COURSES AND EVALUATION SCHEME

M. Tech. Production Engineering

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				Subject Total
						SESSIONAL EXAM			ESE	
			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 Method and Computer Programming	3	1	0	30	20	50	100	150
3	TPE-513	Production Technology	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/TRAINING/PROJECT										
6	PPE-511	Machine Tool Design Lab	0	0	2	50	50	100	-	100
7	PPE-512	Numerical Method and Computer Programming Lab	0	0	2	50	50	100	-	100
8	GPP-511	General Proficiency(NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**4**	**250**	**250**	**500**	**500**	**1000**

COURSES AND EVALUATION SCHEME

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

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total
						SESSIONAL EXAM			ESE	
			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	CAD/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/TRAINING/PROJECT										
6	PPE-521	Advanced Machining Process Lab	0	0	2	50	50	100		100
7	PPE-522	CAD/CAM and Robotics Lab	0	0	2	50	50	100		100
8	GPP-521	General Proficiency(NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**4**	**250**	**250**	**500**	**-**	**1000**

NUMERICAL METHODS AND COMPUTER PROGRAMMING

TPE-512

Unit-I

Solution of Algebraic and Transcendental Equation: Newton-Raphson method including method of complex roots, Graeffe's root square method (Computer based algorithm and programme for these methods)

Unit-II

Interpolation and Approximation: Lagrange's and Newton-divided difference formula, Newton interpolation formula for finite differences, Gauss's forward and backward interpolation formulae, Bessel's and Laplace-Everett's formulae, Cubic spline, least squares approximation using Chebyshev polynomial.

Unit-III

Solution of Linear Simultaneous Equations: Cholesky's (Crout's) method, Gauss-Seidel iteration and relaxation methods, Solution of Eigenvalue problems; Smallest, largest and intermediate Eigen values (Computer based algorithm and programme for these methods)

Unit-IV

Numerical Differentiation and Integration: Numerical differentiation using difference operators, Simpson's 1/3 and 3/8 rules, Boole's rule, Weddle's rule.

Unit-V

Solution of Differential Equations: Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor-Corrector method, Stability of Ordinary differential equation, Solution of Laplace's and Poisson's equations by Liebmann's method, Relaxation 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 for Engineers by S.K. Gupta, Wiley Eastern Ltd.
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

PRODUCTION TECHNOLOGY

TPE-513

Unit-I

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.

Unit-II

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.

Unit-III

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.

Unit-IV

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.

Unit-V

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.

References:

1. P.C. Mukherjee, Fundamentals of metal casting technology - Oxford and IBH. (Ch. 9,10,11,12)
2. R. Bittle, Welding technology, TMH. (Chap. 3 and 4)
3. W.H.Bruckner, Metallurgy of welding - Pitam. (Chap 1, 2, 10 and12)
4. Dieter, Mechanical Metallurgy, Mc Graw Hill, Kogakusha. (Chap. 18, 19, 20 and 22)
5. V. Korolkove. Casting properties of metals and alloys.
6. Alexander and Brewar, V. Nostrand. Manufacturing properties of metals and Alloys.
7. Campbell, Manufacturing properties of materials - TMH.

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.

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

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

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 finishing process, Magnetic abrasive finishing process

Unit-III

Thermal Type Advance Machining Processes: Classification, General principles and applications of Electro discharge, Plasma arc, Ion beam, Laser beam, Electron beam machining, Mechanics of metal removal in EDM, selection of EDM pulse generator dielectric, machining accuracy, surface finish and surface damage in EDM, Generation and control of electron beam for machining applications, advantages and limitations.

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: Introduction to ECDM, ECAM, Abrasive EDM etc.

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.

CAD/CAM & 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

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-II

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-III

Modern Trends in Welding: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

Unit-IV

Mechanization in Welding: Mechanization of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanization of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables petitioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

Unit V

Robotics in Welding: Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.

References:

1. Advanced Welding Processes by Nikodaco & Shansky MIR Publications.
2. Welding Technology and Design by VM Radhakrishnan New Age International.
3. Source Book of Innovative welding Processes by M.M. Schwariz Americal Society of Metals (Ohio).
4. Advanced Welding Systems, Vol. I, II, III by J. Cornu Jaico Publishers.
5. Manufacturing Technology (Foundry, Forming and Welding) by P.N. Rao Tata McGraw Hill.

FINITE ELEMENT METHOD

TPE-524

Unit-I

Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches, Shape functions,

Unit-II

Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.

Unit-III

Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials, Structural stability, other applications e.g., Heat conduction and fluid flow problems.

Unit-IV

Idealization of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organization of the Finite Element programs, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems, FEM an essential component of CAD,

Unit-V

Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.

References:

1. The Finite Element Method by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill
2. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill
3. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill
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. Introduction to Finite Elements in Engineering by T.R Chandragupta and A.D. Belegundu Prentice Hall India
7. Finite Element and Approximation by O.C. Zenkiewicy & Morgan

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

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-III

Unconstrained Optimization Techniques: Introduction, Direct search method - Random, Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods, Quasi-Newton's and Variable metric method, Examples.

Unit-IV

Geometric Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, Constrained minimization problems, Generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization.

Unit-V

Novel methods 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 algorithm, genetic annealing 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.

MACHINE TOOL DESIGN LAB

PPE- 511

1. Measurement and analysis of cutting forces in orthogonal turning.
2. Time characteristics for single point cutting tools.
3. Testing the main spindle of a lathe for axial movement and true running.
4. Process capability determination of a center lathe.
5. Flatness checking of a surface plate.
6. A study of devices for intermittent motion used in machine tools e.g. ratchet gear & Geneva Mechanism
7. A study of Kinematics structure of lathe/milling machine.
8. A study of the drives for reciprocation used in machine tools.
9. Development the speed chart and gearing diagram for a gassed head lathe.
10. Studies of the cone pulley drive in center lathe and development of its ray diagram for the speed structure.
11. Efficiency testing of lathe at various parameters-values.
12. Accuracy analysis of finished cylindrical work-pieces produced on a lathe.
13. Cutting (turning) with inclined placed tool (in tool fixture).
14. Turning with two simultaneously cutting tool (one from front on usual tool post and the other tool from back on tool-fixture on carriage)

NUMERICAL METHODS AND COMPUTER PROGRAMMING

PPE-512

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.

ADVANCE MACHINING PROCESS LAB

PPE-521

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

CAD/CAM AND ROBOTICS LAB

PPE-522

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

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				Subject Total
						SESSIONAL EXAM			ESE	
			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/TRAINING/PROJECT										
3	PPE-631	Seminar	0	0	2	50	50	100		100
4	PPE-632	Special Problem	0	0	2	50	50	100		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**	**210**	**290**	**500**	**500**	**1000**

COURSES AND EVALUATION SCHEME

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

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total
						SESSIONAL EXAM			ESE	
			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**

List of Electives

Elective-I

S. No.	Subject Code	Subject
1.	EPE-631	Fracture Mechanics
2.	EPE-632	Manufacturing System Analysis
3.	EPE-633	Metal Casting
4.	EPE-634	Metal Forming

Elective-II

S. No.	Subject Code	Subject
1.	EPE-635	Composite material
2.	EPE-636	Industrial Tribology
3.	EPE-637	Machining Science
4.	EPE-638	Micro-Electro-Mechanical Systems

FRACTURE MECHANICS

EPE-631

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-632

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-633

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-634

Unit-I

Introduction: Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes, Formability 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: Various methods of analyzing the metal working processes (slip-line field theory, Upper bound Solution, stab methods).

Unit-III

Mechanics of Forming Processes: Rolling: Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings, Forging-Forces in strip forging and disc forging, Drawing-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, Bending-Determination of work load and spring back, Extrusion-Determination of work load from stress analysis and energy consideration, Power loss, Hydrostatic extrusion, Punching & Blanking-Mode of metal deformation and failure, 2D deformation model and fracture analysis, Determination of work force.

Unit-IV

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.

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

COMPOSITE MATERIALS

EPE-635

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-636

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.

MACHINING SCIENCE

EPE-637

Unit-I

Mechanics of metal cutting-Tool geometry, 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

Thermodynamics of chip formation, Machining at super high speeds, Theories of tool wear, Basic action of cutting fluids, tool life, Factors governing tool life, Machinability-definition and evaluation.

Unit-III

Economics of metal cutting-Single and Multi pass machining operations, Criteria, variables, and restrictions for the economical conditions. Dynamic metal cutting-Comparison of steady and dynamic process, Shear angle and force relationships.

Unit-IV

Grinding mechanics, Wheel characteristics and theory of wheel wear, Lapping, Honing, High speed grinding theory, Grinding of drills, form cutters etc., Problems associated with machining of plastics,

Unit-V

Tools for plastic cutting, Analysis of nonconventional machining processes ECM, EDM, LBM, WJM, USM etc.

References:

1. Metalwork and Machining Hints and tips (Workshop Practice) by Arnold Throp.
2. Machining Fundamentals by Walker John R Goodheart.
3. Introduction to Machining Science by GK Lal New Age International.
4. Non-Conventional Machining by P K Mishra Narosa Publishing House.

MICRO-ELECTRO-MECHANICAL SYSTEMS

EPE-638

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