepest descend and prualty function methods.

Unit II: Integer Programming

Algorithms, applications stochastic programming, linear, non-linear and dynamic programming applications introduction to linear programming.

Unit III: Non-linear Programming Techniques

One-dimensional minimization, elimination and interpolation methods, unconstrained optimization, direct search and descent methods, constrained optimization, direct and indirect methods, application to mechanical design problems.

Unit IV : Stochastic Programming

Basic concepts of probability theory, Stochastic linear and non-linear programming.

Unit V : Non-Traditional Optimization Algorithm

Genetic algorithms, Working principle, Differences & Similarities between
Gas& traditional methods, Gas for constrained optimization. Simulated Annealing approach – Introduction (only)

Textbooks

1. Rao S S “Optimization”, Wiley Eastern, New Delhi,1995.
2. Kalyanamoy Deb, “Optimization for Engineering Design”, Prentice Hall of India, New Delhi, 2000.

References

1. Ray C Johnson, “Mechanical design synthesis with optimization Applications”, Van Nostrand, Reinhold Company, 1971.
2. Wild D J, “Globally optimum Design”, John Wiley & Sons New York,178.

PE217 THEORY OF MACHINES

Credit 3 : 1 : 0
Marks 40 + 60

UNIT I : Simple Mechanisms And Cams

Links, Pairs, chain, Mechanism, inversion of machines, structure, degree of freedom, inversion, four bar chains. Cams; Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM. Layout of profile of plate cams of the above types with reciprocating and oscillating followers-knife-edge, Rollers and flat faced followers.

UNIT II : Gear Trains And Gyroscope

Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains. Gyroscope-couple and effects in ship, motor cycle, car, aircraft and space vehicles, gyroscope stabilization.

UNIT III : Balancing Of Masses

Static and dynamic balancing of rotating masses in single and different planes, primary and secondary forces and couples, partial balancing of reciprocating masses of in-line, V and radial engines. Direct and reverse crank method.

Unit IV : Longitudinal Vibrations

Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Under damped system - Logarithmic decrement. Forced vibration of single degree of freedom systems. Constant Harmonic excitation, steady state vibration, magnification factor versus frequency ratio for various damping ratios.

UNIT V : Transverse And Torsional Vibrations

Transverse vibrations of beams – natural frequency of energy method, vibration isolation and transmissibility, critical speed – whirling of shafts – industrial noise controls. Torsional vibrations – torsional vibration of single and multiple rotor systems, equivalent shafts, geared systems, Holzer's method and signature analysis.

Text Books

1. Amitabha Ghosh and Ashok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East and West Press Limited, 1988.
2. Khurmi R.S. "Theory of Machines" Khanna Pub. Delhi, 2000.
3. Grover G. K. "Mechanical vibrations", New Chand and Brothers Roorkee,1986.

Reference Books

1. Ballaney P.L. "Theory of Machines" Khanna Pub. Delhi, 1996
2. Shigley J.E and Uicker J.J "Theory of Machines and Mechanisms," .McGraw Hill ISE, 1981.
3. Thomas Bevan.,"Theory of Machines" ELBS and longmans green co. London,1984.

PE 218 WORKSHOP TECHNOLOGY

Credit: 4:0:0
Marks 40+60

Unit I

Lathe - types, specification, lathe operations, attachment for various operations, type of tools, caption and turret lathe, Automatic lathes milling: types, specification, milling tool nomenclatures and its specifications, indexing types, simple compounding and differential.

Unit II

Drilling, Boring, Broaching: Specifications Tools, Nomenclature and its specification, shaper, planer, difference between shaper and planer. Grinding types grinding, grinding wheel. Specification, Grinding wheel shapes and sizes mounting, dressing, truing and balancing of grinding wheel.

Unit III

Non-Traditional machining – classification, abrasive jet machining, ultrasonic machining, electric discharge machining. Electron beam machining, electron beam machining, laser beam machining, Ion beam machining, electrochemical grinding.

Unit IV

Metal forming: Rolling principle, rolling load, rolling variables, forging classification, extrusion principle, classification, defects in rolled, forged and extruded components, explosive forming, hydroelectric forming. Electromagnetic forming.

Unit V

Moulding and casting: pattern, pattern allowance and types, mouldings and preparation, types of core. Special casting process, shell moulding, permanent moulding, precision moulding, investment casting. Die casting, centrifugal casting and continuous casting.
Welding: Classification, gas welding, Arc welding – TIG, MIG, resistance welding, laser beam welding, forge welding, explosion welding, Thermit welding.

Text Books

1. S.K. Hajra Choudray, S.K. Bose, 'Elements of Workshop Technology, Vol.II, 'Machine Tools', Media Promoters & Publishers (P) Ltd. 2000.
2. P.N. Rao, 'Manufacturing Technology', 2nd Edition, Tata McGraw Hill Publishing Ltd., 1999.

References:

1. HMT, 'Production Technology', TMH (India), 1996
2. Heine, Richard, Carl R Loper and Philip Rosenthal, 'Principles of Metal Casting', Tata McGraw Hill Publishing Ltd., 2000
3. George E. Dieter, 'Mechanical Metallurgy', S.I. Metric Ed., McGraw Hill Book Company, 1988.

PE 219 - MANUFACTURING DRAWING LABORATORY

Credit :0:0:1
Marks 25+25

List of Exercises:

1. 2d / 3d Modeling basics using CAD software
2. Conversion of 3D Model to 2D drawing using CAD software
3. Representation of
   Standard machining features like Countersink, Knurl, Necks etc,
   Surface Finish
   Parts like Cam, Gear, Chains etc.,
4. Drawing Practice of Geometric Dimensioning and Tolerancing of Machine components
5. Modeling & Drawing practice of
   Cast / Forge Part to Detailed Machining Drawing
6. Drawing Practice of Welding Fabrication Drawing (With symbols)
7. Modeling & Drawing Practice of Industrial Piping Work
   (With Valves, Fittings, Pipes etc)
8. Drawing Practice of Sheet metal work and Lay out preparation
   (With Punch and Die)
9. Modeling & Drawing practice of Cutting tools, Jigs and Fixtures and holding devices.

References:

1. Sham Tickoo, "AutoCAD 2000", TMH, 2001
2. George Omera, "AutoCAD 2002" ,BPB Publishers 2002
3. Manuals of AutoCAD, SolidWorks, Inventor Software
4. David Madison, "Engineering Design and Drawing" , Delmar Pub., 2002
5. Foster.W, " A Workbook on Geometric Dimensioning", Foster Associates,1996
6. Smith, "Welding skills and Technology", McgrawHill,1983
7. Joshi, "Tooling Data" ,Wheeler Pub,1999

PE220 PRINCIPLES OF MANAGEMENT & INDUSTRIAL PSYCHOLOGY

Credits: 3: 0 : 0
Marks 40 + 60

UNIT I

Nature of Management and its process – Functions – Taylor's Principles – Contribution of Taylor to Scientific Management – Schools of Management – Types of organizations – Organizations charts and manuals - Management by objectives, Management by exception and Management information system.

UNIT II
Plant location – Factors – Decision – Plant layout – Types, procedure and techniques – Material handling – principles, equipments and selection – plant maintenance – Objective, types and techniques.

UNIT III
Production, productivity, Economic growth and standard of living – Factors affecting productivity – Role of work study – Human factors – Method study – Objective and procedure – Charting and photographic techniques – SIMO Chart – Principles of motion economy – work measurement – Stop watch time study – Rating concept and systems

UNIT IV
Introduction – Nature and Scope of Industrial psychology – Hawthorne studies – individual behaviour and group behaviors – formal and informal organizations. Fatigue and accidents – causes and remedial measures – Accident proneness.

UNIT V
Employees needs and satisfaction – Job satisfaction – Attitude – Morale – Motivation – Theories of Motivation – Importance and methods of training the employees – Role of Supervisor, Importance of Supervision

Text Books:

1. Khanna O.P., 'Industrial Engineering and Management', McGraw Hill Pub,, 1990.
2. Blum. M.L, 'Industrial Psychology', CBS, 1984,

Reference Books:

1. Harrell. T.W., 'Industrial Psychology', Oxford India, New Delhi.
1. Monks E.S., 'Modern Production/Operations Management', McGraw Hill, ISE.
2. Elwood. S. Buffa, 'Modern Production/Operations Management', Wiley Eastern, 1991.

PE 221 MACHINING TECHNOLOGY

Credit :4:0:0
Marks 40+60

Unit I : Lathes, Capstan and Turret lathes
Lathes-introduction, types, specification, construction, mechanism and attachments for various operations, nomenclature of single point cutting tool and its specifications and cutting parameters, capstan and turret lathes, tooling.

Unit II
Shaper, Planer, Slotter and Broaching machine-Shaper, planer and slotter: Introduction, types, specification, mechanism, holding devices. Difference between shaper and planer, Broaching: introduction, types, mechanism, nomenclature of broaching tool and its specifications.

Unit III

Drilling and Boring machines Drilling, cutting parameters, mechanism, nomenclature of drilling and reaming tools. Deep hole drilling, Boring, Introduction, types, specification, various operations, jig boring

Unit IV

Abrasive Machining -Abrasive machining-grinding process, types, work holding devices, grinding wheel and specifications and fine finishing process-honing, lapping, super finishing, polishing, buffing, metal spraying, galvanizing and Electro-plating.

Unit V

Milling and Gear cutting - Gear milling, gear shaping, gear hobbing and bevel gear generation. gear finishing-gear shaving, gear grinding. Milling process, introduction, types, specification, mechanisms, holding devices, types of milling operations. Milling tool nomenclature

Textbooks

1. S. K. Hajra Choudhruy, S. K.Bose, Elements of work shop Technology, Vol II Machine tools, media Promoters & Publishers (P) Ltd., Bombay 10th Edition, 2000.
2. HMT, 'Production Technology", TMH(India), 1996.

Reference Books

1. ASM, "Hand book on metals", Vol 3, McGraw Hill book co, 1990.
2. Sharma. P.C., " Production Engineering", S. Chand & Co,1993.
3. Roy, A. Lindberg, " Process and materials of manufacture", Allied publishers, 4th Ed., 1999

PE 222 MACHINING LAB - I

Credit: 0:0:1
Marks: 25+25

List of Experiments

1. Plain turning.
2. Step turning
3. Taper turning
4. Internal and external thread cutting
5. Drilling and tapping
6. Boring, counter boring and counter sinking
7. Knurling
8. Tool grinding

References

1. S. K. Hajra Choudhruy, S. K.Bose, Elements of work shop Technology, Vol II Machine tools, media Promoters & Publishers (P) Ltd., Bombay 10th Edition, 2000.
2. Lathe shop manual, K.I.T

PE 223 CAD/CAM LABORATORY

Credit : 0: 0:2
Marks 50+50

CAD LABORATORY

List of Exercises:

1. Introduction to fundamentals of Solid Modeling-
   Parametric and Non Parametric, Feature based Modeling, Assocativity
   Brep, CSG Methods in modeling
   Modeling Software
2. 2d Sketch construction and constraining practice
   Datum Features
3. Creation of Parts using various features –Extrude,Revolve,Sweep,Blend etc
4. Duplicating of Features using pattern and copy
5. Concept of relations and Macro programming
6. Assembly modeling of Parts
7. Generation of Drawing views of part
8. Generation of Drawing views of Assembly (Multi model Views)
9. Information tools –
   Bill of Material
   Mass properties
   Interference and Clearance analysis
10. Importing and Exporting CAD Data files

References:

1. Kelly.D, "ProEngineer Instructor" McgrawHill 2001
2. ShamTickoo, "Designing with ProEngineer", TMH 2002
3. ProE,UG,IDEAS,Inventor Manuals
4. CAD Lab Manual , KIT-2003

CAM LABORATORY

List of Exercises

1. Study and application of common formats and codes for manual programming.
2. Tool Identification
   Planning &
   Selection for machining center/turning center
3. Creating a manual CNC program for Turning center
4. Creating a manual CNC program for Machining center
5. CNC Program entry, editing and On hand Practice in CNC Turning Center
   Setting up the Lathe
   Verification of Program and Tool path simulation
   Establishing Program Zero and Tool offset
   Running by blocks and Manufacturing the part
   Inspecting the sizes to the tolerances
6. CNC Program entry, editing and On hand Practice in CNC Machining Center
   Setting up the Machining Center

Verification of Program and Tool path simulation
Establishing Program Zero and Tool offset
Running by blocks and Manufacturing the part
Inspecting the sizes to the tolerances

7 Part Programming through CAM Software
Setting the Manufacturing model and the Process environment

8 Part Programming through CAM Software
Creation of NC Sequences and Manufacturing Geometry

9 Part Programming through CAM Software
Posting CL data to controller specific G & M codes

10 Project(Optional)

References:

1. ProE, UG, IDEAS, MASTERCAM Manuals
2. BFW ,BATLIBOI operation and Maintenance manuals
3. Catalogues of SANDVIK and ISCAR tooling systems
4. CAM Lab Manual –KIT 2003

PE 224 METAL FORMING AND CASTING ENGINEERING

Credit 4:0:0
Marks 40+60

UNIT-I

Theory of metal forming: Plastic flow of metals: The flow curve, yield criteria for ductile metals-metal flow theories, Classification of forming process. Effects of Temperature, Strain rate, microstructure and friction in metal forming, Introduction to Powder Metallurgy.

UNIT-II

Rolling: Types of rolling mill – Force and geometrical relationship –process variables – rolled product defects. Analysis of rolling load.

Forging: Classification, Process, Forging equipment, Forging load calculations, forging defects and remedies. Extrusion: Types of Extrusion –Calculation of Extrusion Load-Process Variables – defects

UNIT- III

Sheet metal work: Blanking, force calculation piercing, Bending, drawing and deep drawing. Unconventional Forming Process: High Energy Rate forming (HERF) processes- Explosive forming- Electro Magnetic forming- Electro Hydraulic forming, High Velocity Forming processes (HVF) – Petro forge hammer- Dynapak

UNIT IV

Casting processes: Introduction, advantages, limitations and applications of casting process. Pattern: allowance, materials, types and colour coding. Moulding sand-properties, ingredients, sand preparation, and types of moulding sand. Core and Core making. Introduction to Gating and Risering principles. Defects in casting, Fettling, Inspection and Testing of Castings, Brief introduction to melting equipments.

UNIT- V

Special casting Processes: Metal mould casting-permanent mould casting, Die-casting, Non metallic mould casting-Centrifugal casting, Carbon dioxide moulding, Investment mould casting, Shell moulding, Plaster moulding, Vacuum moulding, Continuous casting, Squeeze casting, no bake process.

Text Books:

1. Dieter, G E., "Mechanical Metallurgy", McGraw Hill, 1988
2. Nagpal.G.R.,"Metal Forming Process", Khanna,New Delhi,1998.
3. Jain.P.L,"Principles of Foundry Technology", Tata McGraw Hill.1988.

Reference:

1. Heine, Loper and Rosenthal, "Principles of metal casting", Tata McGraw Hill, 1978.
2. Schuler,"Metal forming Hand Book ",Springer, First Edition,1998

PE 225 MACHINE TOOLS AND CNC MACHINES

Credits :4:0:0
Marks 40+60

UNIT I : Introduction to Machine Tools

Machining as a production process - Classification of machinery processes - Principles of machining –Machine Tool Construction - Factors- Kinematic arrangement of different types of machine tools – Work holding and Tool holding devices.

UNIT II: Machine Tool Components and Design

Materials for beds and column - Design of beds and columns - slideways - types - materials - linear notion guide ways - Drive system - various types - Advantages and Disadvantages

UNIT III: Concepts and Programming of CNC Machines

Different types of CNC machines - constructional features - Drives and control systems - Accessories – Feed back devices - Manual part programming - Basics - using special functions - canned cycles.

UNIT IV: Capp and Tooling

Computer Aided part programming - APT - CAM packages - Tooling for CNC - Interchangeable tooling systems - Preset and qualified tools - classification of tooling - workholding devices - Fixing concepts of CNC.

UNIT V: Recent Advances

Computer Aided Manufacturing - Concepts – CAD part programming, NC tool path generation and verification. Integration - Computer Aided process planning – variant, generative process planning. Internet based manufacturing – Basics of ERP, SCM and Product life cycle management.

Text Books:

1. Radhakrishnan P., " Computer Numerical Control Machines ", New Central Book Agency, 1996.

References:

1. Radhakrishnan P., Subramanian S., " CAD/CAM/CIM ", Wiley Eastern, 1994.
2. Groover, " Automation, Production Systems and CIM ", Prentice Hall, 1990.
3. Thyer GE, " Computer Numerical Control of Machine Tools ", BH.Newners, 1991.
4. Krar S., " CNC Technology and Programming ", McGraw Hill, 1990.
5. Acherkan N., " Machine Tool Design Vol.III ", MIR Publishers, 1978.
6. Metha. N.K, "Machine Tool Design and Numerical Control" TNH 1996

PE301 FRACTURE MECHANICS & APPLIED MATERIALS ENGINEERING

Credit : 4:0:0
Marks 40 + 60

Unit I : Elastic & Plastic Behaviour

Elasticity in metals and polymers- mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour- Super plasticity- Deformation of non-crystalline material.

Unit II : Fracture behaviour.

Griffith's theory, intensity factor fracture, toughness- toughening mechanism- Ductile brittle transition in steel - High temperature fracture, creep- Larson- miller para meter- Deformation and fracture mechanism maps- Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanism and Paris law – Effect of surface and metallurgical parameters on fatigue- fracture of non metallic materials.-Failure analysis, sources of failure, procedure of failure analysis.

Unit III : Modern metallic materials.

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, transformation induced plasticity (TRIP) steel, Maraging Steel- intermetallics, Ni and Ti aluminides- smart materials, shape memory alloys- Metallic glass- Quasi crystal and nano crystalline materials. Applications, selection criteria, Nano structures.

Unit IV : Non metallic materials.

Polymeric materials- Formation of polymer structure- Production techniques of fibres, foams, adhesives and coatings- structure, properties and applications of engineering polymers- advanced structural ceramics, WC, TIC, TaC, AI_2O_3, SiC, Si_3N_4 CBN and diamond- properties, processing and applications. Selection criteria

Unit V : Composite Materials

Fibres - glass carbon, boron, ceramic, Aramid. MATRIX materials - Polymer, graphite, Bolted and bonded joints metal, ceramics processing, PMC, applications, selection criteria

Text Books

1. Thomas H. Courtney, Mechanical Behaviour of Materials, (2nd Edn.) McGraw Hill, 2000.
2. Charles, J. A. Crane, F. A. A and Fumess, J. A. S, Selection and use of engineering materials.(3rd Edition), Butter worth- Heiremann, 1997.

References

1. Flinn R. A. and Torjan , P.K. Engineering Materials and their Applications, (4th Edition) Jaico,1999.
2. George E. Dieter, Mechanical Metallurgy, McGraw Hill (10th Edition),1994.
3. Mattiall. P.K. Fibre Reinforce composites" Manual deletur Inc. 1993.

PE302 ADVANCED STRENGTH OF MATERIALS

Credit : 4:0:0
Marks 40 + 60

Unit I : Elasticity

Stress- Strain Relations and general equation of elasticity in Cartesian, Polar and spherical coordinates, differential equations of equilibrium-Compatibility – Boundary conditions-representation of three dimensional stress of tension, generalized hook's law, St. Venant's principle-plane stress- Airy's stress function.

Unit II

Shear Centre. Location of shear center for various sections- shear flows.
Unsymmeritical bending: Stress and deflections in beams subjected to unsymmeritical loading –kern of a section.

Unit III

Curved flexible members:
Circumference and radial stresses-deflections- curved beam with restrained ends- closed ring subjected to concentrated load and uniform load- chain links and crane hooks.

Unit IV

Stresses in flat plates:
Stress in circular and rectangular plates due to various types of loading and end conditions-buckling of plates.
Torsion of Non-Circular Sections.
torsion or rectangular crosses sections-st. venant's Theory- elastic membrane analogy-Prandtl's stress function-torsional stress in hollow thin walled tubes.

Unit V

Stresses due to rotary sections:

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speeds.

Theory of contact stresses:
Methods of computing contact stress-deflection of bodies in point and line contact-applications.

Text Book

1. Seely and Smith, " Advanced Mechanics of Materials", John Wiley international Ed., 1952.
2. Srinath L.S. "Advanced Strength of Materials", TMH 2003

Reference

1. Timoshenko and Gooddier, "Theory of Elasticity", Mc Graw Hill. 1972.
2. Wang, "Applied Elasticity", Mc Graw Hill.
3. Robert D. Cook, Warren C. Young. " Advanced mechanics of Materials", Mac millan pub., Co., 1985.

PE303 ADVANCED MECHANISM DESIGN.

Credit : 4:0:0
Marks 40 + 60

Unit I : Introduction
Review of fundamentals of kinematics- mobility analysis- formation of one D. O. F. multiloop kinematic chains, Network formula- Gross motion concepts.

Unit II : Kinematic Analysis
Position Analysis- Vector loop equations for four bar, slider crank, inverted slidercrank, geared five bar and six bar linkages. Analytical methods for velocity and acce;leration Analysis- four bar linkage jerk analysis. Plane Complex mechanisms. Path Curvature theory. Fixed and moving centrodes, inflection points oandinflection circle. Euler Savary Equation, graphical constructions- Cubic of stationary curvature.

Unit III : Synthesis Of Mechanisms
Type synthesis- Number synthesis- Associated Linkage concept. Dimensional synthesis-function generation, path generation, motion generation, Graphical methods. Cognate linkage- coupler curve synthesis, Design of six-bar mechanisms. Algebraic methods. Application of instant centre in linkage design. Cam Mechanisms- determination of optimum size of Cams.

Unit IV : Dynamics Of Mechanisms
Static force analysis with friction – inertia force analysis- combined static and inertia force analysis, shaking force, kinetostatic analysis. Introduction to force and moment balancing of linkages.

Unit V Spatial Mechanims And Robotics

Kinematic Analysis of spatial RSSR mechanism- Denavait- Hartenberg parameters forward and inverse kinematic of Robotic manipulators.

Study and use of Mechanism software packages.

Text Book

1. Sandor G. N. and Erdman. A. G., " Advanced mechanism Design analysis and synthesis", Prentice Hall, 1984.

References

1. Singhley , J. E. And uicker J.J., " Theory of Mechanics and mechanism", McGraw Hill 1985.
2. Amitabha Ghosh and ahsok kumar Mallik, "Theory of mechanism and Machines", EWLP, Delhi, 1999.
3. Nortorn R. L. " Design of Machinery", Mc Graw Hill, 1999.
4. Kenneth J. Waldron, Gary L Kinzel, " Kinematics, dynamics and design of machinery", John wiley- sons 1999.

PE304 FINITE ELEMENTS ANALYSIS

Credit : 4:0:0
Marks 40 + 60

Unit I

Introduction: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies in stress analysis, classical analysis techniques-finite element packages.

Solution of Finite Equations: Solution of equilibrium problems- Gauss elimination techniques, Choleski method solution of Eigen value problem , Jacobi method power method, subspace interaction method- Solution of propagation problems, numerical solutions.

Unit II

General Procedure: Discretization of Domain- basic element shapes- interpolation polynomials- natural coordinates- formulation of element characterstic matrices and vectors- direct approach- variational approach and weighted residual approach. Formulation of one dimensional , two dimensional three- dimensional elements., continuity conditions- isoparametric elements- curve sided elements- numerical integration.

Unit III

Solid and structural mechanics: basic equations of solid mechanis- Static analysis- formulation of quilibrium equations- analysis of trusses and frames- analysis of plates- Solid of revolution. Dynamic analysis –dynamic equations of motion- consistent and lump mass matrices- Free vibration analysis – dynamic response calculation.

Unit IV

Field problems: Two dimensional field equation- governing differential equations- Integral Equations for the element matrices- Element matrices- Triangular element, Rectangular element problems. Torsion of Non circular sections: General theory- Twisting of a square bar- shear stress components- Evaluation of the twisting torque- Computer solutions for the square bar problems.

Unit V

Heat Transfer Problems. Basic equations of heat transfer derivation of finite element equation- one dimensional axisymmetric and three dimensional heat transfer. Fluid mechanics problems: Basic equations- Solutions procedure- compressible flows- Galerkin approach.

Text Book

1. Rao. S.S. ' The Finite element method in Engineering', IInd Ed., Pergamon Press, Oxford, 1989.

Reference Books

1. K.J. Bathe, ' Finite Element Procedures in Engineering Analysis", Prentice hall, Engle Wood chiffs, 1981.
2. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 1972.
3. Belakuntu, "Finite Element Methods in Engineering", PHI, 2002

PE305 INDUSTRIAL ROBOTICS

Credit : 4:0:0
Marks 40 + 60

Unit I : Introduction And Robot Kinematics

Definition need and scope of industrial robot, anatomy- work volume- precision movement – end effects – Sensors. Robot kinematics- Direct and inverse kinematics- Robot trajectories- control of robot manipulators- Robot Dynamics- method for orientation and location of objects.

Unit II : Robot Drives And Control

Controlling the Robot motiobn- Position and velocity sensing devices- Design of drive valves- Electro hydraulic and pneumatic drives- Linear and rotary actuators and control valves- Electro hydraulic servo valves, electric drives- Motors- Desigining of end effectors- Vacuum, magnetic and air operated grippers.

Unit III : Robot Sensors

Transducers and sensors- sensosrs in Robot- Tactile sensor- proximity and range sensors- sensing joint forces- Robotic vision system- image gribbing- Image processing and analysis- Image segmentation- pattern recognition- Training of vision system.

Unit IV : Robot Cell Design and Application

Robot work cell design and control- Safety in Robots- robots cell layouts- Multiple robots and machine interference- robot cycle time analysis. Industrial application of robots.

Unit V : Robot Programming, Artifical Intelligence and Expert Systems

Methods of Robot programming – Characterstics of task level languages lead through programming methods - Motion interpolation. Artifical intelligence- Basics- Goals of artifical intelligence - Al Techniques- problem representation in AI - problem reduction and solution techniques, Application of Al and KBES in robots.

Text Books

1. K.S. Fu. R. C. Gonzalez and C.S.G. Lee, " Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.
2. Richard. D. Klafter, Thomas, A., Chmieleswski Michael Negin, Robotics Engineering an Integrated approach", Prentice Hall of India P. Ltd., 1998.

References

1. Yoram Koren, " Robotics for Engineers", McGraw Hill, 1987.
2. Kozyrey, Yu " Industrial Robots", MIR Publishers Moscow,1985.
3. Deb. S. R. " Robotics Technology and Flexible Automation", Tata Mc Graw Hill, 1994.
4. Mikell, P. Groover, Mitchell Weis, Roger, N, Nagel. Nicholas G. odrey, " Industrial Robotics Technology, Programming and Application", MC Graw – Hill int. 1986.
5. Timothy Jordanides etal, " Expert Systems and Robotics", Springer- Velag, New York May1991.

PE306 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credit : 4:0:0
Marks 40 + 60

Unit I : Nature and Scope of Product Engineering

Creative thinking and organizing for product Innovation criteria for product success in life cycle of a product.CE design Methodology Colloborative product development in CE. Design Process Product lifecycle-Technological Forecasting, Market identification Bench Marking Human factors in design Industrial Design. quality by Design Robust Design, FEMA for product development.

Unit II : Modeling and simulation

The role of models in product design- mathematical modeling- similitude relations - weighted property index. Use of IT in product design-Geometric Modeling, FEA, Mechanism simulation etc . Application of AI and Expert system in product design and Development.

Unit III : Materials Section

Motivation for selection, cost basis and service requirements- Selection for mechanical properities, strength, toughness, fatigue and creep- Selection for surface durability, corrision and wear resistance- Relationship between materials selection and processing Case Studies in materials selection with relevance to aero, auto marine, machinery and nuclear applications. cost versus performance relations-weighted property index. value analysis

Unit IV : Functional and production design

Form design-influence of basic design, mechanical loading and material on form design-form design castings, and forgings, plastic moldings, welded fabrications, manufacture by machining methods. Influence of space, size, weight, etc., on form design aesthetic and ergonomic considerations.

Unit V : Dimensioning and Tolerancing a product

Functional production and inspection, datum-tolerance analysis. Tolerance work sheets and centrality analysis, examples. Design features to facilitate machining datum features-functions and manufacturing.

Text Books

1. Jones. J.C. " Design Methods", interscience, 1970.
2. Buhl, H. R., " Creative Engineering Design", Iowa State University press, 1960
3. Dieter, G. E., " Engineering Design", McGraw Hill, 1983.
4. Wade, Or., " Tolerance control in Design and Manufacture", Industrial Press, Inc.
5. Component Design- machining Considerations, Redesign for manufacturing examples.

References

1. Robert Matouseek, " Engineering Design", Blackie & son Ltd., 1963.
2. Niebel, B.W., & Draper, A.B., " Product Design and Process Engineering", Mc Graw Hill 1974.
3. Hary Peck, " Desigining for Manufacture", Sir Issac Pitman and sons ltd., 1973.
4. Gladman, C. A., " Manual for Geometric Analysis of Engineering Designs" Australian Trade Publications Ltd

PE307 COMPUTER GRAPHICS

Credit : 4:0:0
Marks 40 + 60

Unit I

Computer Graphics, Basic Concepts And Systems.

Origin of computer Graphics, Fundamentals of Computer Hardware- interactive graphic display- Graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors. Introduction and study of various Operating systems like Unix ,Windows 98-NT-2000 etc and CAD software.

Unit II : Graphic Primitive.
output primitive-point plotting techniques co-ordinate systems, increment methods. Line-drawing algorithms. Circle generating algorithms. Parametric Representation of Line, Circle, Ellipse, Parabola and Hyberbola. Programming using C/Auto Lisp to generate various primitives.

Unit III : 2D & 3D Transformation
Translation, scaling, rotation - matrix representations and Homogeneous co-ordinates. Composite transformations (concatenation) – Concatenation properties. General transformation equations. Windowing and clipping –line-clipping midpoint sub division, clipping other graphic entities, polygon clipping viewing and windowing transformation Writing interactive programs using C/AutoLisp for transformations.Perspective projection-Techniques for visual realism- hidden line- Surface removal – Algorithms for shading and Rendering. Concepts of Animation and Virtual reality.

Unit IV : Curves,Surfaces,Solids
Representation of curves- Bezier curves- cubic spline curve B—Spline curves Rational curves- Surfaces modeling techniques-surface patch. Coons patch bi-cubic patch- Beizer and B- spline surfaces- Volume modelling Techniques- Boundary models- CSG, Feature Based Modeling-Parametric Modeling- Variational Modeling. Creation of parts using software packages2D Representation- Development of surfaces using C/AutoLisp.

Unit IV : Graphics Standards for CAD.
Need of Graphics and computer standards- GKS,Vector and Bitmaps, Open Architecture in CAD- Open GL,Windows Graphics Language.Study of Modeling Kernels-Parasolid,ACIS solids – Data Exchange standards-STL - IGES-STEP-CALS-DXF- Communication standards- Study of Various Protocols like –TCP/IP. Network fundamentals -WAN, LAN. Application of Object broker Architecture in CAD/Cam data transfer.

Textbook

1. Chris Mc Mohan and Jimmi Browne, " CAD/CAM Principles, practice and manufacturing management", Pearson Education Asia Ltd., 2000.

References

1. Donald Hearn and M. Pauline Baker " Computer Graphics", Prentice Hall. Inc, 1992.
2. IBRAHIM ZEID " CAD/CAM- Theory and Practice" McGraw Hill, International Edition, 1998.

PE308 COMPUTER APPLICATIONS IN DESIGN & MANUFACTURING

Credit : 4:0:0
Marks 40 + 60

Unit I : Integration of Modeling through CAD
The Design Process using CAD, Types and Application of design Models, Computer representation- of Models and Drawings. Features of Various solid modeling packages-Various modules- Associative, Parametric nature of models, Assembly Tolerance modeling,

analysis ,Mass property calculation of Models. And Mechanical Simulation and synthesis of Assemblies, Implementation of Artificial Intelligence and Expert systems in CAD.

Unit II : Integration Of Design Analysis And CAD

Graphical aid for pre-processing in FEA- mesh Generation techniques- Post processing – Adaptive Meshing. Machining for 3D Model- generative machining – cutter location- gouge detection- tool path generation from solid models- STL formats for rapid prototyping – Slicing techniques- Introduction to fractional geometry.

Unit III : CNC Machine Tools and Programming

Development of CNC technology Principles , features. NC, CNC,DNC concepts, classifications of CNC machine tools, CNC controllers. CNC programming for various controllers -sinumeric, fanuc, CNC coordinate system, structure of part programs, G & M codes. Part programming of Prismatic and revolved components Automated part programming using APT part programming using CAD CAM software.

Unit IV : Computer Aided Process planning and PPC.

Part families, classification and coding. Concepts of group technology and applications. Computer aided process planning- retrieval generative approaches. Study of various CAPP softwares like CAMI Appas, Auto plan. Pro CPPP, AI and expert system in CAPP. CA features. Materials requirements and manufacturing resource planning software. Factory data and automated collection systems. Computer aided inspection techniques CAQC Interfacing CMM with cad Software.

Unit V : Computer Integrated Manufacturing Systems.

Concurrent engineering and design methodology, collaborative product development Product data management for manufacturing and design data rescue, Product life cycle management and Collaborative Product commerce. Advanced manufacturing – Cellular- Synchronous – Agile-Lean - manufacturing systems. Concepts of Rapid prototyping, reverse engineering, re engineering- Case studies.

Text Book

1. David Bedworth, " Computer Integrated design & Manufacturing" TMH, New Delhi, 1998.

References

1. Groover, M. P., " Automation, Production system and CIM", Prentice –Ha ll of India, 1998.
2. Yorem Koren, " Computer Integrated Manufacturing systems", Mc Graw Hill 1983.
3. Ranky, Paul G., " Computer Integrated Manufacturing", Prentice Hall International, 1986.
4. R. W. Yeomamas, A. Choudry and P.J. W. Ten Hagen, " Design rules for a CIM system", North Holland Amsterdam, 1985.
5. Prasad, "Concurrent Engineering fundamentals: Integrated product Development", Prentice Hall, 1996.
6. Computer aided Manufacturing , Tien Chang, Prentice Hall , 1996.

PE309 DESIGN FOR MANUFACTURING AND ASSEMBLY

Credit : 4:0:0
Marks 40 + 60

Unit I : Embodiment Design

Steps, Basic rules, principles, guidelines, design for ease of assembly, Design for standards, design for maintenance, Recycling, minimum risk, Evaluating embodiment design, Design for minimum cost, DFM approach and Processes, DFM Guidelines, DFMEA, PFMEA.

Unit II : Tolerance Analysis

Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process Cumulative effect of tolerances-sure fit law, normal law and truncated normal law.

Selective Assembly: - Interchangeable part manufacture and selective assembly, deciding the number of groups- Model-I Group tolerances of mating parts equal; Model II total and group tolerances of shaft equal. Control of axial play- introducing secondary machining, operations laminated shims, examples.

Unit III : Datum Systems

Degrees of freedom, grouped datum systems- different types, two and three mutually perpendicular grouped datum planes; grouped datum system with spigot and recess, pin and hole; grouped datum system with spigot and recess pair and tongue- slot pair – computation of translational and rotational accuracy, geometric analysis and applications.

Unit IV : True Position Theory

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

Form Design Of Castings And Weldments: Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols.

Unit V : Tolerance Charting Techniques

Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. Design features to facilitate machining: Datum features- functional and manufacturing. Components design-machining considerations, redesign for manufacture, examples.

Case Studies:- Redesign to suit manufacture of typical drive - system example, design of experiments. Value analysis and design rules to minimize cost of a product. Computer Aided DFMA, Poke Yoke principles.

Text Books

1. Harry Peck, " Designing for Manufacture", Pitman Publications, 1983.

2. Matousek, " Engineering Design- A Systematic Approach" Blackie & Son Ltd., London.

References

1. Spots. M. F. " Dimensioning and Tolerance for Quantity production", Prentice Hall Inc.
2. Oliver R. Wade, " Tolerance Control in Design & Manufacturing", Industrial Press Inc. New York 1967.
3. James G,. Bralla, " Hand Book of Product design for Manufacturing", Mc Graw Hill publications, 1983.
4. Trucks H.E., " Design for Economic Production", Society of Manufacturing Engineers Michigan, 2nd Edition, 1987.
5. Poka-Yoke, " Improving Product quality by preventing defects", Productivity Press, 1992
6. Creveling C.M., " Tolerance Design- A Hand Book for developing Optimal Specifications" Addision Wesley Long man, Inc. 1997.

PE 310 FLEXIBLE MANUFACTURING SYSTEMS

Credit : 4:0:0
Marks 40 + 60

Unit I

AN OVERVIEW: Definition of FMS – types & configurations concepts- types of flexibility & performance measures. Functions of FMS host computer – FMS host and area controller function distribution.

Devolopment And Implementation: Planning phases integration- system configuration – FMS layouts – simulation –FMS project development steps. Project management –equipment development – host system development - planning – hardware & software development.

Unit II

AUTOMATED MATERIAL HANDLING AND STORAGE.: Functions- types – analysis of material handling equipments, Design of conveyor & AGV systems. Storage system performance- AS/RS – carousel storage system – WIP storage system – interfacing handling storage with manufacturing.

Unit III

MODELLING AND ANALYSIS: Analytical, heuristics, queuing, simulation and pertinent modeling techniques – scope applications and limitations. Application of Simulation software, manufacturing data systems- planning the FMS database.

Unit IV

CONCEPTS OF DISTRIBUTED NUMERICAL CONTROL: DNC system – communication between DNC computer & machine control unit – hirarchical processing of data in DNC system – features of DNC systems.

Programmable Controllers: Control system architecture – elements of programmable controllers: languages, control system flowchart, comparison of programming methods . Introduction to micro controllers Applications

Unit V

SCHEDULING AND LOADING OF FMS: introduction, scheduling of operations on a single machine –2 machine flow shop scheduling – 2 machine job shop scheduling, 3 machine flow shop scheduling – scheduling 'n' machines – scheduling rules – loading problems – tool management of FMS, material handling system schedule, Knowledge based scheduling in FMC

Fms Relationale: Economic and technological justification for FMS – as GT, JIT- operation and evaluation – personnel and infra structural aspects – typical case studies – future prospects.

Text books

1. Parrish D.J, "Flexible manufacturing", Butter Worth – Heinemann Ltd, Oxford, 1993.
2. Groover M.P. "Automation, Production system and computer Integrated manufacturing", Prentice Hall India (P) Ltd, 1989.
3. Kusiak A "Intelligent Manufacturing Systems", Prentice Hall, Englewood Clitts, NJ, 1990.

References

1. Considine D M. and Considine G.D, "Standard Handbook of Industrial Automation", Chapman and Hall, London, 1986.
2. Viswanadham N and Narahari Y, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India (P) Ltd. 1992.
3. Ranky P G, " The Design and Operation of FMS", IFS Pub. UK,1988.

PE311 MANUFACTURING INFORMATION AND DECISION SUPPORT SYSTEMS.

Credit : 4:0:0
Marks 40 + 60

Unit I : Introduction

Terminologies- Entities& attributes- Data Models; Schemas& Subschemas- Structure, tree & plex- Relational Database- distributed database- data description languages- Addressing and searching techniques. Decision making in a manufacturing systems.

Unit II : Design of Manufacturing Information Systems

Concepts- Design and implementation of MIS- product and its structure- Shop-floor control; Data structure and procedures, the standard model, order model, flow model, the input/output analysis module.

Unit III

Human and Machine Intelligence- Concept of Fifth Generation Computing, programming in AI environment, develop artificial intelligence system, definition of Expert systems, Natural Language processing, neural networks- Introduction to basic algorithm and networks. Applications in manufacturing. Tools for Machine Thinking- Forward Chaining, Backward chaining, use of Probability and Fuzzy Logic.

Unit IV

Expert System Development- Choice of Domain, Collection of knowledge base, selection of Inference mechanism, Case studies of Expert System development in Design and manufacturing. Expert System tools: General structure of an expert system shell. Industrial application of AI and expert systems: robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition.

Unit V

Genetic algorithm in design

Introduction to GA fundamental theorems. Two armed and K armed pundit problem, genetic representations . Design applications of Ga – helical springs, fly wheels, connecting rod. Use of neural network in GA.

Text Books

1. Robert Levine et al; " A Comprehensive guide to AI and Expert Systems", McGraw Hill, 1986.
2. Ragurama Krishnan, " Data Base Management System", McGraw Hill Inc. 1998.

References

1. Henry C. Mishkoff, " Understanding AI", BPB Publication, New Delhi, 1986.
2. Bipin C. Desai, " An introduction to Data Base Systems", West Publishing Co., 1990.

PE312 ADVANCED MODELING LAB

Credit : 0:0:2
Marks 40 + 60

List Of Exercises

1. Solid modeling of machine/Engine parts
   i) Tailstock
   ii) Drilling jig
   iii) Gear box

2. Assembly modeling of Machine/Engine parts.

3. Surface modeling practice using
   i) Splines,
   ii) Curves
   iii) Patches.

4. Surface modeling of complex shapes
    i) Helmet
    ii) Carbody.

5. Generation of manufacturing drawings for the above models.
6. Mechanism Design of
    i) Tailstock
    ii) Drilling jig
    iii) Gear box
7. Programming Practice for Customization and Automation.

8. Graphics Programming of standard primitives using C++/Autolisp/ PRO PROGRAM .

PE313 ADVANCED MANUFACTURING LAB

Credit : 0:0:2
Marks 50 + 50

List Of Exercises

1.Practice of part programming and operations of

    i) Turning center.
    ii) Machining center.

2. Tool planning and selection for

    iii) Turning center.
    iv) Machining center.

3. Tool Design for a plastic component.
    i) Core and Cavity Extraction of industrial switch knob
    ii) Gating Design.

4. Asembly of various die components for the above

5. Pattern Design for a casting component.
    i) Cope and Drag Design of a butterfly valve.
    ii) Gating Design

6. Asembly of various pattern components for the above.
7. Generation of G & M codes for the above assemblies and Electrodes..
8. Programming and Study of robots for material handling.

PE 314 ADVANCED ANALYSIS LAB.

Credit : 0:0:2
Marks 50 + 50

List Of Exercises

1. Simulation of standard linkages and study of movements.
2. Simulation of stock absorber for load capacity
3. Simulation of mating gears and study of interference effects and load transmitting capacity.
4. Simulation of pulley and study.
5. Finite element modeling & analysis of static structures - Stress analysis of a Plate with hole
6. Finite element modeling & analysis of dynamic structures - Spring
7. Finite element modeling & analysis of heat transfer - Heat conduction through fins.
8. Finite element modeling & analysis of fluid flow problems - Air flow through Aero foils
9. Transient analysis of time dependent problems - Frequency of simple pendulum.

PE315 COMPUTER GRAPHICS

Credit:3:1:0
Marks: 40+60

Unit I

Computer Graphics, Basic Concepts And Systems.
Origin of computer Graphics, Fundamentals of Computer Hardware- interactive graphic display- Graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors. Introduction and study of various Operating systems like Unix ,Windows 98-NT-2000 etc and CAD software.

UnitII Graphic Primitive

Output primitive - point plotting techniques, co-ordinate systems, increment methods. Line-drawing algorithms. Circle generating algorithms. Parametric Representation of Line, Circle, Ellipse, Parabola and Hyberbola.

Unit III 2D & 3D Transformation

Translation, scaling rotation- matrix representations and Homogeneous co-ordinates. Composite transformations (concatenation) – Concatenation properties. General transformation equations. Windowing and clipping –line-clipping midpoint sub division, clipping other graphic entities, polygon clipping viewing and windowing transformation Perspective projection- Techniques for visual realism- hidden line- Surface removal – Algorithms for shading and Rendering. Concepts of Animation and Virtual reality.

Unit IV Curves,Surfaces,Solids

Representation of curves- Bezier curves- cubic spline curve B—Spline curves Rational curves- Surfaces modeling techniques-surface patch. Coons patch bi-cubic patch- Beizer and B- spline surfaces- Volume modelling Techniques- Boundary models- CSG, Feature Based Modeling-Parametric Modeling- Variational Modeling. 2D Representation

Unit V Graphics Standards for CAD.

Need of Graphics and computer standards- GKS, Vector and Bitmaps, Open Architecture in CAD- Open GL, Windows Graphics Language. Study of Modelling Kernels-Para solid, ACIS solids – Data Exchange standards-STL - IGES-STEP-CALS-DXF- Communication standards- Study of Various Protocols like –TCP/IP. Network fundamentals -WAN, LAN. Application of Object broker Architecture in CAD/CAM data transfer.

Textbook

1. Chris Mc Mohan and Jimmi Browne, " CAD/CAM Principles, practice and manufacturing management", Pearson Education Asia Ltd., 2000.
2. H. Hagen , "Geometric Modeling: Methods & Applications" Springer 1997
3. IBRAHIM ZEID " CAD/CAM- Theory and Practice" McGraw Hill, International Edition, 1998.

References:

1. Donald Hearn and M. Pauline Baker " Computer Graphics", Prentice Hall. Inc, 1992.
2. Making CAD-CAM Data Transfer Work : IGES & Other Solutions (A Hands-On Guide), John Stark Associates 1992

PE316 DESIGN FOR MANUFACTURING AND ASSEMBLY

Credit:3:1:0
Marks: 40+60

Unit I Embodiment Design and Tolerance analysis

Steps, Basic rules, principles, guidelines, DFM approach and Processes
Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk cost aspects, Feature tolerances, geometric tolerances, surface finish, relationship between tolerance grades machining process. Cumulative effect of tolerances-sure fit law, normal law and truncated normal law.

Unit II Selective assembly and Datum systems

Selective Assembly: - Interchangeable part manufacture and selective assembly, deciding the number of groups- Model-I Group tolerances of mating parts equal; Model II total and group tolerances of shaft equal. Grouped datum systems- different types, two and three mutually perpendicular grouped datum planes; grouped datum system with spigot and recess, pin and hole; grouped datum system with spigot and recess pair and tongue- slot pair – computation of accuracy

Unit III True Position Theory:

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

Unit IV Form Design
Form Design Of Castings And Weldments: Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols. Machining: Design features to facilitate machining: Datum features- functional and manufacturing. Components design- machining considerations, redesign for manufacture,

Unit V Charting Techniques And Recent Advances:
Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.
Value Engineering and design rules to minimize cost of a product. Computer Aided DFMA, Poke Yoke principles, Design for Automated Assembly. Environmental factors in Design for Manufacturing.

Text Books.
1. Foster. L , "A workbook on Geometric Tolerancing" Foster Assoicates, 1996
2. Harry Peck, " Designing for Manufacture", Pitman Publications, 1983.
3. Matousek, " Engineering Design- A Systematic Approach" Blackie & Son Ltd., London.1963

References:
1. James G,. Bralla, " Hand Book of Product design for Manufacturing", Mc Graw Hill publications, 1998.
2. Creveling C.M., " Tolerance Design- A Hand Book for developing Optimal Specifications" Addision Wesley Long man, Inc. 1997.
3. Spots. M. F. " Dimensioning and Tolerance for Quantity production", Prentice Hall Inc.1983
4. Oliver R. Wade, " Tolerance Control in Design & Manufacturing", Industrial Press Inc. New York 1967.
5. Poka-Yoke, " Improving Product quality by preventing defects", Productivity Press, 1992

PE317 DESIGN OF FLUID POWER CONTROL SYSTEMS

Credit:3:1:0
Marks: 40+60

Unit I: Oil Hydraulic Systems
Hydraulic power Generators- Selection and specification of pumps, pump characteristics.
Hydraulic Actuators: Linear and rotary actuators- selection , specification and characteristics.

Unit II Control and Regulation Elements
Pressure- Direction and flow control valves- relief valves, non return and safety valves- actuation systems.

Unit III Hydraulic Circuits
Reciprocation, quick return, sequencing synchronizing circuits- Accumulator circuits- industrial circuits- press circuits- hydraulic milling machine- grinding planning, copying, forklift, earth mover circuits- Design and selection of components- Safety and emergency mandrels.

Unit IV. Pneumatic Systems and Circuits
Pneumatics fundamentals- control elements, position and pressure sensing- logic circuits- switching circuits- fringe conditions modules and these integration – sequential circuits- cascade methods- mapping methods- step counter method- compound circuit design- Combination circuit design.

Unit V. Installation, maintenance and special circuits.
Pneumatic, equipments selection of components- design calculations- Applications fault finding- hydro pneumatic circuits- use of microprocessors for sequencing- PLC low cost automation – robotics circuits.

Text Books
1. Antony Espossito, " Fluid Power with applications", Prentice Hall, 1980.
2. Dudley, A Pease and John. J. Pippenger, " Basic Fluid power", Prentice Hall, 1987.

Reference:
1. Andrew parr " Hydraulic and pneumatics", (HB) Jaico Publishing House, 1999.
2. Bolton, W. Pneumatic and Hydraulic Systems", Butterworth- Heinemann, 1987.
3. Peter Rohner, 'Introduction to Fluid Power' 1996, Wiley & Sons

PE318 DESIGN OF CNC MACHINE TOOLS

Credit:4:1:0
Marks: 40+60

Unit I : Introduction to CNC Machine Tools
Development of CNC Technology, Principles, features, advantages, economic benefits, applications, CNC, DNC concept, classification of CNC machine, types of control, CNC controllers, Characteristics, interpolators.

Unit II : Structure of CNC Machine Tool
CNC Machine Building, structural details, configuration and design, guide ways- friction and antifriction and other types of guide ways, elements used to convert the rotary motion to a linear motion- screw and nut. Recirculating ball screw, planetary roller screw, re circulating roller screw. Rack and pinion, torque transmission elements- gears, timing belts, flexible. Couplings bearings.

Unit II : Drives and Controls
Spindle drives- Dc shunt motor, 3 phase AC induction motor, feed drives-stepper motor servo principle, DC & AC servo motors. Open loop and closed loop control. Axis measuring system- Synchro, synchro revolver, gratings, moiré fringe gratings, encoders, inductosyn laser interferometer.

Unit IV : CNC Programming
Coordinate system, structure of a part program, G &M codes, Manual part programming for Fanuc, Sinumeric control system, CAPP, APT part Programming using CAD/CAM, Parametric Programming.

Unit V : Tooling and Maintenance of CNC
Cutting tool materials, carbide insets classification, qualified, semi qualified and preset tooling, tooling system for machining centre and Turning centre work holding devices maintenance of CNC machines.

Text Books.

1. HMT, Mechatronics, TATA McGraw –Hill Publishing company Ltd. New Delhi, 1998.

References

1. James Madison, CNC Machining Hand book, Industrial Press inc. 1996.
2. Steve Krar, Arthur Gill, CNC Technology and Programming, Mc-Graw Hill International Editions, 1990.
3. Berry Leathan- Jones, Introduction to Computer Numerical control, pitman, London, 1987.
4. Sadasivan, T. A. And Sarathy D. Cutting tools for Productive Machining, Widia (India) Ltd., August 1999.
5. Radhakrishnan. P. Computer Numerical Control Machines, New Central Book agency, 1992.
6. Peter Smid. CNC Programming Hand book, Industrial Press Inc., 2000.

PE319 RAPID PROTOTYPING

Credit:4:0:0
Marks: 40+60

Unit I
Introduction
Basic Concept - overview of existing technologies of proto typing tooling- Need for speed design to market operations

Unit II
Product Development
State of the Technology- Conceptual design- prototype tooling- Engineering Pilot- limitations.

Unit III
CAD Processes.
Data Requirements for Solid modeling- Data representation- Part orientation and support- STL format- Slicing – post processing

Unit IV
Rapid prototyping systems
Selective laser sintering- Working Principles- Advantages and limitations- Sterolithography- Working principles- Applications, advantages and limitations- Case- Applications.

Unit V
Other systems.
Laminated Object modeling- Waving principles, applications- Advantages and limitations – Fused Deposition, modeling- Direct shell production casting- Applications.

Text Book:

1. Paul. F. Jacobs, " Rapid prototyping and Manufacture Fundamentals of Stereo lithography"

References:

1. Soenen. R. and Olling, " Advanced CAD/ CAM Systems", Narosa Publishing house, 1995.
2. Duvvent. W. R " TheLithograpy Hand book" Narosa Publishing house, 1995.
3. Rapind News, University of Warwick, UK, 1995. www.cc.utah.edu/~asn8200/rapid.html

PE320 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credit:4:0:0
Marks: 40+60

Unit I : Nature and Scope of Product Engineering
Creative thinking and organizing for product Innovation criteria for product success in life cycle of a product.CE design Methodology Collaborative product development in CE. Design Process Product lifecycle-Technological Forecasting, Market identification Bench Marking Human factors in design Industrial Design. quality by Design Robot Design, FEMA for product development.

Unit II : Modeling and simulation
The role of models in product design- mathematical modeling- similitude relations -weighted property index. Use of IT in product design-Geometric Modeling, FEA, Mechanism simulation etc . Application of AI and Expert system in product design and Development.

Unit III : Materials Section
Motivation for selection, cost basis and service requirements- Selection for mechanical properties, strength, toughness, fatigue and creep- Selection for surface durability, corrosion and wear resistance- Relationship between materials selection and processing Case Studies in materials selection with relevance to aero, auto marine, machinery and nuclear applications. cost versus performance relations-weighted property index. value analysis

Unit IV : Functional and production design

Form design-influence of basic design, mechanical loading and material on form design- form design castings, and forgings, plastic moldings, welded fabrications, manufacture by machining methods. Influence of space, size, weight, etc., on form design aesthetic and ergonomic considerations.

UNIT V : Recent Advances

Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing - Use of STEP standards in CIM.

Text Books:

1. Dieter, G. E., " Engineering Design", McGraw Hill, 2000.
2. Jones. J.C. " Design Methods", Wiley Interscience, 1980.
3. Buhl, H. R., " Creative Engineering Design", Iowa State University press, 1960

References:

1. Niebel, B.W., & Draper, A.B., " Product Design and Process Engineering", Mc Graw Hill 1974.
2. Robert Matosek, "Engineering Design", Blackie & son Ltd., 1963.
3. Hary Peck, " Designing for Manufacture", Sir Issac Pitman and sons ltd., 1973.

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
PE226	Theory of Machines	3:1:0
PE227	Metrology and Computer Aided Inspection	3:1:0
PE228	Material Science and Engineering	4:0:0
PE229	Computer Aided Design and Analysis	4:0:0
PE230	Metal forming and Casting	4:0:0
PE231	Computer Numerical Control & Non Traditional Machining Techniques	4:0:0
PE232	Artificial Intelligence and Expert System	4:0:0
PE233	Personnel Management	4:0:0
PE234	Industrial Safety Engineering	4:0:0
PE235	Design of Jigs ,Fixtures and Press Tools	4:0:0
PE236	Industrial Robotics	4:0:0
PE321	Manufacturing Information Systems	4:0:0
PE322	Computer Applications in Design & Manufacturing	4:0:0
PE323	Concurrent Engineering	4:0:0
PE324	Mechatronics in Manufacturing Systems	4:0:0
PE325	Precision Engineering & CAI	4:0:0
PE326	Production Management Systems.	4:0:0
PE327	Computer Aided process planning.	4:0:0

PE226 THEORY OF MACHINES

Credit 3 : 1 : 0 **Marks 40 + 60**

UNIT I : Velocity and Acceleration of simple Mechanisms

Links, Pairs, chain, Mechanism, inversions, structure, degree of freedom, inversion of four bar chains. Velocity and Acceleration of simple mechanisms by Relative velocity method, Klein construction for slider crank chain.

UNIT II

Cams: Types of cams and followers, displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM. Layout of profile of plate cams of the above types with reciprocating follower of type knife-edge, roller and flat face. Belt and Rope Drives.

UNIT III : Gear trains and Gyroscope

Gear trains: Theory of Gearing and Nomenclature, Types, velocity ratio and torque calculation in epi-cyclic gear trains. Gyroscope-couple and effects in ship, car, aircraft, gyroscope stabilization.

UNIT IV : Balancing of Masses
Static and dynamic balancing of rotating masses in single and different planes, primary and secondary forces and couples, partial balancing of reciprocating masses of in-line V W and radial engines. Direct and reverse crank method.

UNIT V : Vibrations
Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Under damped system - Logarithmic decrement. Transverse vibrations of beams – natural frequency of simply supported beams, critical speed – whirling of shafts, Torsional Vibrations of single rotor systems.

Text Books
1. Amitabha Ghosh and Asok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East and West Press Limited, 1988.
2. Khurmi R.S. "Theory of Machines" S. Chand Pub. Delhi, 2000.

Reference Books
1. S. S Rattan, "Theory of Machines" TMH, 1999.
2. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill ISE., 2003

PE227 METROLOGY AND COMPUTER AIDED INSPECTION

Credit 3 : 1 : 0 **Marks 40 + 60**

Unit I : General Concepts Of Measurement
Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, selection and care of instruments.

Unit II : Linear And Angular Measurements
Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges-comparators, various types-principle and applications-limits, fits and tolerance-design of gauges-interferometry applications-angular measuring instruments-bevel protector, levels, clinometers-sine bar, angle dekkor-alignment telescope, autocollimator.

Unit III : Measurement Of Form Errors, Surface Roughness and Measuring Machines
Straightness, flatness, alignment errors-surface texture-various measuring instruments-run out and concentricity, Tool makers microscope-metro scope

Unit IV : Measurement of Screw Threads And Gears
Various elements of threads-2 wire and 3 wire methods-gears elements -various errors and measurements. Dovetail Measurement – measurement of center line of hole and hole size.

Unit V : Computer Aided And Laser Metrology

Coordinate measuring machine-LASER micrometer- Introduction to Interferometer, optical - LASER interferometer-Non contact and in-process inspection, vision system, Image analyser, Opto electronic devices-Applications in Online Processing systems.

Text Book:

1. I.C.Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai and Sons, 2000

Reference Books

1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.
2. G.N.Galyer F.W and C.R.Shotbolt, " Metrology for Engineers ", ELBS Edn 1990.
3. "ASTME Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
4. Robert.G. Seippel, "Optoelectronics for technology and engineering ", Prentice Hall New Jersey,1989.
5. Parson. S ,"Metrology and Gauging", McDonald & Evans, 1970.

PE228 MATERIAL SCIENCE AND ENGINEERING

Credit 4:0:0 **Marks 40 + 60**

UNIT I: Crystallography

Crystal systems, space lattices, miller indices of atomic planes and directions, allotropy. Crystal defects – point, line and surface defects, Effects of crystal imperfection in mechanical properties, X-ray diffraction – Bragg's law, metallurgical and electron microscopes.

UNIT II: Mechanical Behaviors of Materials and Strengthening Mechanisms

Stress – strain curve, elastic deformation, characteristic of elastic deformations, Anelastic deformation, strain-time curves, damping capacity, Viscous deformation, Plastic deformation, mechanism of plastic deformation – slip and twinning. Strengthening mechanisms for the improvement of mechanical properties – work hardening.

UNIT III: MECHANICAL TESTING AND FRACTURE OF MATERIALS

Tensile test – stress strain curves for ductile and brittle materials – mild steel, copper, concrete, cast iron, proof stress, yield point phenomenon, Luder's bands. Compression test, Hardness test – various hardness tests. Impact test. Fracture –mechanism of brittle and ductile fracture fatigue-Griffith's theory, Fatigue failure and its prevention, Creep fracture – mechanism, different stages in creep curve, factors affecting creep

UNIT IV: Phase diagram

Basic concept, solubility limit, Phases-phase equilibrium, Gibbs phase rule, Equlibrium phase diagram-interpretation of phase diagram-phases present, determination of phase amounts and composition, Iron-Carbon equilibrium diagram-Development of microstructure in hyopeutectoid, eutectoid and hyper eutectoid steel-Non-equilibrium cooling-TTT diagram-continuous cooling transformation

UNIT V: Heat Treatment and Surface Hardening

Heat Treatment-need for heat treatment, Annealing, Normalising, spherodising, hardening, tempering, martempering, austempering, ausforming and malleablizing, Surface hardening processes – diffusion method-carburising, nitriding, cyaniding, carbonitriding-thermal method-flame hardening, induction hardening, Hardenability-Jominy end quench test – Important safety procedures.

Text Books

1. Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 1995.

Reference Books

1. Anderson, J.C., Leaver. K.D., Rawlings, R.D., Alexander, J.M., "Material Science", ELBS, 1985.
2. Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.
3. Shanthakumar, S.R.J. , " Metallurgy & Materials Science", Anuradha agencies, Kumbakonam., 1999.

PE229 COMPUTER AIDED DESIGN AND ANALYSIS

Credit 4:0:0 **Marks 40 + 60**

Unit I : Fundamentals of CAD

Benefits of CAD, CAD hardware, input devices- keyboards, lightpads. Digitizing tablets, Mouse systems joysticks, trackballs thumbwheels, output devices-Graphics displays, hardcopy printers and plotters, CAD software- Graphics standards, database, DBMS, database coordinate system, working coordinate system screen coordinate system, operating systems. Applications of CAD.

Unit II : Geometrical Modeling

Representations of curves-Bezier, cubic spline, B-spline curves, representation of surface, fundamentals of solid modeling B-rep- Constructive solid Geometry (CSG) sweep representation. Features of solid materials package – Introduction to modeling – Wire, surface, solid modeling.

Unit III Geometric transformations

Transformation of Geometric models- Translation, scaling, reflection rotation, homogeneous representation concatenated transformations. Graphics aids- Geometric modifiers, layers, Grids, Dragging and clipping.

Unit IV : Fundamentals of FEA

Introduction, types of analysis, general procedure of FEM. Boundary and initial value problem, Element types and characteristics- basic element shapes, aspect ratio, element

shape function generalised coordinates and nodal shape function, 1D spar and truss elements

Unit V : Stress Analysis

Concept of element assembly, global and local coordinate systems, boundary conditions, solution of simultaneous equations, Gaussian elimination and cholesky decomposition methods. Basics of Higher order and isoparametric elements, 1D quadratic and cubic elements. Continuous and convergence requirement

Text Books

1. Rao S. S. "The Finite Element Method in Engineering", 3rd Edition, Pergamon Press, Oxford, 2001
2. Ibrahim Zeid " CAD/CAM Theory and practice", Mcgraw hill 2000.
3. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997.

Reference Books

1. Rajasekaran "Finite Element Techniques", Tata McGraww Hill 1993.
2. Donald J. Frieth " Introduction to CAD", Tata Mcgraw Hill 1988.

PE230 METAL FORMING AND CASTING

Credit 4:0:0 **Marks 40 + 60**

UNIT I

Theory of metal forming: Plastic flow of metals: The flow curve, flow stress, yield criteria for ductile metals, Effects of Temperature, Strain rate, microstructure and friction in metal forming. Classification of metal forming process.

UNIT II

Rolling: Types of rolling mill – Force and geometrical relationship –process variables – rolled product defects. Analysis of rolling load. Forging: Classification, Process, Forging equipment, Forging load calculations, forging defects and remedies. Extrusion: Types of Extrusion –Calculation of Extrusion Load-Process Variables – defects

UNIT III

Sheet metal work: Blanking, force calculation piercing, bending, drawing and deep drawing, stretch forming, coning, embossing. Unconventional Forming Process: High Energy Rate forming (HERF) processes- Explosive forming- Electro Magnetic forming- Electro Hydraulic forming, High Velocity Forming processes (HVF) – Petro forge hammer-Dynapak

Unit IV

Casting technology: Introduction, advantages, limitations and applications of casting process. Sand casting process-steps involved in sand casting process, pattern-types, material, allowance, Moulding sand-types, properties, preperation of sand, sand ingredients, Core and

Core making. Introduction to Gating and Risering principles, progressive and directional solidification Defects in casting.

UNIT V

Special casting Processes: Expendable mould casting-precision investment casting, shell mould casting, Co_2 mould casting, plaster mould casting, ceramic mould casting, vacuum mould casting, Multiple use mould casting-permanent mould casting, die casting-hot and cold chamber, centrifugal casing-types, continuous casting

Text Books

1. Dieter, G E.,"Mechanical Metallurgy", McGraw Hill, 1988
2. Nagpal.G.R., "Metal Forming Process", Khanna Publishers, 1st Edition, New Delhi, 2000
3. Jain.P.L,"Principles of Foundry Technology", Tata McGraw Hill.1988.

Reference

1. Heine, Loper and Rosenthal, "Principles of metal casting", Tata McGraw Hill, 1978.
2. Schuler,"Metal forming Hand Book ",Springer, First Edition,1998

PE231 COMPUTER NUMERICAL CONTROL AND NON-TRADITIONAL MACHINING TECHNIQUES

Credit 4:0:0 **Marks 40 + 60**

Unit I : Introduction to Numerical Control

Components of NC Machine Tools - Types of NC Machine Tools , Co-ordinate system – Types of NC system , Interpolation schemes – CNC and DNC systems. Machine structures and slide ways , Positional transducers – transmission and slide positioning systems. Control of slide position – Optical grating , pneumatic, hydraulic system , Servo system.

Unit II : NC part programming and Machines

Manual part programming - Computer assisted part programming – APT language – NC part programming using CAD/CAM – Turning centre, Milling centre – Automatic Tool Changers (ATC) – NC Tooling.

Unit III : Computer Aided Electrical Discharge Machining

Process principles – Equipment power supply – dielectric system, electrodes, servo system, process parameters, process capability – application, examples. Electrical Discharge wire cutting: Process principles – Equipment positioning system, wire drive system, power supply, dielectric system

Unit IV : Electron Beam Machining

Electron Beam Gun, Power supply, Electron beam machining system, process parameters, process capabilities, application – examples. Laser processing: Process principles – Equipment – Solid state lasers, gas lasers. Applications – drilling cutting, marking, and

welding. Plasma arc machining: Process principles – equipment – process capabilities - application examples.

Unit V : Surface finishing

Electro Chemical grinding process: Various types of grinding processes, work holding devices, Process principles - equipments – process parameters – process capabilities – application. Process principles –equipments – Capabilities of Ultrasonic and Abrasive jet machining.

Text Books.

1. P.Radhakrishan, 'Computer Numerical Control', New Central Book Agency (p) Ltd., 1st Edition, 1999
2. Gary F. Benedict, 'Non-traditional Manufacturing Process', Marcel Dekker Inc, NY, 3rd Edition, 1987.

Reference Books

1. P.C. Pandey & H.S. Shan, 'Modern Machining Process', TMH, 2nd Edition, 2000.
2. ASTME, 'Non Traditional Machining Process' USA.

PE232 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Credit 4:0:0 **Marks 40 + 60**

Unit I

Introduction: Intelligence - Definition, types, cognitive aspect approach: measuring intelligence - early efforts, IQ and AI; aspects of Intelligence - learning, problem solving, creativity, behaviour and biology. Artificial Intelligence: Historical background: applications of AI; objections and myths. AI Languages: Introduction to PROLOG & LISP

Unit II

Cognitive psychology: The mind - information and cybernetics components for thought, modes of perception - visual, auditory and other systems; memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote parameters, method and concept; Game playing, reasoning

Unit III

Knowledge Engineering: Introduction - role of knowledge engineer, knowledge representation - psychology, production rules, logic and programming. Common sense and fuzzy logic; semantic networks learning systems.

Unit IV

Visual perception: Introduction - biology of vision, computational aspects; Towards Artificial vision - picture procession identifying real objects; vision programs; factory vision system. Robotics: AI impact; Robot sensors; factory robots; personal robots; robots tomorrow.

Unit V

Expert systems: introduction, knowledge acquisition for Expert systems, features of Expert systems- System structure, Inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems - VP expert - Assignment - Development of a simple expert system

Text Book

1. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India, 1997
2. Elaine, R., and Kevin, Artificial Intelligence, 2nd ed. TMH 1994

Reference Books

1. Charnaik, E., and McDermott, D., Introduction to Artificial Intelligence, Addison Wesley, 1985
2. Dan, W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall of India 1992.
3. Winston, P.H., Artificial Intelligence, Addision Wesley, 1990

PE233 HUMAN RESOURCE MANAGEMENT

Credit 4:0:0 **Marks 40 + 60**

Unit I

Study and evolution of managerial practices and policies in the administration of personnel, role of Human Resource in the management, the competency mapping, advisory and service function to other departments, typical organisation set up of the personnel department

Unit II

Recruitment, selection and replacement – sources of labour supply methods of selection, use of tests in selection and placement, development of personnel.

Unit III

Types and methods; TWI management development – its meaning, scope and methods – induction of personnel. Performance appraisal, transfer, promotion and termination of services – developing and administering promotion planes. Work environment, safety and accident prevention.

Unit IV

Principles and techniques of wage fixation, job evaluation, merit rating, methods of wage payment, incentive schemes. Communication – importance, channel and media of communication – suggestion schemes. Brain storming and KAIZEN. Morale – importance of morale, employee attitudes and behaviours, their significance to employer productivity.

Unit V

Trade union movements in India – their Organisation structures and policies; Joint consultation and employee participation in management, intervention of state in the settlement of employer

– employee difference, collective bargaining, Integration of personnel policy directed towards good industrial relation, Industrial psychology and worker's welfare.

Text Books

1. Arun Monappa & Saiydian "Personnel Management", TMH Publication, 1998.
2. O.P Khanna, "Industrial Engineering & Management", Dhanpatrai Publications, 1994.

Reference Books

1. Lawrence K.C., Personnel Management, Hutchison Educational Ltd., London, 1972
2. Northcott C.H. Personnel Management, Sir Isacc Pitman & Sons Ltd., 3rd edition, 1956

PE234 INDUSTRIAL SAFETY ENGINEERING

Credit 4:0:0 **Marks 40 + 60**

Unit : I

Accident Prevention: Definition: Accident, Injury, Unsafe act, unsafe condition, Dangerous occurrence, reportable accident, Theories and principles of Accident causation, cost of accidents, Accident reporting and investigation, Identification of key factors, corrective action, safety education and training, Involvement in safety, safety and law.

Unit II : Safety Management

Safety Systems, Three level approach, Hazard analysis (HAZOP), Total loss control, safety management techniques – safety inspection, IRT, JSA, Safety audit, Safety Survey.

Unit III : Material Handling

General Safety consideration in Material handling – Manual and Mechanical, Selection and Maintenance of common elements used in material handling equipment like ropes, chains, slings, hooks, safety in conveyors, cranes.

Unit IV : Human Factors Engineering

Man machine system, Human behaviour, Principles of ergonomics, factors impeding safety, personal protective equipment.

Unit V : Occupational Health And Hygiene

Physical hazards, chemical hazards, TLV, Control measures, Industrial Toxicology Occupational work capacity – Aerobic and Anaerobic work, Steady state, Rest pauses, shift work, Environmental Safety.

Text Book

1. Krishnan N.V., "Safety in Industry", Jaico Publishing House, 1996
2. 'Accident Prevention Manual', NSC Publishers, 1992.

Reference books:

3. Naylor J.C, 'Industrial Psychology', CBS Publishers, Delhi , 1984 Ed.
4. Alen D Swain, 'Human Elements in System Safety', 1st Ed., 1992.

5. Thomas J. Anton, 'Occupational Safety and Health Management', McGraw Hill Book Company, 1991.

PE235 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

Credit 4:0:0 **Marks 40 + 60**

Unit I

Principles of location and clamping - location and clamping methods and devices. SMED objectives of Jigs design - Principles of Jig. Types of drill jigs and their design - Modular design ,chip control, drill bushing.

Unit II

Fixtures - Objectives of fixture design - Fixtures and economics. Types of fixtures - lathe fixtures, grinding fixtures, milling fixture, shaping fixture, welding fixture and assembly fixture. Clamping force calculations, errors in location and clamping, Design and drawing.

Unit III

Sheet metal - Power press types - press specification, material handling, equipment cutting action in punch and die operations, die clearance, cutting forces in blanking, piercing and shearing, punch and die mounting, striping force, press tonnage. Pilot, stripper, pressure pad and automatic stop - strip layout and material calculations. Selection of die sets - designing of simple, progressive and compound die sets.

Unit IV

Forming die design - bending methods, bend radius, bend allowance, spring back, bending pressure. Design of bending die, metal flow in drawing, single and double action die, development of blank reduction factor, drawing forces, blank diameter calculation, design of drawing die. Principles of forging and extrusion dies. Defects and remedies.

Unit V

Computer Aided jig and fixture design-Introduction ,Recent Development, Basics of Fixture Planning, Configuration, Design and Verification.

Text Books:

1. Donaldson, C., Tool Design, TMH, 3rd edition, 1997
2. Hoffman, G., Fundamentals of Tool Design, SME Publishers, 1997

Reference Books

1. Kempster, Introduction to Tool Design and Jigs and Fixtures, ELBS, 1978
2. Korasakow, Fundamentals of jigs and Fixtures, MIR Publishers, 1968.
3. Joshi, P.H., Jigs and Fixtures, TMH, 1996.
4. Y.Rong, "Computer Aided Fixture Design", Marcel Dekker, 2000.

PE236 INDUSTRIAL ROBOTICS

Credit 4:0:0 **Marks 40 + 60**

UNIT I : Introduction

Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions –Point to point control - Continuous path control.

UNIT – II : Components and Operations

Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators – director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors –Grippers - Tools as end effectors - Robot/End - effort interface.

UNIT III : Sensing and Machine Vision

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

UNIT IV : Robot Programming

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation – Search techniques - AI and Robotics.

UNIT V : Industrial Applications

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM –Hostile and remote environments.

Text Book

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 1989.

References

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw Hill, 2003
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

PE321 MANUFACTURING INFORMATIONS SYSTEMS

Credit 4:0:0 **Marks 40 + 60**

UNIT I : Introduction.

Definition , Characteristics of Manufacturing Information Systems (MIS) , Objectives, MIS support to Computer Integrated Manufacturing (CIM), Collaborative manufacturing network. Conceptual frame work of information system, components of information system, architecture. Total quality management of MIS.

UNIT II :Database for MIS.
Database concepts, models, data models, database design-conceptual model and physical model, performance monitoring and tuning , security , DBMS , RDBMS, MIS and RDBMS, Query languages, Basics concepts of object oriented databases.

UNIT III: Information system applications in manufacturing Sector.
Information system for Production Management, Financial Management, Materials Management, Personnel Management, Marketing Management., Corporate overview reports. Manufacturing systems modules-Manufacturing database, Master production schedule, Work in process control , inventory control.

UNIT IV: Decision Support systems (DSS) and Executive Information Systems (EIS).
Definition , Characteristics ,ingredients, categories and classifications of DSS. Benefits and limitations of DSS. Definition of EIS, Characteristics, EIS needs, components, development process, obstacles.

Unit V : Business Process Reengineering (BPR) and Enterprise Management Systems (EMS):
Definition of BPR, Business performance measure, business process, process model of the organization, value stream model of the organization, reengineering opportunity , process of BPR exercise, relevance of IT ,MIS and BPR. EMS- meaning, components. Enterprise Resource planning system (ERP),architecture, models and modules, ERP basic features, benefits of ERP.

Text Book
1. W.S.Jawadekhar, "Management Information Systems", 2nd Ed. TMH, 2002 (Unit II, V)

References
1. James A.O'Brien , "Management Information Systems" , 4th Ed, Irwin McGrawHill , 1999. (Unit I)
2. R.Senapathy , "Management Information Systems", Laxmi Publications,2004 (Unit I)
3. A.K.Kochhar, "Development of Computer based production systems" , Edward Arnold, 1979. (Unit III)
4. George M.Marakas, "Decision support systems in the 21st century", Pearson Education, 2003. (Unit IV)

PE322 COMPUTER APPLICATIONS IN DESIGN & MANUFACTURING

Credit 4:0:0 **Marks 40 + 60**

Unit I : Introduction to Computer Graphics
Output primitives - line drawing algorithm- Circles and other curves-Attributes of output primitives.
2D,3D transformations- Translation- Rotation –scaling Concatenation
Introduction to graphic standards. –GKS, PHIGS,OPEN GL, IGES, STEP,CALS ,DXF

Unit II :Techniques For Geometric Modeling.
Representation of curves- Bezier curves- Cubic spline curve- B-Spline curves- Rational curves. Surface modeling techniques- Surface patch- Coons patch- bi- cubic patch- Bezier and B-Spline surfaces. Volume modeling – Boundary models – CSG -other techniques.

Unit III : Three Dimensional Computer Graphics
Viewing transformations – Perspective projection- techniques for visual realism- hidden line –Surface removal- Algorithms for shading & rendering .

Unit IV : 3D Modeling Applications -I
Integration of design analysis and CAD – Graphical aid for preprocessing in FEA- Mesh generation techniques –Post processing
Machining from 3D model – Generative machining – Cutter location – Gouge deletion – Tool path generation from solid models – STL formats for rapid prototyping –Slicing techniques – Introduction to fractional geometry.

Unit V : 3D Modeling Applications -II
Modeling assembly of parts, Mechanical Tolerancing – Model properties calculations – mechanism simulation – animation.

Text Book
1. Chris McMahon and Jimmie Brown , "CAD/CAM Principles, practice, and Manufacturing ", Pearson Education Asia Ltd., 2002, II edition.
2. Ibrahim Zeid , "CAD/CAM Theory and Practice", McGraw Hill, 2003

Reference Book
1. Tien Chang, "Computer Aided Manufacturing", Prentice Hall, 1996.
2. Mortensen .M, "Geometric Modeling" , Wiley ,1996.

PE323 CONCURRENT ENGINEERING

Credit 4:0:0 **Marks 40 + 60**

UNIT I : Introduction
Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

UNIT II :Use of Information Technology
IT support - Solid modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design

UNIT III : Design Stage
Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints

UNIT IV : Manufacturing Concepts and Analysis
Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system - JIT system - low inventory - modular -Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

UNIT V : Project Management
Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development

References

1. Anderson MM and Hein, L. Berlin, "Integrated Product Development", Springer Verlog, 1987.
2. Cleetus, J, "Design for Concurrent Engineering", Concurrent Engg. Research Centre, Morgantown, WV, 1992.
3. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", Wiley, JOhn and Sons Inc., 1992.
4. Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development", Prentice Hall, 1996.
5. Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", Wiley, John and Sons Inc., 1998.

PE324 MECHATRONICS IN MANUFACTURING SYSTEMS

Credit 4:0:0 **Marks 40 + 60**

Unit I : Introduction
Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems- Traditional design and Mechatronics Design

Unit II : Sensors and Transducers
Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors-Signal processing-Servo systems

Unit III : Microprocessors in Mechatronics
Introduction-Architecture-Pin configuration-Instruction set-Programming of Microprocessors using 8085.instructions-Interfacing input and output devices-Interfacing D/A Converters and A/D Converters-Applications-Temperature control-Stepper motor control-Traffic light controller

Unit IV : Programmable Logic Controllers
Introduction-Basic structure-input/output processing-programming-Mnemonics Timers, Internal relays and counters-Data handling-Analog input/output-Selection of PLC.

Unit V : **Design And Mechatronics**
Designing-Possible design solutions-Case studies of Mechatronics systems

References

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems",McGraw Hill International Editions,1999
2. Bradley, D.A.,. Dawspn, D, Buru, N.C. and Loader, AJ., Mechatronics, Chapman and Hall,1993
3. Ramesh,S,Gaonkar, "Microprocessors Architecture, Programming and Applications", Wiley Eastern,1998
4. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, AnIntroduction to Mechatronics", Prentice Hall 2000.
5. Ghosh,P.K. and Sridhar, P.R., 8000 to 8085 " Introduction to Microprocessors for Engineers and Scientists", Second Edition, Prentice Hall, 1995.

PE325 PRECISION ENGINEERING AND CAI

Credit 4:0:0 **Marks 40 + 60**

Unit I : Concepts of Accuracy
Introduction - concept of accuracy of machine tools - spindle and displacement accuracies - Accuracy of numerical control systems - Errors due to numerical interpolation - Displacement measurement system and velocity lags.

Unit II : Geometric Dimensioning And Tolerancing
Tolerance zone conversions - Surfaces, features, features of size, datum features-Datum, oddly configured and curved surfaces as datum features, equalizing datums-Datum feature of size representation-form controls, orientation controls - Logical approach to tolerancing.

Unit III : Fundamentals of nanotechnology and measuring systems
Processing system of nanometer accuracies - Mechanism of metal processing - Nano physical processing ofatomic-bit-units Nanochemical and electrochemical atomic-bit processing. In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

Unit IV : Coordinate Measuring Machine (CMM)
Evolution of measurement - coordinate measuring machines - Non Cartesian CMMs - Accessory elements -Application software - Performance evaluations -Temperature fundamentals - Environmental control -Accuracy enhancement - Applications - Measurement integration.

Unit V : Computer Integrated QA

Total quality control - quality assurance - Zero defects-POKA-YOKE Statistical evaluation of data using computer-data integration of CMM and data logging in computers - TQM.

References

1. Murthy,R.L., - " Precision Engineering in Manufacturing ", New age International(P) Limited,publishers,1996.
2. James.D. Meadows, - " Geometric Dimensioning And Tolerancing ", Marcel Dekker Inc.1995.
3. Norio Taniguchi, " Nano Technology ", Oxford university,Press,1996.
4. Ulrich-Rembold, Armbruster and Ulzmann- "Interface technology for computer controlled manufacturing processes", Marcel Dekker Pub.New York,1993
5. Thomas.G.G. - " Engineering metrology ", Butterworth PUB.1974.
6. Taguchi.G and Syed.L. et al., "Quality Engineering in production systems", McGraw Hill,1980
7. John Bank, " Essence of TQM ",Prentice Hall of India Pvt.,Ltd.,1990.

PE326 PRODUCTION MANAGEMENT SYSTEMS

Credit 4:0:0 **Marks 40 + 60**

Unit-I : Forecasting

Introduction, measures of forecast, Accuracy, forecasting methods- time series smoothing-regression models-exponential smoothing- seasonal forecasting-cyclic forecasting.

Unit II : Facility Location and Layout

Location factors, location evaluation methods. Different types of layouts for operations and production. Arrangement of facilities within departments.

Unit III :Aggregate Planning And Master Production Scheduling

Approaches to aggregate planning – graphical, empherical optimization. Development of a master production schedule materials requirement planning (MRP-I) and manufacturing resource planning (MRP-II).

Inventory analysis and control: Definitions-ABC inventory System-EOQ models for purchased parts- inventory order polices-EMQ models for manufactured parts- lot sizing techniques, Inventory models under uncertainty.

Unit IV : Scheduling And Controlling

Objective in scheduling –major steps involved- information system linkages in production planning and control- production control in repetitive, batch and job shop manufacturing environment.

Just In Time Manufacturing: Introduction: Elements of JIT- uniform production

Rate-pull versus push method-kanban system-small lot size- quick, inexpensive set-up-continuous improvement. Optimized Production Technology.

Unit V

Project Planning: Evolution of network planning techniques- Critical Path Method (CPM)- Project Evaluation and Review Technique (PERT) Net Work Stochastic consideration. Project monitoring, line of Balance.

SCHEDULING WITH RESOURCE CONSTRAITNS: Allocation of units for a single resource- allocation of multiple resources- Resource balancing line balancing- Helgeson Brine approach-region approach. Stochastic mixed- product- line balancing—flexible manufacturing system- concepts- advantages and limitation-computer integration and AI in manufacturing and operations. Electronic data interchange.

Text Book

1. Dilworth, B. James, "Operation Management- Design", Planning and Control for manufacturing and Services", McGraw Hill Inc, New Delhi, 1992.
2. J.L.Riggs "Production Planning and Control" ,John Wiley,1986.

Reference Book

1. Bedworth, DD. " Integrated Production Control system- Management, Analysis Design", John Wiley & Sons, New York, 1982.
2. Vollman, T. E. " Manufacturing Planning and Control Systems", Galgotia publication (P) Ltd, New Delhi, 1998.

PE327 COMPUTER AIDED PROCESS PLANNING

Credit 4:0:0 **Marks 40 + 60**

Unit I: Process Planning.

Definition- computer Aided tools- Effective use of manufacturing resources- Activities functions- Panes- instructions- Engineering drawings- specifications- demand for cast routing- sequence- tooling and fixtures- process plans- individual operations- machining parameters- Quality assurance check points.

Unit II: Computer Aided Process planning.

Five Stage- Manual Classification-Computer maintained process plans- Variant CAPP Generative CAPP- Dynamic CAPP.

Unit III: CAPP –Planning process

Variant process planning system-GT classification-coding structure-Development of decision rules- if then type statements- Al approach- object oriented programming- features Technology (FT)

Unit IV: CAD/CAM Integration and CAPP features.

Integration of CAD/CAM- tool path CNC programmes-CAPP software- Selective tools feeds and Speeds.

Unit V: CAPP Benefits.

Process planning Effort- Direct Labour-Material- Working process time- intangible benefits-Case Studies.

Text Books

1. Computer Aided Process planning, H.P. Wang, J.K. Li., Elsevier science, 1991.
2. Tien-Chien-Chang,Richard A.Wysk, "An Introduction to automated process planning systems", PrenticeHall1985

Reference Books

1. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons,1996
2. Rao, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.