

UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN



M TECH (Power Electronics and Drives) Programme 2018

UTTRAKHAND TECHNICAL UNIVERSITY, DEHRADUN

STUDY AND EVALUTION SCHEME

M.TECH. (PRODUCTION ENGINEERING)

S. NO	COURSE CODE	COURSE TITLE	CRED IT	L	T	P	EXAMINATION DURATION(HRS)		EVALUATION SCHEME				UNIVERSITY EXAM	TOTAL
							THEORY	PRACTICAL	SESSIONAL					
									CT	ATTD	TA	TOTAL	ESE	
Ist Year				Ist Semester										
1	MPET-100	Advanced Mathematics	4	3	1	0	3		30	10	10	50	100	150
2	MPET-101	Modeling & Simulation	4	3	1	0	3		30	10	10	50	100	150
3	MPET-102	Total Quality Management	4	3	1	0	3		30	10	10	50	100	150
4	MPET-103	Advanced Welding Technology	4	3	1	0	3		30	10	10	50	100	150
5	MPEP-101	Minor Project -1	0	0	0	4	0		30	10	10	50	100	150
		TOTAL	16	12	4	4						250	500	750
Ist Year				IInd Semester										
1	MPET-201	Advanced Manufacturing Process	4	3	1	0	3		30	10	10	50	100	150
2	MPET-21X	Major Elective - 1	4	3	1	0	3		30	10	10	50	100	150
3	MPET-22X	Major Elective – 2	4	3	1	0	3		30	10	10	50	100	150
4	MPET-23X	Major Elective - 3	4	3	1	0	3		30	10	10	50	100	150
5	MPEP-201	Minor Project -2	0	0	0	4	0		30	10	10	50	100	150
		TOTAL	16	12	4	4						250	500	750
2nd Year				IIIrd Semester										

1	MPET-39X	Open elective – I	4	3	1	0	3		30	10	10	50	100	150
2	MPET-39X	Open Elective –II	4	3	1	0	3		30	10	10	50	100	150
3	MPES-301	Seminar	4											
4	MPEP-301	Project	4											
5	MPED-301	M.Tech dissertation	12											
		Total	28	6	2							100	200	300

2nd Year

IVth Semester

1	MPED-401	M.Tech Dissertation	24											
		Total	24											
		Grand totat	84											

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Elective subject list		
Open Elective -1		
	Subject code	Name of subject
1	MPET-391	Computer Aided Engineering
2	MPET-392	Computer Aided Processes Planning & Control
Open Elective - 2		
1	MPET-393	Industrial Design & Ergonomics
2	MPET-394	Operation Research
Major Elective -1		
1	MPET-211	Finite Element Method
2	MPET-212	Production & Operation Management
Major Elective -2		
1	MPET-221	Flexible Manufacturing System
2	MPET-222	Welding Science
Major Elective -3		
1	MPET-321	Production Design & Development
2	MPET-322	Metal Casting

MPET-100	Advanced Mathematics	L	3	T	1	P	0	Credit 04
----------	----------------------	---	---	---	---	---	---	-----------

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)

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.

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)

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

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.

Books:

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

MPET-101	MODELLING AND SIMULATION	L	3	T	1	P	0	Credit 04
----------	--------------------------	---	---	---	---	---	---	-----------

Physical Modelling: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, stochastic activities, Static and Dynamic models, Principles of modelling.

System Simulation: Techniques of simulation, Monte Carlo method, discrete probability functions, continuous probability functions, Types of simulation, Generation of random numbers, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems,

System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams.

Probability Concepts in Simulation: Stochastic variables, Discrete and Continuous Probability Functions, Random numbers, rejection method.

Simulation of Mechanical Systems: Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems.

Simulation of flow and thermal systems: laminar and turbulent flow modelling. Simulation of conduction, convection and radiation problems.

Simulation of Manufacturing Systems: Simulation of Job shop model with material handling and Flexible manufacturing systems.

Books:

1. System Simulation Geoffrey Gordon Prentice Hall
2. System Simulation: The Art and Science Robert E. Shannon Prentice Hall
3. System Modelling and Control J. Schwarzenbach and K.F. Gill Edward Arnold
4. Modelling and Analysis of Dynamic Systems Charles M Close and Dean K. Frederick Houghton Mifflin
5. Simulation of manufacturing Allan Carrie John Wiley & Sons

MPET-102	TOTAL QUALITY MANAGEMENT	L	3	T	1	P	0	Credit 04
-----------------	---------------------------------	----------	----------	----------	----------	----------	----------	------------------

Introduction, Definition of quality, Dimensions of quality planning ,Quality cost analysis, techniques for quality costs, basic concepts of TQM, historical Review, Principle of TQM, Leadership Concepts, role of senior management ,Quality council, Quality statements, Strategic planning, Deming Philosophy, Barriers of TQM implementations.

TQM principles, Customer satisfaction- Customer Complaints, Service Quality, Customer retention, Employee -Motivation, Empowerment, Teams, recognition and Reward, Performance appraisal, benefits, Continuous process Improvement - Juran trilogy, PDSA cycle, 5S,Kaizen,Supplier Partnership - Partnering, Sourcing, supply Selection, Supplier Rating, Relationship Development, Performance measures-Basic Concepts, Strategy, Performance Measure.

Statistical process control, The seven tools of Quality, Statistical fundamentals-Measures of central Tendency and Dispersion, Population and sample, Normal curve, Control charts for variables and attributes, process Capability, Concept of six sigma, New seven management tool

TQM tools, Bench marking-Reason of bench mark, benchmarking processes, quality function deployment – house of quality ,QFD processes, Benefits, Taguchi quality loss function, Total productive maintenance-Concept ,Improvement needs, FMEA – Stages of FMEA

Quality System, Need of ISO (9)000 and other quality systems ,ISO (9)000:2000 Quality system- Elements, Implementation of Quality system, Documentation, Quality Auditing ,QS (9)000 ,ISO 14000- Concepts, Requirements and benefits.

Books:

1. Total Quality Control F. Ammandev Tata McGraw Hill
2. Total Quality Management Besterfield, et. al. Prentice Hall of India
3. TQM: Text and Cases B. Janakiraman & RK Gopal Prentice Hall of India
4. What is Total Quality Control? K. Ishikawa Prentice hall
5. TQM: The Route to Improving Performance J.S. Oakland Butterworth Heineman Oxford
6. Out of Crisis W.E Dming Centre of Advance Engineering Study, Cambridge

MPET-103	ADVANCED WELDING TECHNOLOGY	L	3	T	1	P	0	Credit 04
----------	-----------------------------	---	---	---	---	---	---	-----------

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

Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanisation 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.

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.

Books:

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

MPET-201	ADVANCED MANUFACTURING PROCESSES	L	3	T	1	P	0	Credit 04
----------	----------------------------------	---	---	---	---	---	---	-----------

Advance machining theory and practice: Review of orthogonal cutting – Mechanism of chip formation ,Shear and angel Relation, Theoretical Determination of cutting forces , analysis of turning drilling and milling operation, mechanics of grinding dynamometry, Thermal aspects of machining ,tool wear and extended tool life equation, Machinability, Economics of machining.

Advance machining process:

Introduction , Process Principle, material removal mechanism , parametric analysis and applications of processes such as ultrasonic machining(USM), abrasive jet machining(AJM) ,Water jet Machining(WJM), Abrasive water jet machining(AWJM), Electro chemical Machining(ECM), Electro discharge machining(EDM), electron beam machining(EBM), laser beam machining (LBM) processes.

Advance cutting Processes: Permanent Mould casting, continuous casting, squeeze casting, vacuum mould casting, shell moulding, gating system design

Rapid prototyping (RP): Process Chain in RP, layering techniques, Stereo lithography, fused deposition modelling, laminated object manufacturing, Repetitive Masking and depositing

Advance metal forming processes: Detail of high energy rate forming process, Electro-magnetic Forming, Explosive forming, electro hydraulic forming, Stretch forming, and Contour role forming.

Books:

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

MPET-391	COMPUTER AIDED ENGINEERING	L	3	T	1	P	0	Credit 04
-----------------	-----------------------------------	----------	----------	----------	----------	----------	----------	------------------

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.

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.

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.

Computer Aided Process Planning: Introduction, Manual process planning vs. Computer aided process planning, Basics of variant and generative process planning methods, Examples of automated process planning systems.

Computer Integrated Manufacturing: Introduction, features and applications of CIM, key elements, advantages and disadvantages of CIM.

Artificial Intelligence in Manufacturing: Introduction, Elements of Expert Systems, Introduction to Neural Networks, Expert Systems application in manufacturing, Case studies.

Books:

1. Computer Control of Manufacturing Systems Koren -
2. CAD/CAM Groovers Prentice Hall
3. NC Machine Tools S J Martin -

4. CAD/CAM P N Rao Tata McGraw Hill
5. CAD/CAM P Radhakrishnan, S Subramanyam, V Raju -
6. Computer Aided Manufacturing Chang, Wysk & Wang Prentice Hall of India

MPET-392	COMPUTER AIDED PROCESSES PLANING AND CONTROL	L	3	T	1	P	0	Credit 04
----------	---	---	---	---	---	---	---	------------------

Introduction to Process Planning: Principles and scope, Manual process planning, Experienced based process planning, Decision table and decision trees, process capability analysis, Tolerance analysis, Variant process planning, Generative approach, Forward and Backward planning.

Computer Aided Process Planning: Logical design of process planning systems, Implementation considerations, Computer based process monitoring and control, Computer and process interfacing, Totally integrated process planning systems, Process planning for rotational and prismatic parts, Machining of curves and surfaces, Process planning of freedom surfaces, Development of NC codes, Computer aided design of fixtures, Expert systems and their use in developing process planning systems.

Process Control: Process control concepts; On, Off, Proportional, Integral derivatives; control action and their selection; Pneumatic and electronic controllers, discrete process control using programmable logic controllers (PLCs); Logic control ladders and logic diagrams; Time line diagrams; use of counters and timers etc. Microcontrollers, microprocessors and digital signal processors, Role of instrumentation buses, DMA and timing interrupts etc., Real time operating systems, scheduling and priority, embedded systems and their requirement.

Books:

1. Computer Control of Processes M Chidanbaram Narosa Publishing House
2. Computer Aided Process Control SK Singh Prentice Hall of India
3. Computer Processing of Remotely Sensed Images: An Introduction

MPET-393	INDUSTRIAL DESIGN & ERGONOMICS	L	3	T	1	P	0	Credit 04
	CONTROL							

Introduction to Ergonomics and Industrial Design: An approach to industrial design- elements of design, Structure for industrial design in engineering; Application in modern manufacturing systems; General approach to the man-machine relationship, Work station design, Working position.

Control and Displays: Shapes and sizes of various controls and displays- Multiple displays and control situations; design of major controls in automobiles, machine tools etc.; Design of furniture; Redesign of instruments.

Ergonomics and Production: Ergonomics and product design, ergonomics in automated systems; Expert systems for ergonomic design; Anthropometrics data and its applications in ergonomic design; Limitations of anthropometric data, Use of computerized database; Case study.

Visual Effects of Line and Colour: The mechanics of seeing; Psychology of seeing; General influence of line and form; Colour and light; Colour and objects; Colour and the eye; Colour consistency; Colour terms; Reaction to colour and colour continuation; Colour on engineering equipments.

Aesthetic Concepts: Concept of unity; Concept of order with variety; Concept of purpose style and environment; Aesthetic expressions; Style, Components of style; House style; Observation style in capital goods; Case study.

Industrial Design in Practice: General design; Specifying Design equipments; Rating the importance of industrial design; Industrial design in design process.

Books:

1. Industrial design for Engineers W.H. Mayall London Hiffee Books Ltd.
2. Introduction to Ergonomics R.C. Bridger McGraw Hill
3. Human Factor Engineering Sanders & McComlick

MPET-394	OPERATION RESEARCH	L	3	T	1	P	0	Credit 04
-----------------	---------------------------	----------	----------	----------	----------	----------	----------	------------------

Introduction: Linear Programming: - algebraic and geometric representation. Graphical method, simplex. Convergence properties, duality and post optimality analysis. Sensitivity analysis, network flow model: transshipment and shortest route model. Assignment model, transportation will) transshipment, game theory.

Non –Linear Programming Model: unrestricted search, elimination method, large step approach, method of convex combination, quadratic and separable programming, GPP.

Dynamic Programming Models: multistage decision process, probabilistic dynamic programming, linear programming as a case of dynamic programming.

Waiting Line Models (Queuing Model):

- Taxonomy
- Probability distribution
- Single server and multi server problems

Network Method: introduction, Minimal spanning tree algorithm, shortest route problem maxima flow model minimal cost capacity floe problem CPMPLVT

Books:

1. Ravindra A.Et.Al, Operation And Research Principles And Practice By John Wiles & Sons
2. Wagner MII “ Principles Of OR
3. Rao, SS, Wiley Eastern “Optimization Theory and Applications.
4. H A Hillier And G I Lieberman

5. S D Sharma “ Operation Research”

MPET-211	FINITE ELEMENT METHOD	L	3	T	1	P	0	Credit 04
-----------------	------------------------------	----------	----------	----------	----------	----------	----------	------------------

Formulation of FEM, Variational and Weighted residual approaches, Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.

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.

Idealisation of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems, FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.

Books:

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley

6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu
Prentice Hall India
7. Finite Element and Approximation O.C. Zenkiewicz & Morgan

MPET-212	<p style="text-align: center;">PRODUCTION & OPERATION MANAGEMENT</p>	L	3	T	1	P	0	Credit 04
----------	---	---	---	---	---	---	---	-----------

Introduction: Operations strategy, Framework for operations strategy in manufacturing, Operations strategy services, Meeting the competitive challenges.

Managing the Supply Chain: Supply chain management, Purchasing, JIT purchasing, Global sourcing, Electronic information flow, Forecasting, Qualitative techniques, Time series analysis, Selection of forecasting method, Focus forecasting, Aggregate planning techniques, Inventory systems for independent demand, Fixed order quantity and fixed time period models, Inventory systems for independent time period models, Inventory systems for dependent demand, MRP type systems, Embedding JIT into MRP, Lot sizing in MRP, Advanced MRP Systems.

Operations Scheduling: Scheduling & control functions, Priority rules and techniques, Single machine scheduling problems, Scheduling in jobs on ‘m’ machines, Personal scheduling, Simulation methodology, Two assembly simulation.

Design of Facilities & Jobs: Strategic capacity planning concepts, determining capacity requirements, Planning service capacity, JIT production systems, JIT implementation requirements, Facility location, Plant location methods, Facility, Process and Product layout, GT layout, Retail service layout, Computer aided layout techniques. Job design and work measurement, Considerations in job design, Work measurements and standards, Financial incentive plans, Learning curves and its applications.

Product Design & Process Selection: Product design process, Designing for the customer QFD, Value analysis, designing products for manufacturer & assembly. Process selection, product process matrix, Choosing from alternative processes & equipment, Virtual factory, Waiting line management & models, Quality management, Quality specifications & costs, Tolls and procedures for continuous improvement, Shingo system of fail-safe design, Review of SQC models.

Books:

1. Operations management Buffa John Wiley
2. Operations management Starr Prentice Hall
3. Production and Operations management Adam & Ebert Prentice Hall India

MPET-221	FLEXIBLE MANUFACTURING SYSTEMS	L	3	T	1	P	0	Credit 04
----------	--------------------------------	---	---	---	---	---	---	-----------

Introduction: FMS definition and classification of manufacturing systems, Automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.

FMS Equipment: Why FMS, Factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS, Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment, Automated material handling and storage equipment, cutting tool and tool management, Work holding considerations, Fixture considerations in FMS environment.

Group Technology: GT concepts, Advantages of GT, Part family formation-coding and classification systems; Partmachine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping, Cellular vs FMS production. *FMS related problem and Solution Methodology:* · FMS design problems: Part assignment, Machine selection, Storage system selection, Selection of pallets and fixtures, Selection of computer hardware and software, designing for layout integration of machine storage, Material handling System and computer system, Communication networks. · FMS planning problems: Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems. · Operational & Control

problems: Part scheduling, Machines robots & AGVS, Process monitoring & control. · FMS Implementation: Objectives, acceptance testing, Performance goals and expectation maintenance concerns.

Books:

1. Automation, Production System & Computer Integrated Manufacturing Groover Englewood
2. Design and Operation of SMS Rankey IFS
3. Flexible Manufacturing System Wernecks Spring-Verlag
4. FMS in Practice Bonctto Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India
6. Performance Modelling of Automated Manufacturing Systems Vishwanathan & Narahari Prentice Hall India

MPET-222	WELDING SCIENCE	L	3	T	1	P	0	Credit 04
----------	-----------------	---	---	---	---	---	---	-----------

Classification of welding processes, Physics of Arc welding: Arc characteristics, Effect of shielding gas on arc, arc blow. Mechanism and types of metal transfer, Welding power sources: Characteristics, Duty cycle, and Power factor, Static and dynamic characteristics. Welding processes: TIG, MIG, MM AW, CO₂ Welding, SAW, Resistance Welding, Friction Welding, Diffusion Welding, Ultrasonic Welding, Electron beam Welding and Laser welding processes. Heat flow in welding, Residual stress & its measurement, Distortion, Weldability of plain carbon steel, stainless steel and aluminum, Cast iron

Books:

Welding Engineering And Technology By R S Parmar

ASM International (2003). Trends in Welding Research. Materials

Cary, Howard B; Scott C. Helzer (2005). Modern Welding Technology.

[Lincoln Electric](#) (1994). The Procedure Handbook of Arc Welding.

MPET-231	PRODUCTION DESIGN & DEVELOPMENT	L	3	T	1	P	0	Credit 04
----------	---------------------------------	---	---	---	---	---	---	-----------

Stages in design process: introduction to various stages of the design process. Formulation of problem generation of alternatives, evaluation, guided redesign, case study.

Product life cycle: new product introduction, early introduction, increased product life cycle management tools, system intermigration, QFD, house of quality, Pugh`s method, Pahl and beitz method, case study.

Value engineering: introduction, nature and measurement of value, value analysis job plan, creative and techniques of creativity, value analysis test, case study.

Concurrent / reverse engineering: introduction, basic principles, components, benefits of concurrent engineering, concept of reverse engineering.

Material selection: materials in design, the evolution of engineering materials , design tools, and material data, function , material, shape and process, materials selections strategy, attributes limits, selections process, computer aided materials selections, case study.

Process selections: introduction, process selection: shaping, joining, and finishing, system process selection, ranking, process cost, computer aided process selection.

Design for manufacture and assembly(DFMA): Design for manufacture and assembly(DFMA), reason not implementing DFMA, advantages of DFMA with case studies, design features and requirements, regard to assembly , production, design for manufacture in relation to any two manufacturing process, machining and injection moulding, need , objectives.

Design for X: introduction, design for safety, packaging and storage, quality, reliability, environment conservation, environment, aesthetics, ergonomics, maintenance, recycle ability, and disposal studies.

Patents, liability and ethics: introduction, protecting your design: patents copy rights, basic toll design production, liability issues in product design. Ethical considerations, Examples / case studies (12 hrs).

Books:

1. Karl T.Ulrich, Steven D. Eppinger
2. John M. Usher, Utpal Roy And H.R. Parasaei
3. G. Boothroyd, P. Dewhurst And W Knight

MPET-232	METAL CASTING	L	3	T	1	P	0	Credit 04
-----------------	----------------------	----------	----------	----------	----------	----------	----------	------------------

Introduction: Features of casting problems, Survey and Scope of Foundry Industry, Solidification Phenomena.

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

Special casting methods: Review and critical comparison of various established processes, recent developments e.g. 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, Centrifugal casting, Investment casting, shell mold casting, CO₂ casting.

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

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. Non distract testing of casting.

Books:

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