DIVISION
OF
PRODUCTION ENGINEERING
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<tr>
<th>Code No.</th>
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<td>PE101</td>
<td>Computer Aided Graphics (ME103)</td>
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<td>PE102</td>
<td>Workshop Practice (ME104)</td>
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<td>PE201</td>
<td>Welding Technology</td>
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<td>PE202</td>
<td>Foundry, Smithy, Welding &amp; Sheet Metal Lab</td>
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<td>PE203</td>
<td>Material Science &amp; Engineering</td>
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<td>PE204</td>
<td>Metallurgy Lab</td>
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<td>PE206</td>
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<td>PE207</td>
<td>Theory of Metal Cutting and Tool Design</td>
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<td>PE208</td>
<td>Statistical Quality Control &amp; Reliability Engineering</td>
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<td>PE209</td>
<td>Fluid Power Control System</td>
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<td>PE211</td>
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<td>PE212</td>
<td>Computer Aided Design and Analysis</td>
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<td>PE214</td>
<td>Principles of Management and Industrial Psychology</td>
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<td>PE215</td>
<td>Production Drawing</td>
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<td>PE216</td>
<td>Design and Optimization of Products</td>
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<td>PE217</td>
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<td>PE224</td>
<td>Metal Forming and Casting Engineering</td>
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<td>PE225</td>
<td>Machine Tools and CNC Machines</td>
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<td>PE301</td>
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<td>PE302</td>
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<td>PE304</td>
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<td>PE306</td>
<td>Product Design and Development Strategies</td>
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<td>PE307</td>
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<td>Computer Applications in Design &amp; Manufacturing</td>
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<td>Design for Manufacturing and Assembly</td>
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<td>PE310</td>
<td>Flexible Manufacturing Systems</td>
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<td>PE311</td>
<td>Manufacturing Information &amp; Decision Support Systems</td>
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<td>PE312</td>
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<td>PE316</td>
<td>Design for Manufacturing and Assembly</td>
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<td>PE317</td>
<td>Design of Fluid Power Control Systems</td>
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<td>PE318</td>
<td>Design of CNC Machine Tools</td>
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<td>PE319</td>
<td>Rapid Prototyping</td>
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<tr>
<td>PE320</td>
<td>Product Design and Development Strategies</td>
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**PE101 (ME103) COMPUTER AIDED GRAPHICS**

**Unit I**

**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**

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

**Text Book**

**Reference Books**
PE102 (ME104) WORKSHOP PRACTICE

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

Unit I
A. Carpentry
Handling of carpentry tools: Practice in marking, sawing, planing 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
UNIT 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

Reference Books

PE 202 FOUNDRY, SMITHY, WELDING & SHEET METAL LAB

Foundry:

Smithy:

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:

UNIT II: Mechanical behaviors of materials:

UNIT III: Mechanical testing and fracture of materials

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

Text Books

Reference Books
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.
10. Sieve analysis and grain fineness number.
12. Permeability of foundry sand.
13. In-situ Metallography by replication technique.

PE 205 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

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

Textbooks
2. HMT, ‘Production Technology”, TMH (India), 1996.

Reference Books

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, properties, 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

Reference Books

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

Text Books

Reference Books

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**

**Reference Books**

**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), Enterprise 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

Reference books

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, AI 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

Text Books

Reference Books

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, lightpens. 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-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

Unit IV : Fundamentals of FEA
Introduction, types of analysis general procedure the FEM. Boundary and initial value problem, function variational calculus, variational formulation of boundary value problem. weighed residual method Ritz method, Element types and characteristics- basic element shapes, aspect ratio, element shape function generalised coordinates and nodal shape function, 1D spar and beam elements, 2D rectangular and triangular elements, axisymmetric 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 cubic elements. Use of natural coordinate systems area coordinate system continuous and convergence requirement, static analysis, analysis of trusses and frames

Text Books

Reference Books

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.
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.
12. Study of reverse engineering component drawings.

**CAM LABORATORY**

5. Generation of CNC programming using ProE
7. Study of pick and place Robot- basic components, configuration, work volume.

**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

Reference Books
1. McCormick.E.J, Daniel Ilgen “Industrial Psychology”, PHI, 1931

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

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

**Reference Books**
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**

**References**
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

Text Books

Reference Books
PE 218 WORKSHOP TECHNOLOGY

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

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

Text Books

References:
1. HMT, ‘Production Technology’, TMH (India), 1996
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)

References:
3. Manuals of AutoCAD, SolidWorks, Inventor Software

PE220 PRINCIPLES OF MANAGEMENT & INDUSTRIAL PSYCHOLOGY

Credits: 3: 0 : 0
Marks 40 + 60

UNIT I
UNIT II

UNIT III

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:

Reference Books:

PE 221 MACHINING TECHNOLOGY

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
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

Textbooks
2. HMT, ‘Production Technology”, TMH(India), 1996.

Reference Books

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.
8. Tool grinding.

References
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:
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

Division of Production Engineering
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

PE 224 METAL FORMING AND CASTING ENGINEERING
Credit 4:0:0
Marks 40+60

UNIT-I

UNIT-II
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

UNIT IV
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:

Reference:

PE 225 MACHINE TOOLS AND CNC MACHINES

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

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
Text Books:

References:

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 parameter- 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, Al₂O₃, SiC, Si₃N₄ 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

References

PE302 ADVANCED STRENGTH OF MATERIALS

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.
Unsymmetrical bending: Stress and deflections in beams subjected to unsymmetrical 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

Reference

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

Unit III : Synthesis Of Mechanisms

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 Mechanisms And Robotics
Kinematic Analysis of spatial RSSR mechanism- Denavit- Hartenberg parameters forward and inverse kinematic of Robotic manipulators.
Study and use of Mechanism software packages.

Text Book

References

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.

Unit II
General Procedure: Discretization of Domain- basic element shapes- interpolation polynomials- natural coordinates- formulation of element characteristic 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
Unit IV

Unit V

Text Book

Reference Books

PE305 INDUSTRIAL ROBOTICS
Credit : 4:0:0
Marks 40 + 60

Unit I : Introduction And Robot Kinematics

Unit II : Robot Drives And Control
Controlling the Robot motion- 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- Designing of end effectors- Vacuum, magnetic and air operated grippers.

Unit III : Robot Sensors
Transducers and sensors- sensors in Robot- Tactile sensor- proximity and range sensors- sensing joint forces- Robotic vision system- image grabbing- 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, Artificial Intelligence and Expert Systems

Text Books

References
Unit III : Materials Section

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

References

PE307 COMPUTER GRAPHICS
Credit : 4:0:0
Marks 40 + 60

Unit I
Unit II: Graphic Primitive.

Unit III: 2D & 3D Transformation

Unit IV: Curves, Surfaces, Solids

Unit IV: Graphics Standards for CAD.

Textbook

References

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.**

**Unit V : Computer Integrated Manufacturing Systems.**

**Text Book**

**References**
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.

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

References

PE 310 FLEXIBLE MANUFACTURING SYSTEMS

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.


Unit II

Unit III

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

Text books

References

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

Unit IV

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

References

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
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  


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. Assembly 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. Assembly of various pattern components for the above.  


8. Programming and Study of robots for material handling.
PE 314 ADVANCED ANALYSIS LAB.

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.

PE315 COMPUTER GRAPHICS

Unit I

Unit II Graphic Primitive

Unit III 2D & 3D Transformation

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.

Textbook
2. H. Hagen , ”Geometric Modeling: Methods & Applications” Springer 1997

References:

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
ture 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.

References:

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

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

Reference:

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
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

References

PE319 RAPID PROTOTYPING
Credit:4:0:0
Marks: 40+60

Unit I
Introduction
Basic Concept - overview of existing technologies of prototyping 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:
   lithography”

References:
   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:

References:
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**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  
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

Reference Books
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:

Reference Books

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

UNIT IV: Phase diagram
Basic concept, solubility limit, Phases-phase equilibrium, Gibbs phase rule, Equilibrium phase diagram-interpretation of phase diagram-phases present, determination of phase amounts and composition, Iron-Carbon equilibrium diagram-Development of microstructure in hypoeutectoid, eutectoid and hyper eutectoid steel-Non-equilibrium cooling-TTT diagram-continuous cooling transformation
UNIT V: Heat Treatment and Surface Hardening

Text Books

Reference Books

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

Unit III Geometric transformations

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

Reference Books

PE230 METAL FORMING AND CASTING
Credit 4:0:0 Marks 40 + 60

UNIT I

UNIT II

UNIT III

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, preparation 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, CO₂ 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

Reference

PE231 COMPUTER NUMERICAL CONTROL AND NON-TRADITIONAL MACHINING TECHNIQUES

Credit 4:0:0 Marks 40 + 60

Unit I : Introduction to Numerical Control

Unit II : NC part programming and Machines

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

Unit V: Surface finishing

Text Books.

Reference Books
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

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

Text Book
2. Elaine, R., and Kevin, Artificial Intelligence, 2nd ed. TMH 1994

Reference Books

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**

**Reference Books**

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 imped ing 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**

**Reference books:**

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:

Reference Books
1. Kempster, Introduction to Tool Design and Jigs and Fixtures, ELBS, 1978
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 feedback, 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

References

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.

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
   (Unit II, V)

References

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.

Unit III : Three Dimensional Computer Graphics

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

Reference Book

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

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
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

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 of atomic-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)
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
5. Thomas.G.G. - " Engineering metrology ", Butterworth PUB,1974,

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

Text Book

Reference Book

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- AI 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.
Text Books

Reference Books