COURSE CURRICULUM AND EVALUATION SCHEME
M. Tech. Production Engineering
(w.e.f. session 2017-18)

G. B. Pant Engineering College, Pauri Garhwal
(Uttarakhand), 246194

1st Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

M. Tech. Production Engineering
Year-I, Semester-I

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TPE-511	Machine Tool Design	3	1	0	30	20	50	100	150
2.	TPE-512	Numerical Methods in Engineering	3	1	0	30	20	50	100	150
3.	TPE-513	Machining Science	3	1	0	30	20	50	100	150
4.	TPE-514	Design of Production Systems	3	1	0	30	20	50	100	150
5.	TPE-515	Rapid Prototyping and Tooling	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PPE-511	Metal Machining and Welding Lab	0	0	2	30	20	50	50	100
7.	PPE-512	Numerical Method and Computer Programming Lab	0	0	2	30	20	50	50	100
8.	GPP-511	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**4**	**210**	**190**	**400**	**600**	**1000**

MACHINE TOOL DESIGN

TPE-511

Unit-I

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

Unit-II

Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Unit-III

Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Unit-IV

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws.

Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Unit-V

Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, closed loop system, Dynamic characteristics of cutting process, Stability analysis.

References:

1. Machine Tool Design by N.K. Mehta, Tata McGraw Hill
2. Machine Tool design Handbook - CMTI Banglore

NUMERICAL METHODS IN ENGINEERING

TPE-512

Unit-I

Solution of Algebraic and Transcendental Equation: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method, Multiple roots by Newton's method, Graeffe's root squaring method, Comparision of iterative methods.

Unit-II

Interpolation and Approximation: Finite differences, Newton forward and backward interpolation formula for finite differences, Gauss's forward and backward interpolation formula, Stirling's formula, Bessel's formula, Laplace-Everett's formula, Lagrange's interpolation formula, Newton's divided difference formula, Cubic spline.

Unit-III

Solution of Linear Simultaneous Equations: Cholesky's method, Crout's method, Jacobi's iteration method, Gauss-Seidel iteration method, Relaxation method, Eigen values and eigen vectors, Power method.

Unit-IV

Numerical Differentiation and Integration: Numerical differentiation using difference operators, Newton-Cotes quadrature formula, Trapezoidal Rule, Simpson's one third rule, Simpson's three eighth rule, Boole's rule, Weddle's rule.

Unit-V

Solution of Differential Equations: Euler's Method, Modified Euler's method, Runge-Kutta method: second order, third order and fourth order, Milne's Predictor-Corrector method, Solution of simultaneous first order differential equations: Picard's method and Runge-Kutta method, Finite Difference method, Solution of Laplace equation by Liebmann's method.

References:

1. Numerical Method for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyenger and R.K. Jain ,Wiley Eastern Ltd.
2. Numerical Methods by Sukhendu Dey and Shishir Gupta, Mc-Graw Hill
3. Numerical Methods by B.S. Grewal, Khanna Publications
4. Numerical Methods by A.D. Booth, Academic Press, NY
5. An Introduction to Numerical Analysis by K.E. Atkinson, John Wiley & Sons, NY
6. Introduction Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India
7. Elementary Numerical Analysis by S.D. Conte, McGraw Hill
8. Numerical Methods for Engineers by S.K. Gupta, Wiley Eastern Ltd.

MACHINING SCIENCE

TPE-513

Unit-I

Mechanics of metal cutting: chip formation, Types of chips, tool geometry-effect of rake, lead and clearance angles; Mechanics of orthogonal and oblique cutting, Shear angle relations in orthogonal cutting, Shear angle and chip flow direction in oblique cutting, Chip control methods, Analysis of cutting process, Machining with rotary tools.

Unit-II

Thermal aspects in machining: heat and temperature distribution, modeling of chip formation in metal cutting, machining characteristics in turning, milling, drilling, grinding, etc., measurement of cutting forces and cutting temperatures. Economics of metal machining.

Unit-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure bybrittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, toollife equations, machining optimisation, predominant types ofwear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, theory of toolwear, test of machinability and influence of metallurgyon machinability.

Unit-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, Theory of wheel wear, High speed grinding theory, Grinding of drills, form cutters etc., testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

Unit-V

Micromilling: Micro-milling Tools, Process Results and Micro-milling Applications- micromechanically milled X-ray masks, micro-milled mask materials, Mask Absorption
Quantification, Exposure Quantification.Microdrilling: Micro-drilling and Macro-drilling Techniques.

References:

1. E. J. A. Armarego, R. H. Brown, "The Machining of Metals", Prentice Hall Inc.
2. Kronenberg, "Machining Science and Applications", Pergamon Press.
3. Geoffrey Boothroyd and W. A. Knight, "Fundamentals of Machining and Machine Tools",MarcelDekkel Inc.
4. J. A. McGeough, "Advanced Methods of Machining", Chapman and Hall.
5. P. L. B. Oxley, "The Mechanics of Machining", Ellis Horwood Ltd.
6. Gary F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc.
7. AmitabhaBattacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency
8. Amitabh Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press Pvt.Ltd.
10. B. L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age,International (P) Ltd.
11. V. C. Vekatesh and H. Chandrasekharan, "Experimental Techniques in Metal cutting", Practice Hall ofIndia Pvt. Ltd.
12. Introduction to Machining Science by GK Lal New Age International.

DESIGN OF PRODUCTION SYSTEMS

TPE-514

Unit-I

Essential of Manufacturing Systems: Basic system concepts, System design, Manufacturing systems, Structural and transformation aspect of manufacturing systems, Integrated manufacturing systems and its frame work.

Process System for Manufacturing: Modes of production-mass production, Multi-product small batch production, Group Technology based production, Cellular and flexible manufacturing systems, Automation systems for manufacturing, CAM/CIM, Economic evaluation of processes.

Unit-II

Discrete Part Manufacturing Systems: Different types and management decision system models, Basic approach of modeling, Analytical vs Simulation models, Modelling approach, Long run analysis, deterministic models, Binomial approximation, Sample path analysis, Markov models, Examples

Unit-III

High Volume Production System: Automated flow lines, Method of work part transport, Transfer mechanism, Automation for machining operations, Analysis of automated flow lines, Automated flow lines with/without buffer storage, computer simulation of automated flow lines, Automated assembly system, design for automated assembly, Analysis of multi-station assembly machines, Assembly systems and line balancing.

Unit-IV

Manufacturing Process Design: Process planning and design, Process design operation design, Optimum routing analysis, Facility location and layout planning, Single and multiple facility placement problem, Continuous facility location, Computer Aided plant layout, Material handling system design, Storage & warehousing, Automated storage and retrieval systems, Simultaneous development of plant layout and material handling.

Unit-V

Management systems for Manufacturing: Managerial information flow in manufacturing systems, Decision problem in managerial information, flow, Production planning and scheduling, Production control, Scope and problems; Quality control & function deployment.

Information Systems for Manufacturing: Fundamentals of Information technology information systems, Information networking, computerized manufacturing information systems

References:

1. Manufacturing by Hitomi.
2. Manufacturing Facilities by Sule.
3. Automation, Production Systems & Computer Aided Manufacturing by Groover.

RAPID PROTOTYPING AND TOOLING

TPE-515

Unit-I

Introduction: Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.

Unit-II

RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seiki's solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc.

Unit-III

Power based rapid prototyping systems, selective Laser sintering, Soligen Diren's shell production casting (DSPC), Fraunhofer's multiphase jet solidification (MJS) and MIT's 3D printing (3DP) etc.

Unit-IV

RP Database: Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.

Unit-V

RP Applications: Development of dies for molding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues etc., RP materials and their biological acceptability.

References:

1. Rapid Prototyping of Digital Systems: A Tutorial Approach by Hamblen James O Kluwer.
2. Rapid Prototyping: Principles and Applications by Kai Chua Chee, World Science.
3. Rapid System Prototyping: Accelerating the Design Process by R C Cofer.
4. Rapid Prototyping of Digital Systems by James O Hamblen Springer

METAL MACHINING AND WELDING LAB

PPE- 511

A minimum of 08 experiments from the following:

1. Study of the morphology of chips produced from different materials and machining processes.
2. Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3. Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materialsand tool geometry.
4. Evaluations of tool face temperature with thermocouple method.
5. Roughness of machined surface. Influence of tool geometry and feed rate.
6. Determination of cutting forces in turning
7. Experiments on TIG welding to find out the mechanical properties of metals
8. Experiments on MIG welding to find out the mechanical properties of metals
9. Experiments on Submerged Arc Welding to find out the mechanical properties of metals
10. Experiments on Friction Stir Welding to find out the mechanical properties of metals

* *Additional or any other experiment may be added based on contents of syllabi.

NUMERICAL METHODS AND COMPUTER PROGRAMMING

PPE-512

A minimum of 08 experiments from the following:

1. Write a program to find the root of equation using Newton-Raphson method.
2. Write a program to find the root of equation using Graeffe's root square method.
3. Write a program to find the root of equation using Bisection Method.
4. Write a program to find the root of equation using secant method.
5. Write a program to find the root of equation using Gauss approximation method.
6. Write a program to interpolate data using Lagrange's and Newton-divided difference formula.
7. Write a program to interpolate data using Newton interpolation formula for finite differences.
8. Write a program implement Gauss's forward and backward interpolation formula.
9. Write a program implement Bessel's and Laplace-Everett's formulae.
10. Write a program implement Cubic Spline.
11. Write a program implement least squares approximation using Chebyshev polynomial.
12. Write a program find the solution of simultaneous equation using Cholesky's (Crout's) method, Gauss-Seidel iteration and relaxation methods.
13. Write a program to find the Numerical differentiation using difference operators.
14. Write a program to implement Simpson's 1/3.
15. Write a program to implement 3/8 rules.
16. Write a program to implement Boole's rule.
17. Write a program to implement Weddle's rule.
18. Write a program to implement Modified Euler's method.
19. Write a program to implement Runge-Kutta method of 2^{nd} order equation.
20. Write a program to implement Runge-Kutta method of 3rd and 4th orders.
21. Write a program to implement Predictor-Corrector method.

* *Additional or any other experiment may be added based on contents of syllabi.

COURSES AND EVALUATION SCHEME

M. Tech. Production Engineering
Year-I, Semester-II

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TPE-521	Advanced Machining Process	3	1	0	30	20	50	100	150
2.	TPE-522	CAM and Robotics	3	1	0	30	20	50	100	150
3.	TPE-523	Advanced Welding Technology	3	1	0	30	20	50	100	150
4.	TPE-524	Finite Element Method	3	1	0	30	20	50	100	150
5.	TPE-525	Optimization Techniques	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PPE-521	Advanced Machining Process Lab	0	0	2	30	20	50	50	100
7.	PPE-522	CAD/CAM and Robotics Lab	0	0	2	30	20	50	50	100
8.	GPP-521	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**4**	**210**	**190**	**400**	**600**	**1000**

ADVANCED MACHINING PROCESSES

TPE-521

Unit-I

Introduction: Limitations of Conventional machining processes, Need of advanced machining processes and its classification.

Unit-II

Mechanical Type Metal Removal Processes: Ultrasonic machining; Elements of the process; Tool design and economic considerations; Applications and limitations, Abrasive jet and Abrasive water jet machining principles; Mechanics of metal removal; Design of nozzles; applications, Abrasive Flow Finishing process

Unit-III

Thermal Type Advance Machining Processes: Classification, General principles and applications of Electro discharge Machining Mechanics of metal removal in EDM, selection of EDM pulse generator dielectric, machining accuracy, surface finish and surface damage in EDM, Wire Electric discharge Machining, Electron beam machining,, Ion beam Machining, Laser beammachining, Plasma beam machining .

Unit-IV

Chemical and Electro-chemical Type Metal Removal Processes: Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical de-burring and honing.

Unit-V

Hybrid Unconventional Machining Processes: Electro chemical Grinding, Electric Discharge Grinding, Electro Chemical Discharge Machining, Electric Discharge Diamond Grinding, Magnetic abrasive finishing process

References:

1. Advance Machining Processes by V.K. Jain, New Age.
2. Modern Machining Processes by P.C. Pandey, New Age.
3. Manufacturing Processes by Degarmo.
4. Manufacturing Processes by Kalpak jain, Tata McGraw-Hill International.

CAM AND ROBOTICS

TPE-522

Unit-I

Introduction: Introduction to Automation, Need and future of NC Systems and CAM, Advantages and Disadvantages, Open and Closed loop systems, Historical developments and future trends. Future of NC Machines, Difference between ordinary and NC Machine tools, Methods for improving accuracy and productivity.

Unit-II

Control of NC Systems: Types of CNC Machine Tools systems devices, e.g. encoders and interpolators, Features of CNC Systems, Direct Numerical Control (DNC), Standard Controllers and General Programming features available in CNC Systems, Computer Process monitoring and Control. Adaptive control systems.

Unit-III

NC Part Programming: Manual Programming for simple parts, e.g., turning, milling, drilling, etc., Computer aided NC Programming in APT language, use of canned cycles, Generation of NC Programmes through CAD/CAM systems, Design and implementation of post processors.

Unit-IV

Robotics

Introduction: Definition, Classification of Robots, Geometric classification and control classification.

Robot Elements: Drive systems, Control systems, sensors, End effectors, Gripper actuators and gripper design.

Unit-V

Robot Coordinate Systems and Manipulator Kinematics: Robot co-ordinate system representation, Transformation, Homogeneous transforms and its inverse, Relating the robot to its world. Manipulators Kinematics, Parameters of links and joints, Kinematic chains, Dynamics of kinematic chains, Trajectory planning and control, Advanced techniques of kinematics and dynamics of mechanical systems, Parallel actuated and closed loop manipulators.

Robot Control: Fundamental principles, Classification, Position, path and speed control systems, adaptive control.

References:

1. Computer Control of Manufacturing Systems by Koren.
2. CAD/CAM by Groovers, Prentice Hall.
3. NC Machine Tools by S J Martin.
4. CAD/CAM by P N Rao, Tata McGraw Hill.
5. CAD/CAM by P Radhakrishnan, S Subramanyam, V Raju.
6. Computer Aided Manufacturing by Chang, Wysk & Wang, Prentice Hall of India.

ADVANCED WELDING TECHNOLOGY

TPE-523

Unit-I

Conventional Welding Techniques: Gas welding, Arc welding, TIG welding, MIGwelding, Submergedarc welding, Resistance welding. Electroslagwelding.

Unit-II

Advanced Welding Techniques: Principle, Working and Application of Advanced Welding Techniques such asFriction Stir welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

Unit-III

Welding Metallurgy: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lammellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

Unit-IV

Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldment, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.

Unit-V

Welding automation and robotics: Automation options, Simple mechanization, Dedicated and special-purpose automation, Robotic welding, Modular automation,Programmable control, Remote-control slave and automated systems, Advances in welding automation, Evaluation of and justification for automated welding

References:

1. Welding Engineering and Technology-R. S. Parmer, Khanna Publishers
2. Welding Processes and Technology- R. S. Parmer, Khanna Publishers
3. Metallurgy of welding – J. F. Lancaster, George Alien &Unwin Publishers
4. Welding Metallurgy – Sindo Kou, John Wiley & Sons, Inc., Publication
5. ASM Handbook vol.6, welding Brazing & Soldering
6. Advanced Welding Processes-John Norrish, Woodhead Publishing Ltd Cambridge

FINITE ELEMENT METHOD

TPE-524

Unit-I

Fundamental Concepts: Introduction to Finite Difference Method and Finite Element Method, Applications and advantages of FEM, Commercial FEM packages, Stresses and equilibrium, Boundary conditions, Strain-displacement relations, Stress-strain relations, Potential energy approach to derive spring element equations, Rayleigh-Ritz Method, Galerkin's Method.

Unit-II

One-Dimensional Problems: Introduction, Finite element Modeling, Natural Co-ordinate system, Shape Functions, Potential energy approach, The Galerkin Approach, Element and global stiffness matrix, Assembly of Global stiffness matrix and load vector, Finite element equations: Treatment of boundary conditions, Quadratic shape functions, Temperature effects.

Unit-III

Two-Dimensional Problems: Introduction, finite element modeling, constant strain triangle (CST), Problem modeling and boundary conditions.

Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, finite element modeling: Triangular elements, Problem modeling and boundary conditions.

Unit-IV

Trusses: Introduction, plane trusses, three dimensional trusses, assembly of global stiffness matrix for the banded and skyline solution.

Beams and Frames: Introduction, finite element formulation, load vector, boundary considerations, shear force and bending moment, plane frames.

Unit-V

Two -Dimensional Isoparametric Elements: Introduction, The four-node quadrilateral, Numerical Integration, Higher order elements.

FEM in Fluid Flow & Heat Transfer: 1-D Steady heat conduction, 1-D heat conduction in thin fins, and fluid flow problems.

References:

1. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, Pearson Eduction.
2. Finite Element Methods: Basic concepts and applications by Chennakesava R. Alavala, PHI publications.
3. A First Course in Finite Element Method by Daryl L. Logan, Cengage Publication.
4. Finite Element Analysis by C.S. Krishnamurthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis by R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. The Finite Element Method by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill
7. Finite Element and Approximation by O.C. Zenkiewicy & Morgan
8. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill
9. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill

OPTIMIZATION TECHNIQUES

TPE-525

Unit-I

Introduction: Historical Developments, Engineering applications of Optimization

Classical Optimization Techniques: Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

Unit-II

Unconstrained Optimization Techniques: Introduction, Direct search method - Random, Univariate and Pattern search methods, Simplex Method, Descent methods - Steepest Decent methods, Quasi-Newton's and Variable metric method, Examples.

Unit-III

Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane method and Method of Feasible directions, indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems.

Unit-IV

Geometric and Dynamic Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, Constrained minimization problems. Introduction to dynamic programming, multistage decision processes, Concept of Sub-optimization and the principle of Optimality.

Unit-V

Evolutionary techniques for Optimization: Introduction to simulated annealing, selection of simulated annealing parameters, simulated annealing algorithm; Genetic Algorithm (GA), Design of GA, Key concepts of GA, Neural Networks, A frame work for Neural Network models, Construction of Neural Network algorithm, Examples of simulated annealing, genetic algorithm and Neural Network method.

References:

1. Engineering Optimization by S. S. Rao, New Age International.
2. Applied Optimal Design by E. J. Haug and J.S. Arora Wiley, New York.
3. Optimization for Engineering Design by Kalyanmoy Deb, Prentice Hall of India.
4. Optimization by G.V. Reklaites, A. Ravindran and K.M. Rogsdeth, Wiley, New York.

ADVANCE MACHINING PROCESS LAB

PPE-521

A minimum of 08 experiments from the following:

1. Machining and material removal using EDM machine
2. To study various applications of Electrochemical Machining process
3. To study generation and control of electron beam for machining application
4. Machining of Turbine blades using EBM and ECM
5. To study Hybrid Unconventional Machining Process
6. To study Magnetic Abrasive finishing Process
7. To study Economic Considerations of different Unconventional Machining Process
8. To study Abrasive water jet machining process
9. Experiment on sliding wear test rig

* *Additional or any other experiment may be added based on contents of syllabi.

CAD/CAM AND ROBOTICS LAB

PPE-522

A minimum of 08 experiments from the following:

1. Line drawing or Circle drawing algorithm experiment: writing the program and running it on computer.
2. Transformations algorithm experiment for translation/rotation/scaling: writing program and running it on computer.
3. Design problem experiment: writing the program for design of machine element or other system and running it on computer.
4. Optimization problem experiment: writing a program for optimizing a function and running it on computer.
5. Auto CAD experiment: understanding and use of Auto CAD commands.
6. Writing a small program for FEM for 2 spring system and running it. Or using a FEM package.
7. Use of Graphic software standards packages e.g. GKs/PHICS/GL etc.
8. Use of pro Engineer/Ideas etc.
9. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to-point) and running on NC machine.
10. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
11. Experiment on Robots and it programs
12. Experiment on Transfer line/Material handling.
13. Experiment on difference between ordinary machine and NC machine, study or retrofitting.
14. Experiment on study of system devices such as motors and feedback devices.
15. Experiment on Mechatronics & controls

* *Additional or any other experiment may be added based on contents of syllabi.

2nd Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

M. Tech. Production Engineering
Year-II, Semester-III

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	EPE-63X	Elective I	3	1	0	30	20	50	100	150
2.	EPE-63X	Elective II	3	1	0	30	20	50	100	150
B) PRACTICAL										
3.	PPE-631	Seminar	0	0	2	-	50	50	50	100
4.	PPE-632	Special Problem	0	0	2	-	50	50	50	100
5.	PPE-633	Dissertations/Minor Project	0	0	8	50	100	150	300	450
6.	GPP-631	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**6**	**2**	**12**	**110**	**290**	**400**	**600**	**1000**

List of Electives

Elective-I

S. No.	Subject Code	Subject
1.	EPE-6301	Fracture Mechanics
2.	EPE-6302	Manufacturing System Analysis
3.	EPE-6303	Metal Casting
4.	EPE-6304	Metal Forming
5.	EPE-6305	Materials Characterization
6.	EPE-6306	Facilities Design
7.	EPE-6307	Ergonomics
8.	EPE-6308	Materials Management

Elective-II

S. No.	Subject Code	Subject
1.	EPE-6309	Composite material
2.	EPE-6310	Industrial Tribology
3.	EPE-6311	Automated Materials Handling Systems
4.	EPE-6312	Micro-Electro Mechanical Systems
5.	EPE-6313	Computer Aided Process Planning
6.	EPE-6314	Flexible Manufacturing Systems
7.	EPE-6315	Manufacturing Resources Management
8.	EPE-6316	Computer Integrated Manufacturing
9.	EPE-6317	Modeling and Simulation
10.	EPE-6318	Advance Operation Research

FRACTURE MECHANICS

EPE-6301

Unit-I

Introduction and overview, Concepts of fracture mechanics and strength of materials, Elements of solid mechanics, Elasticity and plasticity, Incremental plasticity and deformation theory.

Unit-II

Elastic crack-tip fields, Basic concepts of linear elastic fracture mechanics, Griffth's theory, stress intensity factor, Energy release rate, Plastic zone and fracture toughness, path invariant integrals and numerical approach.

Unit-III

Plastic crack-tip fields, Mode-I fields and fracture criterion, Engineering approach to plastic fracture, J-integral approaches and numerical concepts, Tearing modulus, Time dependent fracture, non-linear aspects of fatigue crack growth, Theoretical models, Fatigue cracks in welds, standard tests and testing procedures.

Unit-IV

Brittle fracture of welded structures, Notch toughness, weld cracks and joint restrains, Weld defects and service behavior, Application of fracture mechanics concepts and limitations, Weld cracking tests and elimination of joint restraints, Residual stress and its interaction in fracture behavior,

Unit-V

Numerical approaches for estimation of fracture parameters.

References:

1. Fracture Mechanics: Fundamentals and Applications by Anderson, T. L CRC Press.
2. Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue by Dowling, Norman E Dowling Prentice Hall.
3. Advanced Fracture Mechanics by Kanninen, Melvin F Popelar, Carl H Oxford University Press.
4. Analytical Fracture Mechanics by Unger, David J Dover Publication.

MANUFACTURING SYSTEM ANALYSIS

EPE-6302

Unit-I

Basic concept of manufacturing, manufacturing problems, Systems approach to manufacturing problems, Principle of modeling in mathematical and physical form, Types of model, Simulation in modeling, Sources of system errors.

Unit-II

Stability of linear and non-linear system, Adaptive control, System optimization techniques, Product design and part configuration project scheduling by PERT, GERT, flow graph, Productive maintenance.

Unit-III

Automation of production, Computer Aided Design, Computerized layout planning, automated process planning,

Unit-IV

Automatic operation planning, Automatic and Computer Integrated Manufacturing, Automated assembly and testing information systems for manufacturing.

Unit-V

Fundamentals of information system, data bank, On-line production management systems, Parts oriented production information system, Production information and management systems.

References:

1. Manufacturing Process & system Ostwald Willey India Pvt. Ltd
2. Materials & Process in Manufacturing by E. Paul Degarmo, JT Black RA Kosher Prentice Hall of India
3. Manufacturing Systems Design and Analysis by Wu B Kluwer Aca
4. Queuing Theory in Manufacturing Systems Analysis and Design Papadopoulos by H T Chapman
5. Performance Analysis of Manufacturing Systems by Altiok Tayfur Springer-V

METAL CASTING

EPE-6303

Unit-I

Introduction: Features of Casting problems, Survey and Scope of Foundry Industries, Solidification of pure metals, Nucleation and growth in alloys, Solidification of actual casting, Progressive and directional solidification, Centreline feeding resistance, Rate of solidification, Chvorinov's rule, Electrical analog of solidification problems.

Unit-II

Gating and Risering Systems: Gating systems and their characteristics, Effects of gates on aspiration, Turbulence and dross trap, recent trends, Riser design, Risering curves, NRL method of riser design, Feeding distance, Risering of complex casting, Risering of alloys other than steel, Riser design by geometrical programming.

Unit-III

Moulding and Core Making: Review and critical comparison of various established processes, recent developments example low pressure and ferrous die casting, High pressure moulding, Full mould process, Flaskless moulding, Hot and cold box moulding, Ceramic shell moulding, V-process, Continuous casting, Squeeze and pressed casting, Nishiyama process, Shaw process, Anitoch process.

Melting and Fluidity: Selection and control of melting furnaces; melting, refining and pouring; Coupla design, Measurement of fluidity, Effect of various parameters on fluidity, Methods of elimination and control of gases in casting.

Unit-IV

Internal Stress, Defects and Surface Finish: Residual stresses, Hot tears and cracks in casting; Stress relief, defects and their causes and remedies; Parameters affecting surface finish and related defects e.g., Rough casting, bum-on sand bum-in metal penetration, Facing and washes; Mold wall movement; transport zones, Expansion scabbing etc.

Unit-V

Casting of Sand, Design Considerations: Recent developments, e.g., Mulling index; Mouldability index, Compactability; deformability etc.

Foundry Practice: Casting of different Cast Irons, Steel, Aluminum, Zinc, Brass etc., Mechanization in Foundry, Use of Computers in foundry, Inspection and Quality Control-Review of X-ray and gamma ray radiography, Magnetic particle, Penetrant and Ultrasonic inspections, use of statistical quality control.

References:

1. Bronze Sculpture Casting And Patination: Mud Fire Metal by Steve Hurst Schiffer ,Publishing
2. Fine Art Metal Casting by Richard Rome -
3. Casting Technology and Cast Alloys by Chakraborty ,Prentice Hall of India
4. Meta Casting: Principles and Practice by TV Rammana Rao , New Age International

METAL FORMING

EPE-6304

Unit-I

Introduction: Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes.

Forming: Formability, formability limit diagram and theory of sheet metal working, Friction and lubrication in metal working operation, Theories of friction and lubrication, Assessment of friction at interface.

Unit-II

Process Analysis: Introduction to various methods of analyzing the metal working processes like slip-line field theory, Upper bound Solution and stab methods.

Rolling: Introduction to rolling, types of rolling mills, miscellaneous rolling operations, friction and lubrication in rolling, factors affecting rolling process, applications and rolling defects.

Force analysis of Rolling: Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings.

Unit-III

Forging Processes: Introduction forging, types of forging, miscellaneous forging processes, forgeability, forging defects, and applications Forces analysis in strip forging and disc forging.

Drawing & Deep Drawing: Introduction, applications, determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing and drawing & deep drawing defects.

Bending & Sheet metal works: Introduction, Determination of work load and spring back, , Punching & Blanking, Mode of metal deformation and failure, 2D deformation model and fracture analysis, Determination of work force & defects.

Unit-IV

Extrusion: Introduction, types of extrusion, factors affecting extrusion, Extrusion force analysis, Power loss, and defects & and application.

Hydrostatic Extrusion: Comparison with conventional extrusion, Pressure required to extrude, variables affecting the processes.

Unit-V

High Speed Forming: Classification, Comparison of low and high speed forming, operation problems in high speed forming operation, Introduction to high forming process such as explosive forming, Electrical and Mechanical high speed forming techniques advantages and disadvantages over conventional metal forming & applications.

References:

1. An Introduction to the Principles of Metal Working by Rowe Arnold
2. Metal Forming Analysis by Avitzur, McGraw Hill
3. Mathematical Simulation and Computer analysis of Thin Strip Rolling Mill by Polukhin, MIR Publications
4. Plasticity for Mechanical Engineers by Johnson & Mellore Van Nostrand
5. High Velocity Working of Metals , ASTME EEE
6. Manufacturing Science by Ghosh & Mallik, Affiliated East-West
7. Technology of Metal Forming Processes by S. Kumar, Prentice Hall of India

MATERIALS CHARACTERIZATION

EPE-6305

Unit-I

Light Microscopy: Introduction, concept of resolution, Airy rings, numerical aperture, magnification, depth of field, depth of focus, lens defects and their corrections, principles of phase contrast – bright-field and dark-field contrast, polarized light microscopy, Quantitative microscopy, estimation of grain size, grain boundary area, relevance of light microscopy ideas to electron microscopy.

Unit-II

X-ray Diffractometry: Introduction, crystal geometry, lattice directions and planes, zone axis, interplaner spacing and angle, Stereographic projection, Bragg's condition of diffraction, X-ray scattering, application of X-ray diffraction – phase identification, estimation of grain size, particle size, residual stress.

Unit-III

Transmission electron microscopy (TEM): Principle, construction and operation of TEM, Interaction of electrons with specimen, reciprocal space and lattice, Ewald sphere, diffraction from finite crystal, preparation of specimens, bright and dark field imaging, selected area diffraction, indexing of diffraction patterns.

Unit-IV

Scanning electron microscopy (SEM): Principle, construction and operation of SEM, study of fractured surfaces, energy and wavelength dispersive spectroscopy.

Unit-V

Thermal analysis techniques: Principles of differential scanning calorimetry (DSC), differential thermal analysis (DTA), Dilatometry, Thermogravimetric analysis (TGA).

Additional techniques: emission spectroscopy, Atomic Absorption Spectroscopy, Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS), Vibrating Sample Magnometer (VSM), SQUID, four probe resistivity measurement.

References:

1. Goodhew, P.J., Humphreys J. and Beanland, R., "Electron Microscopy and Analysis", Taylor and Francis.
2. Gifkins, R.C., "Optical Microscopy of Metals", Sir Isaac Pitman and Sons.
3. Cullity, B.D., "Elements of X-Ray Diffraction", Addison–Wesley Publishing Company.
4. Brown, M.E., "Introduction to Thermal Analysis: Techniques and Applications", Springer.
5. Speyer, R., "Thermal Analysis of Materials", 1st ed., CRC Press.

FACILITIES DESIGN

EPE-6306

Unit-I

Factory Planning: Introduction, factors to be considered.

Plant Location and Site Selection: Levels of plant location, rural, urban and suburban location of plants, factors influencing the plant location, optimum plant location, location theories.

Unit-II

Plant Layout: Introduction of production system, scope, objectives, importance, and types of plant layout, characteristics of a good plant layout, factoring affecting plant layout, procedure of developing a plant layout, installation and evaluation of plant layout, optimum plant layout.

Unit-III

Group Technology: Definition, objectives, planning, part families and machine cell formation, evaluation of machine cells, types of GT layout, benefits of GT, implementation of GT.

Unit-IV

Line Balancing: Definitions, heuristic and analytical methods of balancing the assembly and production line, single and mixed model line balancing, alternatives to line balancing.

Unit-V

Materials Handling: Definition, scope, objectives, principles, importance, factors in materials handling problem, analysis of materials handling, types and selection of materials handling equipment's, aids and techniques in materials handling equipment selection.Planning of material flow, advantages of planned material flow, flow planning principles, flow patterns, analysis of material flow.

References:

1. Francis, R.L., McGinnis, L.F., and White, J.A.,"Facility Layout and Location: An Analytical Approach", Prentice Hall of India
2. Meyers, F.E., and Stephens, M.P., "Manufacturing Facilities Design and Material Handling", Prentice-Hall, Inc.
3. Groover,M.P.,"Automation, Production Systems and Computer-Integrated Manufacturing",2nd Ed., Pearson Education Inc. Delhi
4. Sule,D.R.,"Manufacturing Facilities-Location, Planning, and Design", PWS Publishing Company
5. Tompkins,J.A., White, J.A.,Bozer,Y.A.,Frazelle, E.H.,Tanchoco, J.M., and Tervino,J.,"Facilities Planning",2nd Ed., John Willey & Sons

ERGONOMICS

EPE-6307

Unit-I

Introduction: Introduction and relevance to work system design, importance of ergonomics in present day scenario, Definition & fundamentals of ergonomics:, historical perspectives, objectives and functions.

Unit-II

Anthropometry: Human body, anthropometrics, postures; Stand, sitting, squatting and cross-legged postures, anthropometric measuring techniques, body supportive devices, vertical and horizontal work surface, design of an ergonomic chair.

Unit-III

Human factors: Behavioral aspects, cognitive issues, mental work load, human error.

Unit-IV

Ergonomic Design: Design methodology and criteria for designing, design for improving occupational safety and reduction in fatigue and discomfort, work system design, environmental factors, visual issues in design, case studies.

Unit-V

Case studies: Design modifications in existing products from the ergonomics point of view.

References:

1. Singh, S (Edt), Ergonomics Interventions for Health and Productivity, Himanshu Publications, Udaipur, New Delhi
2. Chakrabarti D., Indian Anthropometric Dimensions for ergonomic design practice, National Institute of Design, Ahmedabad
3. Salvendy G. (edit), Handbook of Human Factors and ergonomics, John Wiley & Sons, Inc.,
4. Dul, J. and Weerdmeester, B. Ergonomics for beginners, a quick reference guide, Taylor & Francis
5. Green, W.S. and Jordan, P .W, Human Factors in Product Design, Taylor & Francis

MATERIALS MANAGEMENT

EPE-6308

Unit-I

Introduction: Operating environment:, scope, and issues.

Material Requirement Planning: Introduction, Bills of material, Material requirement plans and planning process.

Unit-II

Capacity Management: Definition of capacity, capacity planning, Capacity requirement planning, capacity available and required, Scheduling order, make plan

Unit-III

Production Activity and Control: Data requirements, order preparation, scheduling, load leveling, Scheduling bottlenecks, production reporting.

Unit-IV

Purchasing, forecasting, and Inventory fundamentals: Establishing specifications, selecting suppliers, price determination, demand management, demand forecasting, principle of forecasting, forecasting techniques, seasonality, tracking the forecast, inventory and flow of materials, supply and demand pattern, functions of inventories, ABC, VED and FSN system of selective inventory, EOQ, variation of EOQ models, period order quantity, quantity discount.

Unit-V

Just in time Manufacturing: JIT philosophy, JIT environment, Manufacturing planning and control in JIT environment, MRP, Kanban, theory and constraints.

References:

1. Handfield R.B. and Nichols E.L., Jr "Introduction to Supply Chain Management", Prentice-Hall Inc.
2. Bowersox D. J. and Closs D. J., "Logistical Management: The Integrated Supply Chain Process", McGraw-Hill, New York.
3. Leenders M.R. and Fearon H.E., "Purchasing and Materials Management", 11th Edition, Irwin Burr Ridge, Illinois.
4. Arnold J. R. T. and Chapman S. N., "Introduction to Materials Management", 4th Edition, Pearson Education Asia.

COMPOSITE MATERIALS

EPE-6309

Unit-I

Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres - Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenz-thiazoles etc.

Unit-II

Particulate fillers-importance of particle shape an size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites.

Unit-III

Nanocomposites, short and continuous fibre reinforced composites, critical fibre length, anisotropic behaviour, SMC, BMC, DMC etc.

Unit-IV

Fabrication techniques, pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

Unit-V

Properties and performance of composites. Applications.

References:

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.
2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. Dr Navin Chand, Tribology of Natural fiber Composites, Wood Head Publishing Limited, Eng

INDUSTRIAL TRIBOLOGY

EPE-6310

Unit-I

Introduction: Definition and Scope of tribology, Contact of solids, Surface topology, Surface interaction.

Unit-II

Friction: Definitions, Types, Friction laws, Modern theory of dry solid friction, Temperature of sliding surface, Mechanism of rolling friction, Friction instability, Friction of elastomers.

Unit-III

Wear: Definition, Classification, Theories of adhesives, Abrasives, Surface fatigue and corrosive wear, Miscellaneous wear theory such as Erosive, cavitation and Fretting wear, Wear of miscellaneous machine components such as gears, Plane bearings and rolling elements.

Unit-IV

Lubrication: Lubrication of bearing, Lubricant, Mineral Oil, Grease, Solid lubricant, Lubrication regime, Viscous flow, Reynolds equation and its limitations, Hydrodynamic lubrication, Hydrostatic lubrication, Elasto-hydrodynamic lubrication, Boundary lubrication, Squeeze films.

Unit-V

Applications: Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process.

References:

1. Engineering Tribology P Sahoo Prentice Hall of India
2. Principles and Applications of Tribology D.F. Moore Pergamon Press
3. Fundamentals of Tribology Basu, Sengupta & Ahuja Prentice Hall of India
4. Tribology Handbook M.J. Neele.

AUTOMATED MATERIALS HANDLING SYSTEMS

EPE-6311

Unit-I

Introduction of Material Handling: Overview of MHE, consideration in MHS design, twenty principles of material handling, the unit load concept.

Unit-II

Material Transport Systems: Industrial trucks, automated guided vehicle systems, monorails and other rail guided vehicles, conveyor systems, cranes and hoists.

Unit-III

Evaluation and Selection of Material Handling Layout: Design of bins and hoppers – flow patterns, measurement of flow properties, design methods, feeders, dischargers, silos, chutes and gates; Bulk material sampling and weighing systems, blending of bulk materials, transportation interface – rail and water. monitoring and control.

Unit-IV

Analysis of Material Transport Systems: Rate of deliveries, required number of vehicles, economics of material handling systems.

Unit-V

Automated Storage & Retrieval Systems (AS/RS): Functions of AS/RS, operations of AS/RS, AS/RS components, types of AS/RS, design of an AS/RS, system throughput, size parameters determination of AS/RS.

References:

1. Allegri, T. H., "Material Handling Principles and Practice", Krieger Publishing Company.
2. Meyers, F. E. and Stephens, M. P. "Manufacturing Facilities Design and Material Handling", Prentice Hall.
3. Adam, N. D., Brown, T. W., Rowland, V. D. and Misenheimer, F. P., "Warehouse & Distribution Automation Handbook", McGraw-Hill.
4. Tompkins, J. A., White, J. A., Bozer, Y. A. and Tanchoco, J. M, "Facilities Planning", 4th Ed., John Willey & Sons.
5. Sule, D. R., "Manufacturing Facilities-Location, Planning, and Design", 3rd Ed., CRC Press.

MICRO-ELECTRO MECHANICAL SYSTEMS

EPE-6312

Unit-I

Overview of MEMS and Microsystems: MEMS and Microsystems, Microsystems and Microelectronics, Microsystems and miniaturization, Application of Microsystem**.** Working Principles of Microsystem: Microsensors- Acoustic wave sensors, biomedical sensors and bio sensors, chemical sensors, optical sensors, pressure sensors, thermal sensors. Microactuation- actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces. MEMS and Micro actuators- Micro grippers, micromotors, microvalves, micropumps, microaccelerometers, Microfluidics.

Unit-II

Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, silicon as a substrate material- the ideal substrate for MEMS, single crystal silicon and wafers, crystal structure, the miller indices, mechanical properties of silicon. Silicon compounds- silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon Silicon piezoresistors, Gallium arsenide, polymers for MEMS and Microsystems, conductive polymer, the Langmuir-Blodgett film, packaging materials.

Unit-III

Microsystems Fabrication Processes: Photolithography-photo resists and application, light sources, photo resist development, photo resist removal and post baking. Ion implantation, diffusion, oxidation-thermal oxidation, silicon dioxide, thermal oxidation rates, oxide thickness by color ; Chemical vapor deposition- working principle of CVD, chemical reaction s in CVD, rate of deposition, enhanced deposition ; physical vapor deposition- sputtering ;Deposition by epitaxy ; Etching- Chemical etching, plasma etching

Unit-IV

Micro manufacturing: Bulk Manufacturing- overview of etching, isotropic and anisotropic etching, wet etchants; etch stop, dry etching, and comparison of wet versus dry etching. Surface micromachining-general description, process in general, mechanical problems associated with surface micromachining. The LIGA Process- general description of the LIGA process, materials for substrates and photo resists, electroplating. The SLIGA process.

Unit-V

Microsystems Design: Design Considerations- Design constraints, selection of materials, selection of manufacturing processes, selection of signal transduction, electromechanical system and packaging
Process design- photolithography, thin film fabrications, geometry shaping, Mechanical design- thermo mechanical loading, thermo mechanical stress analysis, dynamic analysis, interfacial fracture analysis. Design of micro fluidic network systems- fluid resistance in microchannels, capillary electrophoresis network systems, mathematical modeling of capillary electrophoresis network systems

References:

1. MEMS & Microsystems Design and Manufacture By Tai-Ran Hsu Tata McGraw-Hill
2. Pelesko, J.A., and Bernstein D.H., "Modeling MEMS and NEMS", 1st Ed., Chapman and Hall CRC
3. Beeby, S., Ensell, G., Kraft, M., and White N., "MEMS Mechanical Sensors", 1st Ed., Artech House, Inc.
4. Bao, M., "Analysis and Design Principles of MEMS Devices", 1st Ed., Elsevier B.V.
5. Mohamed Gad-el-Hak (Editor), "The MEMS Handbook", 2nd Ed., Taylor and Francis.
6. Adams, T.M., and Layton, R.A., "Introductory MEMS: Fabrication and Applications", Springer New York.

COMPUTER AIDED PROCESS PLANNING

EPE-6313

Unit-I

Introduction: Traditional process planning, product design evaluation, various steps in process planning.

Unit-II

Group Technology: Introduction, advantages, part families, classification and coding systems, production flow analysis, design of machine cells.

Unit-III

Concepts Related to Process Planning: Machinability data system, cutting condition optimization.

Unit-IV

Automated Process Planning: Advantages of automated process planning, various approaches to process planning; Variant process planning, its features and different stages, different variant systems; Generative and semi-generative process planning, its features, design strategies, planning, modeling and coding scheme, decision mechanisms; Process capability analysis, intelligent process planning system; Artificial intelligence -- overview and application in process planning; Various recent process planning systems; Case studies.

Unit-V

Interfaces of Process Planning: Integrating with loading, scheduling, MRP II, and capacity planning and other shop floor functions.

References:

1. Chang, T. C. and Wysk, R. A, "An Introduction to Automated Process Planning", Prentice-Hall.
2. Gallagher, C. C and Knight, W. A., "Group Technology: Production Method in Manufacturing", Ellis Horewood.
3. Nilsson, N. J., "Principles of Artificial Intelligence", Springer Verlag.
4. Cornelius, L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.

FLEXIBLE MANUFACTURING SYSTEMS

EPE-6314

Unit-I

Introduction: Definition and classification of manufacturing systems, fundamentals of automated production cycle, need of flexibility, concept of flexibility, various types of flexibility, measures of flexibility.

Unit-II

Flexible Manufacturing System (FMS) Type: Introduction of FMS, definition of FMS, types of FMS, applications of FMS, FMS configuration, FMS host operator interface.

Unit-III

FMS Planning and Control: Functional requirements of FMS equipments, functions of FMS host computer, host system design, planning, scheduling of FMS, FMS simulation, Databases in FMS, GT in FMS, cell design and layout design, CAPP in FMS.

Unit-IV

Material handling in FMS: Material handling principles in FMS, applications of robots in FMS.

Unit-V

Case Studies: Cases on FMS installation and implementation –acceptance testing and maintenance.

References:

1. Groover, M. P., "Automation, Production System and CIM", 2nd Ed., Prentice Hall.
2. Rankey, P., "Design and Operations of FMS", North-Holland Publishing.
3. Warnecke, H. J. (Ed.), "Flexible Manufacturing System", Springer.
4. Bonetto, R., "FMS in Practice", North Oxford Academic Publishers.

MANUFACTURING RESOURCES MANAGEMENT

EPE-6315

Unit-I

Introduction: Production as input output system; Resources of production; Forecasting and resources planning.

Unit-II

Material Management: Definition and scope; Functions; Types of materials; Analytical structure of inventory models; Material requirement planning (MRP); Inventory control systems; Purchase management; Storekeeping and issue of materials; Material handling; Just in Time (JIT) and Kanban systems.

Unit-III

Human Resources Management: Objective; function; organizational planning and development; staffing policies and process; training and executive development; wage and salary policies and administration; motivation; employee services; employee record; labor relations; collective bargaining; personnel research.

Unit-IV

Production Management: Direct and indirect; Machines and equipment planning; jigs and tools planning, material handling equipment planning; Planning of land, roads, building, warehouses etc.; General vs special purpose equipment; Economic analysis; Equipment replacement; Capital resources planning; Method of allocation of resources.

Unit-V

Production Information Management: Management of production technology; information systems; Management Information Systems (MIS); Strategic Information System (SIS); Information networking; Parts oriented production information systems.

References:

1. Hitomi K., "Manufacturing System Engineering", 2nd Edition, Viva Books.
2. Hitomi K, "Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics", 2nd Edition, CRC Press.
3. Groover, M. P., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems",4th Edition, Wiley
4. Gary Dessler, "Personnel Management", 4th Edition, Reston Publishing.
5. Nauhria R. N. and Rajneesh Prakash, "Management of Systems", Wheeler Publishing.
6. Thomas Vollman E., William Berry L. and Clay Whybark D., "Manufacturing Planning and Control Systems", 5th Edition, Galgotia Publishing.

COMPUTER INTEGRATED MANUFACTURING

EPE-6316

Unit-I

Introduction: Introduction to manufacturing system and their analysis. CIM-Basic concepts, Evolution of CIM Manufacturing Automation protocol.

Unit-II

Numerical Control: Introduction- Fundamentals of N. C. Technology, Computer Numerical Controls, Distributed Numerical Control, Application of N.C., Engineering analysis of NC positioning system, N.C. part programming, part programming with APT.

Unit-III

Group Technology: Introduction, Basic layout, process layout, product layout, comparison. Designing process layout. Coding system.

Flexible manufacturing System: Introduction, elements of FMS, Cell technology and FMS, optimization of FMS.

Unit-IV

Material Handling & Storage: Overview of material handling equipment, automated material handling equipment- A.G.V, features, function, types and safety consideration of AGV, Conveyers.

Analysis of material storage system: ASRS and caroused storage, Analysis of storage system.

Unit-V

Manufacturing Support Functions: Introduction to computer aided process planning (CAPP), Just-in-time and Lean Production, MRP I&II, Concurrent engineering.

References:

1. Groover M P, Automation, Production Systems, and Computer-Integrated Manufacturing, PHI Learning Pvt. Ltd.
2. Alavudeen A &Venkateshwaran N., Computer Integrated Manufacturing, PHI Learning Pvt. Ltd.
3. Cornelius,L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.
4. Chang,T.-C., Wysk,R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall.
5. Rao,P. N., Tiwari,N. K. and Kundra,T.K., "Computer Aided Manufacturing", Tata McGraw Hill.
6. Sava,M. and Pusztai,J., "Computer Numerical Control Programming", Prentice Hall.

MODELING AND SIMULATION

EPE-6317

Unit-I

Introduction to Modeling: Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study.

Unit-II

Statistical Models in Simulation: Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models.

Unit-III

Stochastic Simulation: Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random variates, Monte Carlo simulation and its applications in queuing models and inventory models.

Unit-IV

Simulation of Manufacturing and Material Handling Systems: Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modeling downtime failures, trace driven models.

Unit-V

Case Studies on Simulation Packages: Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems.

References:

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., "Discrete Event System Simulation", Pearson Education
2. Law, A.M., and Kelton, W.D., "Simulation Modeling and Analysis", McGraw-Hill
3. Schwarzenbach, J., and Gill, K.F., "System Modeling and Control", Butterworth-Heinemann
4. Carrie, A., "Simulation of Manufacturing Systems", John Wiley & Sons
5. Viswanadham, N., and Narahari, Y., "Performance Modeling of Automated Manufacturing System", Prentice-Hall of India

ADVANCE OPERATION RESEARCH

EPE-6318

Unit-I

Introduction to OR: History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Advance Topics in Linear Programming: Duality theory, Dual Simplex method, Revised simplex method, Sensitivity analysis.

Unit-II

Nonlinear programming: Kuhn- Tucker conditions- quadratic programming- Wolfe's algorithm.

Integer programming: Graphical representation. Gomory's cutting plane method, Solving Zero-One Problems, Branch and Bond Algorithm For Integer Programming, Travelling salesman problem, Cargo loading problem, Mixed Integer Linear Programming.

Unit-III

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

Unit-IV

Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

Unit-V

Special topics: Analytic Hierarchy Process for Decision Making, Extreme Difference Method, Multi-objective Transportation Problem.

Reference:

1. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
2. Taha H. A., Operation Research, 7th Ed., *Prentice Hall of India*, New Delhi, 2002.
3. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
4. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
5. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
6. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
7. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
8. Levin R. et.al, Quantitative approaches to mgmt, McGraw Hill Co.
9. Hiller & Lieberman, Introduction to Operations Research
10. Richard Broson, Govindasamy&Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

COURSES AND EVALUATION SCHEME

M. Tech. Production Engineering
Year-II, Semester-IV

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) PRACTICAL/TRAINING/PROJECT										
1.	PPE-641	Project	-	-	24	-	450	450	500	950
2.	GPP-641	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**-**	**-**	**24**	**-**	**500**	**500**	**500**	**1000**