M.Tech in Production Engineering

With effect from 2009-2010 Academic Session

First Semester

Theory	**Contact Hours**	
Professional Core	**L-T-P**	**Credits**
PDPC101 Theory of Plastic Deformation	3-1-0	4 Credits
PDPC102 Production Technology	3-1-0	4 Credits
PDPC103 Quantitative Techniques in Production Management	3-1-0	4 Credits
Professional Electives-I (Any One)	3-0-0	3 Credit
PDPE101 Advanced Decision Modeling Techniques		
PDPE102 Quality Assurance		
Professional Electives-II (Any One)	3-0-0	3 Credit
PDPE103 Product Design for Manufacturing		
PDPE104 Rapid Prototyping and Tooling		
PDPE105 Production Management		
Practicals/Sessionals	**Contact Hours**	
	L-T-P	**Credits**
PDPR101 Advance Production Engg. Lab-I	0-0-4	4 Credits
PDPT101 Pre-thesis work & Seminar	0-0-3	2 Credits

Total 24 Credits

Second Semester

Theory	**Contact Hours**	
Professional Core	**L-T-P**	**Credits**
PDPC201 Computer Aided Design & Computer Integrated Manufacturing	3-1-0	4 Credits
PDPC202 Non-Traditional Manufacturing Processes	3-1-0	4 Credits
Professional Electives-III (Any One)	3-0-0	3 Credit
PDPE201 Composite Materials		
PDPE202 Metal Forming Technology		
Professional Electives-IV(Any One)	3-0-0	3 Credit
PDPE203 Metrology		
PDPE204 Maintenance Management & Reliability Engineering		
PDPE205 Quality Engineering		
Professional Electives-II (Any One)	3-0-0	3 Credit
PDPE206 Robotics		
PDPE207 IT in Manufacturing Enterprises		
PDPE208 Alternative Energy		
Practicals/Sessionals	**Contact Hours**	
	L-T-P	**Credits**
PDPR201 Advance Production Engg. Lab-II	0-0-4	4 Credits
PDPT201 Pre-thesis work & Seminar	0-0-3	2 Credits
PDCV201 Comprehensive Viva-voce-I	0-0-3	2 Credits

Total 25 Credits

Third Semester

Theory	**Contact Hours**	
	L-T-P	**Credits**
Open Elective (Any One)	3-0-0	3 Credits

1. Mechatronics
2. Engineering Tribology
3. Finite Element in Mechanical Systems
4. Human Resource Management

THESIS Part – I		14 Credit
	Total	**17 Credits**

Fourth Semester

PDPT401	**THESIS Part – II**	20 Credit
PDCV401	Seminar	2 Credits
PDCV402	Comprehensive Viva-Voce-II	2 Credits
	Total	**24 Credits**

Grand Total = 90 Credits

Theory of Plastic Deformation

True stress-strain curve, Bauschinger effect, theory of plasticity, empirical equations to strain, strain curves, three dimensional stress and strain, invariants of stress and strain Yield criteria of metals, Treasca and Von Misces theory, Pandtl Reuss and Levy-Mises stress-strain relations work handling. Plastic instability application to rods in tension, thin walled pipes spherical shells subjected to internal pressure circular natural diaphragm. Equilibrium approach, concepts of friction in metal forming column friction and constants shear friction factor. Application of stress equilibrium approach to extrusion, drawing, rolling and forging, Discipline field theory, application to frictionless flat punch and wedge indentation, simple solution for frictionless extrusion and drawing. Upper and lower bound theorems, application plane-strain problems, simple indentation and extrusion using hodographs.

Text Books:

1. Plasticity for mechanical Engineering - Johnson, Von Nostrand. (Chap.1, 2, 2, 4, 5, 10,12,13)

Reference Books:

1. An introduction to the principles of Metal working - Rowe, Edward Arnold, 1968
2. Metal forming processes and analysis - Avitzur, TMH, 1977

Production Technology

Foundry: Fluidity and factors effecting fluidity, Design of gating system, gases in metals and alloys, gas porosity and shrinkage phenomena in casting, direction solidification, risering of casting, riser design, mechanism of feeding, method of risering, feeding distance and feeder heads, use of padding, chills and fine inoculation of C.I., grain refinement principle, casting defects and their elimination.

Welding: Heat flow of metals, isothermal contours, cooling rate of welds, heat effects in base metal, residual stress and weld ability test, TIG, MIG, ultrasonic and laser welding, plasma area welding, underwater welding, friction welding, electron beam welding, electros lag and electro gas welding, Explosive welding.

Forging: classification, equipments, forging defects, forgability of steels

Rolling: Classification, rolling equipments, hot and cold rolling, rolling of bars and shapes, camber in rolling defects, variables in rolling

Extrusion: Classification, extrusion equipment, load displacement, characteristics, process variables and their optimization, different extrusion dies, extrusion defects, tube extrusion Hydrostatic extension, formality limit diagram .

Sheet metal forming: Formability of sheets, formability tests, principles of deep drawing, redrawing ironing and sinking, stretch forming, hydro-forming, spinning, bending, forming defects.

MEMS: Introduction, history, development, and need of micro-electro-mechanical systems, IC fabrication processes used for MEMS; Mechanical process techniques and process models for micromachining,

Introduction to nano-technology processes.

Text Books:

1. Fundamentals of metal casting technology - P.C. Mukherjee, Oxford and IBH. (Ch. 9,10,11,12)
2. Welding technology, R. Bittle, TMH. (Chap. 3 and 4)
3. Metallurgy of welding - W.H.Bruckner, Pitam. (Chap 1, 2, 10 and12)
4. Mechanical Metallurgy, Dieter, Me Graw Hill, Kogakusha. (Chap. 18, 19, 20 and 22)

Reference Books :

1. Casting properties of metals and alloys - V. Korolkove.
2. Manufacturing properties of metals and Alloys - Alexander and Brewar, Van Nostrand.
3. Manufacturing properties of materials - Campbell, TMH.

Quantitative Techniques in Production Management

Frequency distribution, measure and central tendency-comparing of mean, median and mode, Measuring variability, Probability-introductory ideas, probability distributions, Sampling and sampling distribution, estimation, testing hypothesis, chi-square and analysis of variance, Simple regression and correlation, multiple regression and modeling techniques, non-parametric methods, time series, Linear programming, Simplex method, Transportation problems, assignment problems.

Text Book:
Modern Production Management - Buffa, 5th Ed, John Wiley

Professional Electives

Advanced Decision Modeling Technique

Network analysis: The shortest route problem, the minimal spanning tree problem, the maximal flow problem. Dynamic Programming: Deterministic and probabilistic dynamic programming. Game Theory: Simple games, Games with mixed strategies, graphical solution, solving by linear programming. Decision Analysis: Decision making with and without Experimentation, Decision Trees, Utility function. Simulation: formulation implementing a simulation model, Experimental design for simulation. Algorithms for linear programming: The dual simplex method, parametric linear programming. Integer Programming: The branch and bound technique, a branch and bound algorithms for binary linear programming a bound and scan algorithm for mixed integer linear programming, formulation possibilities through mixed integer programming. Nonlinear programming: The Kuhn-Tucher conditions, Quadratic programming, convex programming.

Text Book:

1. Operations Research - Fredrick S. Hillter and Gerald J. Liebumana, 2nd Ed. (Chap. 5, 6, 7, 14, 15,16, 17 and 18)

Quality Assurance

Introduction to quality assurance and quality control, various elements in Quality assurance program, On-line and Off-line quality control, Statistical concepts in quality, Probability distributions, Central limit theorem, Chance and assignable causes of quality variation, Process control charts for variables, Control chart parameters, Target process setting / centering, Control limits and specification limits. Process capability studies, Capability indices, Quality remedial / Corrective actions, Special purpose control charts, Reject limits, Variables inspection and attributes inspection, control charts for attributes, Narrow limit gauging, Quality rating, Defects classification, Average run length, sensitivity of control charts.Sampling inspection for product acceptance, single, double, multiple and sequential sampling schemes, OC, AOQ, ASN, and ATI curves, Design of sampling plants, standard sampling systems, economics of product inspection, quality costs, ISO 9000 quality system, product quality and reliability, failure data analysis and life testing, problems and illustrations in quality assurance.

Reference Books

1. Juran's Quality Handbook , 1999, Juran, J. M. McGraw-Hill, Inc, New York, NY, ISBN: 007034003X
2. Quality Is Free : The Art of Making Quality Certain, Crosby, Philip McGraw-Hill Book Co., New York, NY, 1979, ISBN #0-07-014512-1

Product Design and Manufacturing

Engineering materials, metals and their properties, uses, processing methods, design data and applications, selection criteria, manufacturing and processing limitations, comparative studies; plastics and composites, types, classifications, properties, processing techniques and limitation, selection of plastics for specific applications, finishing and surface coating of different materials. An overview of three stages of product design, generating and evaluating conceptual alternatives from manufacturing point of view, selection of material and processes, evaluating part configuration for manufacturability, evaluating parametric design for manufacturability, design for manufacture, influence of materials process and tooling on the design of components manufactured by metal casting, forming and joining, form design of components, recent developments in casting machining, forming and finishing, processing of polymers and ceramics, surface modification of materials, product design for manual assembly, product design for high-speed automatic assembly and product design for robot assembly.

Text Books:

1. Dieter, G.E, Engineering Design: A materials and Processing Approach, TMH, 1991
2. Ashby, M.F., Materials selection in mechanical design, Pergamon press, 1992
3. Oswaid, P.F and Begeman, M., Manufacturing Process, John Willy, 1987
4. Levy, S. and Dubois, L.H, Plastics production design Engineering Handbook, Methuen Inc, 1985

Rapid Prototyping and Tooling

Review of solid modeling techniques with comparison advantages and disadvantages, basic principal of RP processes, classification of RP processes various industrial RP systems like stereo lithography, fused deposition modeling, selective Laser Sintering, Laminated object manufacturing, 3D printing, Ballistic particle modeling etc, roll of rapid prototyping and rapid tooling in product development and simultaneous engineering. Process planning for rapid prototyping, STL file generation defects in STL files and repairing algorithm, slicing and various slicing procedures, accuracy issues in rapid prototyping, strength of RP parts, surface roughness problem in rapid prototyping, part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc, rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting. Introduction to reverse engineering, integration of reverse engineering and rapid prototyping.

Text Book:

1. Rapid Prototyping And Tooling, Karunakaran K.P,Vijay P Bapat, Ravi B, Rapid Prototyping Cell, IIT-Mumbai.

Reference Book

1.Computer Aided Manufacturing, ElancheZhian C,Sunder Selwyn T,Shanmuga Sundar G, Laxmi Publications

2. Rapid Prototyping: Theory And Practice by Ali K Kamrani ,Springer Publication

Production Management

Introduction to Production Management: Role of production/operation management, Decision making in production/operation management cost models. Analytical methods: System concepts-analytical methods in production/ operation. Design of Production System: Design of production and services distribution and facility location processes and job design layout of physical facilities line. Production planning and control: Demand for casting and operation-aggregate planning.

Text Book:

1. Modern Production Management - Buffa, 5th Ed, John Wiley.

Practicals/ Sessionals

Advanced Production Engineering Laboratory-I

1. Exercise in computer aided drafting and design, mesh generation, modeling, use of packages
2. Surface flatness measurement using slip gauges
3. Experiments on CAM using CNC Miller
4. Use of Autocollimater
5. Study of various machine tools their operational details and attachments
6. Computer Numerical control of Machine Tools

Computer Aided Design & Computer Integrated Manufacturing

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Introduction to CAD/CAM, representation of curves, surfaces and solids for CAD/CAM applications, computational geometry for manufacturing, product design for manufacture and assembly, computer aided process planning, computer aided assembly planning, computer aided inspection and reverse engineering, manufacturing processes simulation, virtual and distributed manufacturing, computer integrated manufacturing.

Fundamental of Manufacturing and Automation: Production operation and automation strategies, Manufacturing industries, Types of production function in manufacturing, Production concept and mathematical models, Automation strategies. Group Technology: Part families, Part classification and coding, Production flow analysis, Machine cell design, Benefits of Group Technology. Industrial Robotics: Robotic programming, Robotic languages, work cell control Robot cleft design types of robot application, processing operations. Flexible Manufacturing system : What is FMS ?, FMS work station, Material Handling and storage systems, Computer control system, Analysis methods for flexible manufacturing systems, application & benefits. Computer Integrated Manufacturing: What is CAD, CAM & CIMS? CIM Data base Model and Manufacturing data base. Computer aided process planning, Computer integrated Production Planning system. Brief introduction to concurrent Engineering, Rapid Prototypes and Reverse Engineering Programmable Logic controllers: Parts of PLC, Operation and application of PLC, Fundamentals of Net workings. Computer Aided Quality Control: QC and CIM, objectives of CAQC, CMM, Flexible Inspection systems.

Text Books:

1. Automation, Production systems & Computer Integrated Manufacturing - M.P. Groover, PHI.
2. CAD, CAM & CIM - P.Radhakrishna and V.Raju, New Age International

Non-Traditional Machining

Needs for nontraditional machining processes, classification and comparative analysis, Abrasive jet machining: Fundamental principle, application process parameters, MRR models. Water jet machining: Fundamental principle, application process parameters. Chemical machining: Principle of operation, etch ants and mask ants, photochemical process, equipment, applications. Electrochemical machining: Process principle, Analysis of material removal, dynamics of ECM Process, tool design, applications. Ultrasonic machining: Physical principles of USM, Process parameters, Transducers types materials and design, horn design, shaws model of MRP, other applications of Ultrasonic. Electrical discharge machining: Operating principles of EDM, Effects of Dielectric fluids, Electrode materials ,power generators, process parameters and their effects, flashing, wire EDM process, applications. Laser Beam Machining: Lasing process, types of lasers (Gas and solid state), lasing mediums, laser material processing-cutting, drilling, surface treatment, special applications.

Reference Book:

1. Advanced Machining Processes By Hassan Abdel-Gawad El-Hofy Tata McGraw Hill, ISBN 0071453342 / 9780071453349

Professional Electives-III

Composite Materials

Introduction: Classification and characteristics of composite materials, Mechanical behavior of composite, Constituents, Reinforcement materials, Filter – Additive applications and advantages of composites. Processing: Initial form of constituent materials, manufacturing procedures for fiber reinforced plastics, quality control and testing of composites. Mechanical behavior: Stress – Strain relations of anisotropies materials, engineering constants for orthotropic and isotropic materials, plane stress conditions, stress-strain relation for a lamina of arbitrary orientation, strength of an orthotropic lamina. Behavior of Laminated Composites: Classical lamination theory evaluation of laminate stiffness experimental determination of strength of laminates, essential design consideration.

Text Books:

1. Mechanics of composite materials - R.M.Jones, Mc Graw Hill.
2. Fiber Reinforced Composite – materials manufacturing and design - P.K.Mallick, Marcel Decker, NewYork.

Metal Forming Technology

Technological advances in metal forming process- forging, rolling, extrusion, wiredrawing and sheet metal forming, design of roll pass and rolling schedules, description of typical cold

rolling and hot rolling mill plants computer aided die design for forging, extrusion and wiredrawing, automation in metal forming processes, recent development in forming equipment(high speed presses etc) advances in sheet metal forming, sheet metal die design, formability evaluation, unconventional forming process like hydrostatic extrusion, high energy rate forming process, hydro forming of sheets and tubes, power forming, finite element simulation of forming processes.

Text Books

1. Dieter.G.E., “Mechanical Metallurgy”, McGraw-Hill Co. SI Edition. 1995.
2. Nagpal. G.R., “Metal Forming Processes”, Khanna Pub., New Delhi, 2000.

Reference Books

1. Kurt Lange “Handbook of Metal Forming”. Society of Manufacturing Engineers. Michigan. USA. 1988
2. Avitzur, “Metal Forming - Processes and Analysis”, Tata McGraw-Hill Co. New Delhi, 1977.
3. ASM Metals Handbook. Vol.14, “Forming and Forging”, Metals Park, Ohio, USA, 1990.
4. Taylor Altan, Soo I.K. Oh, Harold.L.Gegel. “Metal Forming: Fundamentals and Applications”, ASM. Metals Park. Ohio, USA, 1983

Professional Electives-IV

Metrology

Introduction to dimensional metrology, limits, fits and tolerances, application of tolerances, limit gauging, design of gauges, measuring instruments, comparators and their design considerations, angular measurements, auto collimators and interferometers. Applications of dimensional inspection, measurement of screw threads, thread, Gausges for internal and external threads, gear inspection, inspection of surface quality, parameters for assessing surface finish and experimental methods of surface finish measurement, feature inspection, straightness, flatness, parallelism, square ness, circularity and roundness, automated dimensional measurements, automatic gauging, automatic measuring machines for inspecting multiple work piece dimensions, measurement with coordinate measuring machines.

Text Books

1. GUPTA. I.C. “A Text Book of Engineering metrology”, Dhanpat Rai and sons, 1996

Reference Books

1. R.K. JAIN. “Engineering Metrology”, Khanna publishers 2002
2. G.N.GALYER F.W. and C.R.SHOTBOLT, “Metrology for Engineers”, ELBS, 1990
3. “ASTE Handbook of Industries Metrology”, Prentice Hall of India Ltd., 1992
4. R.K. RAJPUT “Engineering Metrology & Instrumentation”, Kataria &Sons Publishers, 2001

Maintenance Management and Reliability Engineering

Concept of Reliability, Reliability data and analysis, Reliability & quality.Life testing, Accurate life testing. Maintainability and availability cost analysis, Replacement policies, types of maintenance, objective and function of maintenance organization. Simulation and reliability predication, Sylicon reliability modeling modules.Reliability management, Integrated logistic support life cycle cost.

Text Books:

1. Maintenance & spares parts management -P.Gopalakrishnan & A.K. Banerjee, PHI,1991.
2. Maintenance planning and control - Anthony Kelly, EWP.
3. Reliability Engineering and Technology - A.K. Gupta, McMillan India, 1996.
4. Reliability Engineering - A.K. Govil, TMH.
5. The Assurance Science - S. Halperu, PHI.

Quality Engineering

Statistics: Statistical methods, important statistical distributions and their properties, correlation and regression, multiple regression analysis, statistical interference, t-test, F-test, Chi-squire test, ANOVA, DOE and RSM, Time series analysis,

Quality Engineering: Taguchi,s quadratic Loss function, offline and online quality control, importance of parameter design experimental design principles of product and process design, two-level experimental for full factorial and fractional factorial design, S/N ratio, inner and outer arrays, experimental design for control and noise factors, ANOVA in engineering design, computer software in experimental design, components of TQM, PDCA cycle, TQM implementation, quality cost , Ishiwaka diagram, brain storming, QCS, QFD, JIT philosophy and techniques, characteristic features and clauses of ISO 9000 standards, certification procedures, implementation procedures,

Text Books:

1. Statistics for engineering and science by Freund and Miller, PHI
2. Quality Engineering using Robust design by Ms Phadke, Prentice Hall
3. Total quality control essentials by Sarv, singh Soin, McGraw Hill Inc.93 Singapore

Robotics

Review of serial robotic manipulators. Classification of Parallel Robots (Steward Platform, Wheeled Mobile Robots, Walking Machine etc.).Algorithms for inverse and forward kinematic/dynamic analyses of parallel robots. Kinematic design of serial and parallel robots based on singularity, workspace, manipulability, dexterity, etc.Mechanical design of robot links and joints. Introduction to control of robotic systems

Text Books:

1. Robotic technology and flexible automation - S.R Deb, TMH.
2. Robotics - Lee, Fu, Gonzalez, Mc Graw Hill.
3. Industrial Robot - Groover, Mc Graw Hill.
4. Robots manufacturing and application - Paul Afonh, John Wiley.

IT in Manufacturing Enterprises

Production systems, manufacturing enterprises as systems, appreciate the evolving manufacturing environment and multi attributed computation: IT role challenges and opportunities, evolving role of information technology in enterprises: P and I implications, technology management challenges, technical fundamentals: MIS in manufacturing enterprises, FMS (Flexible Manufacturing Systems) CIM systems, intelligent manufacturing systems, concurrent engineering and extended enterprises, ERP (enterprise resource planning), E-business and supply chain management, discreet event simulation and AI application in manufacturing enterprises, implementation issues, future trends, carriers etc.

Text Book

1. Textbook of Manufacturing Technology Manufacturing processes by Rajput Rk (Paperback - 2007)

Reference Book

1. FMS/CIM systems integration handbook by Richard Kendall Miller; Terri C Walker Prentice-Hall, ©1990.

Alternative Energy

Direct Energy Conversion**:** Introduction: Fuel Cells-Working principles, descriptions and classification, electrochemistry of H2-O2 cells, Ernst equation and e.m.f., efficiency calculations, application: Solar Photovoltaic (SPV)-Semiconductors & junctions, working principles, descriptions, I-V chatacteristics,efficiency and fill factor: Thermoelectric devices-Working principles, descriptions: Magneto Hydro Dynamics (MHD) –Working principles, descriptions/classification, e.m.f. calculations (Faraday & Hall configurations), application.

Non-conventional Energy Conversion**:** Solar thermal energy: Air and water heating, power generation, desalination, Solar geometry, collectors, storage (solar pond); Wind Energy Conversion. Principle of conversion, Types of turbines, Geo-thermal energy-Principle of Conversion, classification of plants. Tidal, Wave and Ocean Thermal (OTEC) energy conversion: Basic principles, Description of different types of plants. Pumped storage hydro-Principle of storage and conversion. Alternative Fluids as Energy Carrying Media.

Text Books:

1. Sukhatme, S.P., 'Solar Energy Principle of Thermal Collection and Storage', TMH, 1990.
2. Kriender, J.M., 'Principles of Solar Engineering', McGraw Hill, 1987.

Reference Books:

1. Mangal, V.S., 'Solar Engineering', Tata McGraw Hill, 1992.
2. Bansal, N.K., 'Renewable Energy Source and Conversion Technology', TMH, 1989.
3. Peter J. Lunde., 'Solar Thermal Engineering', John Willey & Sons, New York, 1988.
4. Duffie, J.A and Beckman W.A., 'Solar Engineering of Thermal Processes', Willey & Sons, 1990.

Practicals/ Sessionals

Advanced Production Engineering Lab -II

1. Study of the chip formation in turning process
2. Study of operation of tool and cutter grinder, twist drill grinder, centreless grinder
3. Determination of cutting forces in turning;
4. Determination of cutting forces in drilling
5. Inspection of parts using CMM
6. Experiments and demonstration of EDM
7. Experiments on surface technology.
8. Operation of FMS

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Open Electives

Mechatronics

Hardware of Measurement Systems; A review of Displacement, Position Velocity, Motion, Force,Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors / alongwith Performance Terminology; Selection of Sensors; Input Data by Switches; Signal Conditioning; Brief Review of Operational Amplifier & Digital logics, design of PWM controller; Protection; Filtering; Wheat Stone Bridge; Digital Signals; Multiplexers; Data Acqusition; Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration; Problems. **Design and Mechatronics**: Design Process; Traditional and Mechantronics Design; Possible Mechatronics design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, Automatic Camera, Bar Code Recorder.

Text Books:

1. Mechatronics: Integrated Mechanical Electronics Systems, Paperback

Engineering Tribology

Viscosity of lubricants, liquid and solid lubricants additives, Hydrostatic, hydrodynamic and boundary lubrication, hydrostatic bearings, Journal bearings, slider bearings, end leakage, Bearing materials, lubrication of Gears and Chains, Tapered and roller bearings, Wear and abrasion, Wear Mechanism in metals and , wear measurement, Wearby abrasion, Extent of speed, Temperature and Pressure.

Text Books :

1. Lubrication of bearing - E.I. Radzimovsky, John Wiley.
2. Basic Lubrication – Brewer, Prentice Reinhold, Chap.5.7.8.9.
3. Principles and Applications Tribology - Moore, Pergamon Press.
4. Lubrication Engineering – B.C.Majumdar

Finite Element in Mechanical Systems

Structural stiffness analysis, assembly and analysis of structures, transformation of coordinates, Finite elements of continuum, direct formation of finite elements characteristics energy approach. Plane stress and plane strain problem, element characteristics. Axisymmetric stress analysis, element characteristics, Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Transformation of global coordinates and assembly of elements local direction cosines, Application: Finite element method applied to (i) Static force and deflection analysis of trusses and beams, (ii) Vibration of beams, shafts, general consideration, element equation of motion, Reference system, equation of motion for the complete system.(iii) Heat transfer for the complete system (iv) Plastic deformation analysis of members. Eigen Value problems, response of systems

Text Books:

1. Finite element procedure in Engg. Analysis – K.J. Bathe , PHI.
2. Introduction to finite element methods - Abel & Desai, EWP.
3. The finite element method in Engg. Science - O.C. Zienkiwiecz, TMH.

Reference Books:

1. Finite Element Method - J. N . Reddy, Mc Graw Hill.
2. Matrix, Finite Elements, Computer and Structural Analysis - Mukherjee - Oxford & IBH.

Human Resource Management

Elements of Human Resource Management, Staffing, Recruitment, Selection and Appraisal, Personnel Effectiveness & Commitment: Productivity Training, Employee Morale and communications. Wages and salary Administration. Employee benefits & Service. Labour relations: Policies, Programs, Negotiations and Administration Systematic evaluation: Personnel Administration & Industrial Relations (PAIR)-Audits and Research.

Text Books:

1. Human Resources Management by Wendell L. French, Hardcover: 726 pages, Publisher: Houghton Mifflin Company

2. Human Resource Management (9th Edition) by Gary Dessler, Hardcover: 592 pages, Publisher: Prentice Hall

Reference Books:

1. International Human Resource Management: Managing People in a Multinational Context by Peter Dowling, Denice E. Welch, Randall S. Schuler, Paperback: 324 pages, Publisher: South-Western College
2.