Group No.	Course Code	Course Title	Unique Code
1	20MPT21	Non Conventional Machining Process	201IP001
1	20MPE14	Surface Treatment & Finishing	201IP002
1	20MPD15	Advanced Materials & Processing	201IP003
1	20MEM324	Advanced Fluid Power Systems	201IP004
1	20MSE14	Advanced Joining Processes	201IP005
1	20MPM243	Tool Engineering	201IP006
1	20MPY14	Advanced Foundry Technology	201IP007
1	**20MEM332**	**Product Data Management**	201IP008
2	20MPT12	Decision Making Technique	202IP001
2	20MPE322	Simulation & Modelling of Manufacturing Systems	202IP002
2	20MPD13	Finite Element Analysis	202IP003
2	20MEM15	Managerial Economics	202IP004
2	20MSE251	Micro Machining Processes	202IP005
2	20MPM324	Value Engineering	202IP006
2	20MPY321	Applied Probability & Statistics	202IP007
3	20MPT22	Quality Assurance & Reliability	203IP001
3	20MPE242	Non-Destructive Testing	203IP002
3	20MPD22	Design for Manufacturing	203IP003
3	20MEM253	Robust Design	203IP004
3	20MSE324	Precision Engineering	203IP005
3	20MPM321	Rapid Prototyping	203IP006
3	20MPY331	Maintenance Engineering & Management	203IP007
3	**20MEM22**	**Human Resources Management**	203IP008
4	20MPT13	CIM & Automation	204IP001
4	20MPE331	Nano Technology	204IP002
4	20MPD242	Advanced Manufacturing Practice	204IP003
4	20MEM254	Industrial Robotics	204IP004
4	20MSE323	Smart Materials	204IP005
4	20MPM334	Computer Application in Design	204IP006

5	20MPT14	Theory of Metal Cutting	205IP001
5	20MPE31	Theory of Metal Forming	205IP002
5	20MPD12	Product Design & Development	205IP003
5	**20MEM252**	**Product Life Cycle Management**	205IP004
5	20MSE331	Composite Materials	205IP005
5	20MPM13	Lean Manufacturing System	205IP006
5	20MPY252	Industrial Design & Ergonomics	205IP007

6	20MPT321	Applied Micro-Economics	206IP001
6	20MPE251	Supply Chain Management	206IP002
6	20MPD252	Virtual Design & Manufacturing	206IP003
6	20MSE333	Operations Management	206IP004
6	20MPM31	Total Quality Management	206IP005
6	20MPY333	Project Management	206IP006

(Group-1): Course Code 20MPT21	**Course Title:** Non Conventional Machining Process
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Need for non-traditional machining processes, Classification, Comparison between conventional and non- conventional machining, Process selection. Mechanical Process: Ultrasonic machining (USM): Introduction, Elements of the process, Mechanism of material removal, Essentials of Equipment, Tool materials, Cutting tool system design: Magnetostriction assembly, Tool cone (Concentrator), & Exponential concentrator of circular cross section & rectangular cross section, Hollow cylindrical concentrator, Effect of process parameters, Limitations, Applications.

Abrasive Jet Machining: Principles, Equipment details, Process variables, Material removal rate, Applications, Advantages & Disadvantages. **10 Hrs**

Module-2

Thermal Metal Removal Process: Electric Discharge Machining (EDM): Principle of operation, Mechanism of meta removal, Basic EDM circuitry, Spark erosion generators, Electrode feed control, Analysis of relaxation type of circuit, Material removal rate using relaxation circuit, critical resistance, Electric parameters in R-C Circuit, Die electric fluids, Flushing, Electrodes for spark erosion, Selection of electrode material, Surface finish, Machining accuracy, Applications. **10 Hrs**

Module-3

Electro Chemical and Chemical Processes: Electro Chemical Machining (ECM): Principle of ECM, Elements of ECM process, Chemistry of the ECM, Process parameters, Determination of the metal removal rate; Accuracy, Surface finish, Dynamics of ECM process, Hydrodynamics of ECM process, Tool Design, Advantages and disadvantages, Applications. Electro Chemical Grinding, Electro Chemical honing and Electro chemical deburring.

Chemical Machining: Fundamental principle, Elements of theprocess – Maskants, Etchants, Advantages and disadvantages, Applications. **10Hrs**

Module-4

Plasma Arc Machining (PAM): Introduction, Plasma, Nonthermal Generation of Plasma, Equipment, Mechanism of metal removal, PAM parameters, Process characteristics, Type of torches, Applications.

Electron Beam Machining (EBM): Introduction, Equipment for production of Electron beam, Theory of electron beam machining- thermal & non thermal types, Process characteristics, applications. Laser

Laser Beam Machining (LBM): Introduction, Principle of generation of lasers, Equipment and Machining procedure, Types of Lasers, Process characteristics, Advantages and limitations, Applications. **10 Hrs**

Module-5

Ion Beam Machining (IBM): Introduction, Principle of IBM, Mechanism of metal removal and associated equipment, Process characteristics, Advantages and limitations, Applications.

High Velocity Forming Processes (HERF): Introduction, Development of specific process, Selection, Comparison of conventional and high velocity forming methods, Types of high velocity forming methods: Explosion forming process, Electro hydraulics forming, Magnetic pulseforming. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	New technology: Institution of Engineers	Bhattacharya – India		
2	Modern Machining Process	P.C Pandy& H.S. Shan	Tata	
3	Production Technology		HMT - Tata McGraw Hill	
4	Modern Manufacturing Method	Adithan	New Age International (p) Limited	
5	Modern Machining Processes	P.K. Mishra	Narosa Publishing House	

(Group-1): Course Code: 20MPE14	Course Title: Surface Treatment & Finishing
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Fundamentals of Electro plating, galvanizing, Hot dip metal coating, thin coating, thin coating, chromium plating, Nickel plating. **10 Hrs**

Module-2

Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical Properties of sprayed metals, plasma coating. **10 Hrs**

Module-3

.
Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation. Testing of surface coating-methods. **10 Hrs**

Module-4

Heat treatment methods, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening sub zero treatment Heat treatment methods for gears, spindles, cutting tools. **10 Hrs**

Module-5

Advanced coating technologies: Hard facing, electro deposition technique, nano coatings, coating characterization. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Surface preparations & finishes for Metals	James A Murp	McGraw Hill.	
2	Principles of metal surface treatment and protection	Pergamon Press Gabe, David Russell	Description, Oxford ; New York	1978
3	Handbook of metal treatment and testing	John wiley & sons		

(Group-1): Course Code: 20MPD15 **Course Title:** Advanced Materials & Processing

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Classification and characteristics: Metals, Ceramics, Polymers and composites.

General properties and structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behaviour. **10 Hrs**

Module-2

Ferrous Alloys: iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - TIT diagrams - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Maragingsteels. **10Hrs**

Module-3

Non Ferrous alloys: AlloysofcopperAluminum, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application. **10Hrs**

Module-4

Polymers and polymerizations: Structure and properties of thermoplastics and thermo sets Engineering Applications - property modifications - Mechanical and thermal behavior – processing methods. Ceramics :Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods. **10Hrs**

Module-5

Composites : Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites - Applications.

Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques-tribological Applications. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Engineering Metallurgy	Raymond and Higgens	ELBS/EA	
2	Introduction to Material Science and Engineering	James.F.Shackleford	McMillan, NY	
3	Powder Metallurgy-Metals Hand Book		ASM, USA	Vol.7, 1974
4	Composite Materials - Science and Engineering	Chawla K.K	Springer - Verlag,	2nd edition, 1998
5	Cast Metal Matrix Composites ASM Metals Hand Book	P.K. Rohagti		

(Group-1): Course Code: 20MEM324	Course Title: Advanced Fluid Power Systems
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Pascal Law, Advantages of Fluid Power, Applications of Fluid Power, Components of a FluidPower.

Hydraulic Power Unit: Introduction, Pumping Theory, Pump Classification, Gear Pumps, (Vane Pumps- simple, balanced & pressure compensated vane pump, Vane design) Piston Pumps- Radial, Axial (Bent axis & Swash plate), Pump Performance, Pump Noise, Ripple in pumps.

Hydraulic Actuators: Linear actuator- cylinders, Mechanics of Hydraulic cylinder loading, limited rotation hydraulic actuator, cylinder cushioning, Gear, Vane & Piston motor, Motor performance, Hydrostatic transmission. **08HRs**

Module-2

Power Controlling Elements – Valves :
i) Directional Control Valves – Classification, 2/2, 3/2,4/2 & 4/3 ways Dcv's, Different Centre configurations in 4/3 way valves, actuation of DCV's, Indirect actuation, Valve Lap – Lap during Stationary and during switching.
ii) Pressure Control Valves: Classification, opening & Closing Pressure difference, Cracking Pressure, Pressure Relief Valve – Simple & Compound type, Pressure reducing valve, sequence, unloading &Counter balance valve, Pressure switches.
iii) Flow Control valves – Fixed throttle, Variable throttle, Pressure Compensation principles, pressure compensated Flow control valve – Reducing & Relieftype.
iv) Check valve, Pilot operated check valve. **08HRs**

Module-3

.
Hydraulic Circuit Design & Analysis: Control of Single & double acting cylinder, Regeneration circuit, cylinder sequencing & Synchronizing circuit. Speed control of cylinder & Motors, Analysis of Hydraulic system with frictional losses, Accumulators &accumulator circuits.

Pneumatic System: Introduction, – Generation of compressed air, air receiver, servicing FRL unit, Air filter, pressure regulation, lubricator, Pneumatic cylinder & air motor – different types of cylinder, cushion assembly. Cylinder performance.

Pneumatic Valve: Directional control valves, impulse valve, Quick exhaust valve, shuttle valve, Twin pressure valve, Time delay valve. **08HRs**

Module-4

Pneumatic Circuit & Logic Circuits:- Control of single and double acting cylinder, impulse operation, speed control, sequencing, Pneumatic Vacuum system AND,OR, NOT, NAND, NOR, YES Function, Logic circuits design using shuttle valve & twin pressure valve, Binary Arithmetic, logic & Boolean Algebra, use of kannaughveitch map for pneumatic circuit design. **08HRs**

Module-5

Electrical Control in Fluid Power: Contactors, &Switches, Relays, Limit switch, Electro hydraulic & Electro Pneumatic Circuits, Simple Cylinder reciprocation, interlocking using relays, Proximity switches, application of proximity switches, Time dependent will dependent and travel dependent circuits. **08HRs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Fluid Power with Application	Anthony Esposito	Peason Education	
2	Oil hydraulics -Principles & maintenance	S.R. Majumdar	Tata M C Graw Hill	
3	Components & Application	Bosch Rexroth didactic	Hydraulics Trainer - vol 1.	
4	Pneumatic System, Principles and Maintenance	S.R. Majumdar	Tata M C GrawHillPublication	
5	Pneumatics: Theory and Applications	Bosch Rexroth didactic		
6	Electro Pneumatics	Bosch Rexroth didactic		

(Group-1): Course Code: 20MSE14	Course Title: Advanced Joining Processes
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Distortion- methods to avoid distortion. Stresses in Joint Design. Welding and Cladding of dissimilar materials, overlaying and surfacing. Advanced soldering and Brazing processes different types, Welding of plastics. **10 Hrs**

Module-2

Electro Slag, Welding Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding. Advanced soldering and Brazing processes, Welding of plastics. **10 Hrs**

Module-3

.
Inspection of Welds: Destructive techniques like Tensile, Bend, Nick break, Impact & Hardness. Non-Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye Penetrant, Gamma ray inspection. Welding Symbols- Need for, Representing the welds, Basic weld symbols, Location of Weld, Supplementary symbols, Dimensions of welds, Examples. **10 Hrs**

Module-4

Welding Design - Introduction, Principles of sound welding design, Welding joint design. Welding positions, Allowable strengths of welds, under steady loads. Quality Control in Welding - Introduction, Quality assurance v/s Quality control, Weld quality, Discontinuities in welds, their causes and remedies and Quality conflicts. . . . **10 Hrs**

Module-5

Computer-Aided Welding Design- Introduction. Principles of sound welding design, Wilding joint design. Welding positions. Allowable strengths: of welds. 1D1der steady loads. Weld throat thickness. Solved and unsolved examples. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Welding Engineering Handbook	A.W.S		
2	Welding Engineering	Rossi - McGraw Hill		
3	Advanced Welding processes	Nikodaco&Shansky	- MIR Publications.	

Visvesvaraya Technological University, Belagavi.
Ph.D Coursework Courses – 2020
in
Industrial & Production Engineering/
Manufacturing Science & Engineering/ Industrial Engineering & Management

(Group-1): Course Code: 20MPM243 Course Title: Tool Engineering	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Cutting Tool Materials Introduction and desirable properties ,Carbon and Medium-Alloy Steels ,High-Speed Steels ,Cast-Cobalt Alloys ,Carbides ,Coated Tools, Alumina-Based Ceramics ,Cubic Boron Nitride, Silicon-Nitride Based Ceramics ,Diamond ,Reinforced Tool Materials ,Cutting-Tool Reconditioning.

Design of Cutting Tools-Basic Requirements ,Mechanics and Geometry of Chip Formation , General Considerations for Metal Cutting ,Design of single point Cutting Tools , Design of Milling Cutters ,Design of Drills and Drilling , Design of Reamers, Design of Taps, Design of Inserts , Determining Shank Size for Single-point Carbide Tools. **10 Hrs**

Module-2

Gauges and Gauge Design-Limits fits and tolerances, Geometrical tolerances-specification and measurement., Types of gauges ,Gauge design, gauge tolerances.

Work Holding Devices- Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping : Principles, methods and devices. **10 Hrs**

Module-3

.
Drill Jigs -Definition and types of Drill Jigs ,Chip Formation in Drilling ,General Considerations in the Design of Drill Jigs, Drill Bushings ,Drill Jigs. Design of Fixtures-Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures , Broaching Fixtures , Lathe Fixtures. **10 Hrs**

Module-4

Design of Press Tools-Introduction to press tools and related terminology, effect of clearances, theory of deformation, stages of cutting operation, center of pressure, strap strip layout , die and punch design, design of simple, compound and progressive dies, methods of mounting punches and dies, design of drawing dies, bend allowances, bending and forming dies. **10 Hrs**

Module-5

Dies and moulds - Bending: Types, Parts and functions of bending die, Definition, calculations and factors affecting bend radii, bend allowance and spring back, Method to compute bending pressure, Types, sketch, working and applications of bending dies, Drawing dies-types and method to determine blank size for drawing operation, Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging). **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Jigs & Fixtures	JOSHI P .H,	Tata-McGraw Hill	11thprint 1999
2	Basic die design	Eugene Ostergaard	Tata-McGraw Hill	1963
3	Fundamentals of Tool Design	ASTME	Prentice Hall of India	1983
4	Tool Design	Donaldson	Tata-McGraw Hill	3rd Edition, 2000
5	An Introduction to Jig & Tool Design	KEMPSTER M.H.A.- Bristol		3rdEd.1974

(Group-1): Course Code: 20MPY14	Course Title: Advanced Foundry Technology
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Solidification of Casting: Concept of solidification of metals, Homogenous and heterogeneous nucleation, Growth mechanism, Solidification of pure metals and alloys, Mechanism of columnar and dendritic growth, Coring or Segregation, Solidification time and Chvorinov's rule, Concept of progressive and directional solidifications.

Principles of Casting and Risering: Purpose of the gating system, Components of the gating System and its functions, Design of the gating System, types of gates, Gating ratio and its functions, Definition and functions of the riser, Types of risers and their application, Design of the riser - its shape, Size and location. Use of insulating material and exothermic compounds in risers. **10 Hrs**

Module-2

Design of Casting: Factors to be considered in casting design, Design consideration in pattern making, moulding techniques and core making and assembly, Cooling stresses and hot spots in casting and modification in casting geometry to overcome them.

Casting Quality Control: Casting defects and factors responsible for them, Different inspection and testing methods to evaluate the casting, Quality control activities in a foundry, Salvaging methods of defective casting. . **10 Hrs**

Module-3

Furnace Technology: Study of various furnaces used in foundry, construction and operation of crucible and hearth furnace, Resistance, Arc and Induction furnaces - their construction, Operation and application. Heat treatment furnaces and drying ovens used in foundry.

Gray Cast - Iron Foundry Practice: Chemical Composition and structure of gray cast iron, Moulding, gating and risering techniques, melting of gray cast iron in Cupola and induction furnace, Inoculation of gray cast iron, Application of gray cast iron castings.

Ductile Cast Iron: Chemical composition and structure of ductile cast iron, Melting and spherodization reatment, Inoculation of ductile iron, Properties and application of ductile iron casting. **10 Hrs**

Module-4

Steel Casting Practice: Common steel casting, their composition, structure and properties. Melting and refining of steel, Gating and risering system of steel castings cleaning of steel castings.

Aluminum Foundry Practice: Composition, properties and application of common aluminum alloy casting, Melting and casting of AI-alloys, Gating and risering system of AI alloy casting. **10 Hrs**

Module-5

Copper alloy Foundry Practice: General characteristics of common cast copper alloys, Melting and casting of copper alloys, Gating and risering of cu-alloy castings. Foundry Mechanization and Modernization: Introduction to modernization, Mechanization of foundry and its advantages, Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shake out units, Material handling equipments and conveyor systems, Brief sketches and description of layouts of job, Captive and mechanized foundries. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Principle of metal casting	Heine, et. al	Tata-McGraw-HiII	2003.

(Group-1): Course Code: 20MEM332	Course Title: Product Data Management
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Product Data Management : Product life cycle, Complexity in Product Development, General Description of PDM Basic functionality of PDM: Information architecture, PDM System architecture, Applications used in PDM systems. Trends in PDM. . **10Hrs**

Module-2

Document Management Systems: Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet. . **10Hrs**

Module-3

.
Workflow Management in PDM: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management. **10Hrs**

Module-4

Creating Product Structures: Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures, PDM Tools: Matrix One, Team Center, Windchill. Enovia, PDM resources on the Internet. **10Hrs**

Module-5

PDM Implementation Case Studies: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Computer Integrated Design and Manufacturing	David Bed worth. Mark Henderson &. Philips Wolfe	McGraw Hill Inc	
2	Visual Modeling with Rational Rose and UML	Terry Quatrain	Addison Wesley	
3	Wind-chill - RS.O Reference manuals			2000

(Group-2): Course Code: 20MPT12	Course Title: Decision Making Technique
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Statistics and managerial decisions, statistical data and Operations Research techniques.

Fundamentals of Statistics and Probability: Presentation and Analysis of Statistical Data, Measures of Central tendency and Location, Measure of Dispersion, Skewness and Kurtosis: Numerical Problems, Introduction to Probability and basic rules of probability. **10Hrs**

Module-2

Decision Making under Uncertainty: Alternative criteria for decision under uncertainty, Bayesian approach and Incremental analysis.

Linear Programming Problem: Formulation of LPPs, Solution of LPPs by graphical method.

Solution of LPP by simplex method: Concept of duality and solution of dual problems, Solution of LPP by dual simplex method and Sensitivity analysis.

10Hrs

Module-3

.
Transportation and Assignment Problems: Structure of transportation problem and various methods to find IBFS, Optimality test of transportation problems by MODI method, Solution of degeneracy and unbalanced transportation problems, Time minimisation problems, Assignment problems and solution by Hungarian method, Flight scheduling problems and Traveling Salesman-problem. **10Hrs**

Module-4

Theory of Games: Two person zero sum game, Minimax & Maximin strategies, Solution of game by dominance rules, arithmetic and algebraic methods, m×2 and 2×n games: Solution by method of sub games and graphical method. 3×3 games: Solution by method of matrices, approximate method using iterative procedure. Solution of game by Linear programming approach. Waiting Line: Basic structure of queuing systems and characteristics, Expressions for M/M/l queuing model.

10 Hrs

Module-5

Network Analysis: PERT and CPM, Network construction and determination of critical path, Calculation of ES, EF, LS, LF, TF, FF and IF, Crashing of a project, Scheduling of a project and resource levelling.

Simulation of Management Systems: Simulation and Monte Carlo method, Waiting line and inventory simulation models. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Quantitative Techniques for Managerial Decisions	U K Srivastava, G V Shenoy, and S C Sharma	New Age International (P) Ltd., Publishers	
2	Operations Research	P K Gupta and D S Heera	S Chand & Company Ltd.	
3	Operations Research	H. A. Taha	Prentice Hall of	
4	Introduction to Operations Research	Hillier and Liberman	McGraw Hill International	
5	Operations Research	S. D Sharma, Kedar Nath Ram	Nath & Company Ltd.	

(Group-2): Course Code: 20MPE322 Course Title: Simulation & Modelling of Manufacturing Systems	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Principle of Computer Modelling and Simulation: Monte Carlo simulation. Nature of computer- modeling and simulation. Limitations of simulation, areas of applications. System and Environment: Components of a system - discrete and continuous systems, Models of a system -a variety of modeling approaches. Simulation Software: Selection of simulation software, simulation packages. **08 Hrs**

Module-2

Discrete Event Simulation: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, too server queue, simulation of inventory problem.

Statistical Models in Simulation: Discrete distributions, continuous distributions. **08 Hrs**

Module-3

.
Random Number Generation: Techniques for generating random numbers- Mid square method -the mod product method -Constant multiplier technique -Additive congruential method -Linear congruential method - Tests for random numbers -The Kolmogorov- Smimov test -the Chi-square test.*** IvicaCmkovic, Ulfaskluna and Annitaborsen Dohlgvist Publisher Artechhouse. **08 Hrs**

Module-4

Random Variable Generation: Inversion transforms technique- exponential distribution. uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates-Erlang distribution. **08 Hrs**

Module-5

Empirical Discrete Distribution: Discrete uniform -distribution poisson distribution -geometric distribution - acceptance -rejection technique for Poisson distribution gamma distribution.

Design and Evalution of Simulation Experiments: variance reduction techniques antithetic variables, variables- verification and validation of simulation models. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Discrete Event System Simulation	Jerry Banks & .John S Carson II	Prentice Hall Inc	1984
2	Systems Simulation	Gordan. G.	Prentice Hall India Ltd	1991
3	System Simulation with Digital Computer	Nusing Deo	Prentice Hall of India	1979
4	Computer Simulation and Modeling	Francis Neelamkovil	John Wilely&Sons	1987
5	Simulation Modeling with Pascal	RathM.Davis& Robert M O Keefe	Prentice Hall Inc	1989

(Group-2): Course Code: 20MPD13 Course Title: Finite Element Analysis	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Equations of equilibrium, stress-strain relations for 2-D and 3-D, Potential energy and equilibrium, Boundary conditions, Von Misses Stresses.

FEM for 1-D Problems: General procedure for FEA, Raleigh Ritz method, Galerkin Approach, shape functions, stiffness matrix, load vectors, temperature effects, Applications of boundary conditions using elimination and penalty approaches. **10Hrs**

Module-2

FEM for 1 D and 2-D Problems: Application problems – 1-D bar element. Trusses and beams, Shape functions (2D element), stiffness matrix, strain matrix, load vectors for CST Elements and application problems. **10 Hrs**

Module-3

.
FEM for Axisymmetric Problems: Axisymmetric formulation, triangular elements, PE approach, Body force term, application problems**.** **10 Hrs**

Module-4

FEM for Scalar Field Problems: 1-D Steady state heat transfer, torsion, potential flow and fluid flow in ducts and application Problems. **10Hrs**

Module-5

Dynamic Analysis: Equations of motion for dynamic problems consistent and lumped mass matrices formulation of element mass matrices free vibration and forced vibration problems formulation. . **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Introduction to Finite Elements in Engineering	Tirupathi R.-Chandrupatla Ashok DBelegundu	Prentice Hall India Pvt. Ltd., New Delhi – 3rd Edition	2003
2	Concepts and Applications of finite Element Analysis	Cook R.D - Malkus D.S &PleshaM.E	JohnWiley& Sons	1989
3	Applied Finite Element Analysis	Segerlind L.J	John Wiley & Sons Edition	1984
4	The Finite Element Method in Engineering	Rao SS	Pergomon Press	
5	Finite Element Procedures in Engineering Analysis	Bathe K .J	Prentice Hall NewJersey	1982
6	Energy and Finite Element Methods in Structural mechanics	Shames III &DymC L	Wiley eastern ltd	1995

(Group-2): Course Code: 20MEM15	Course Title: Managerial Economics
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Demand Analysis: Demand Theory, Preference and Choice, Empirical Demand Curves, Goods Characteristics Approach.
Production & Cost: Production Theory and Estimation: Organization of Production and the Production Function, Production Function with two variable inputs, optimal combination of inputs returns to scale. Empirical production functions. Cost Components – Cost functions, Empirical Cost functions **10HRs**

Module-2

Market Structures: Perfect Competition: Meaning characteristics and importance, price and output determination in the short run and long run. Derived demand for inputs, shortcomings of perfect competition . **10HRs**

Module-3

.
Monopoly: Meaning, characteristics and importance, comparison with perfect competition, short run and long run analysis evaluation. Monopolistic Competition: Meaning, Characteristics and Importance short run and long run analysis.
Oligopoly: Meaning, characteristics and importance, Non-Collusive Oligopoly and the kinked demand curve, Collusive Oligopoly, efficiency implications of oligopoly. **10HRs**

Module-4

Pricing in Practice: Cost-plus pricing, Evaluation of cost plus pricing, Incremental Analysisin pricing. **10HRs**

Module-5

Capital Budgeting: Meaning and Importance, Protecting Cash Flows, Present Value and Internal Rate of Return, Comparison of NPV and IRR. Economic Growth, Development and planning economic aggregates and economic relationships. **10HRs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Economics: Principles, Problems and Policies	Campbell R. McConnell	McGraw Hill	2005
2	Theory and Problems of Micro Economic Theory	Dominic Salvator	McGraw Hill	1991
3	Managerial Economics	Joel Dean	PHI	2005
4	Managerial Economics	Dominic Salvator	McGraw Hill	1995

(Group-2): Course Code: 20MSE251	Course Title: Micro Machining Processes
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

INTRODUCTION: Introduction to Micro System design, Material properties, micro fabrication technologies. Structural behavior, sensing methods, micro scale transport – feedback systems. **10 Hrs**

Module-2

MICROMECHANICS: Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including martensite, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials. **10 Hrs**

Module-3

.
BASIC MICRO – FABRICATION: Bulk Processes – Surface Processes – Sacrificial Processes and Bonding Processes – Special machining: Laser beam micro machining – Electrical Discharge Machining – Ultrasonic Machining – Electro chemical Machining, Electron beam machining. **10 Hrs**

Module-4

MECHANICAL MICROMACHINING: Theory of micromachining – Chip formation – Size effect in micromachining – micro turning, micro milling, micro drilling – Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding – Binder less wheel – Free form optics. . . **10 Hrs**

Module-5

SEMICONDUCTORS MANUFACTURING: Basic requirements – clean room – yield model – Wafer IC manufacturing – feature micro fabrication technologies – PSM – IC industry – New Materials – Bonding and layer transfer – devices – micro fabrication industries. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Introduction to Micro Fabrication	Sami Franssila	John Wiley and sons Ltd., UK	2004
2	Fundamental of Micro Fabrication	Madore J	CRC Press	2002
3	Microfabrication and Nanomanufacturing	Mark J. Jackson	CRC Press	2006
4	Microchip fabrication	Peter Van Zant	McGraw Hill	2004

(Group-2): Course Code: 20MPM324	Course Title: Value Engineering
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, Symptoms to apply value analysis, Coaching of Champion concept.

TYPE OF VALUES: Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. **08 Hrs**

Module-2

FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies. **08 Hrs**

Module-3

.
FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies. **08 Hrs**

Module-4

VALUE ENGINEERING TECHNIQUES: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques.

ADVANCED VALUE ANALYSIS TECHNIQUES: Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems). **08 Hrs**

Module-5

APPLICATION OF VALUE ANALYSIS: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Techniques of Value Analysis and Engineering	Lawrence D. Miles	McGraw – Hill Book Company	
2	Value engineering for Cost Reduction and Product Improvement	M.S. Vittal	Systems Consultancy Services Edn	1993
3	Value Management, Value Engineering and Cost Reduction	Edward D Heller Addison	Wesley Publishing Company	1971
4	Value Analysis for Better Management	Warren J Ridge	American Management Association Edn	1969
5	Getting More at Less Cost (The Value Engineering Way)	G.Jagannathan	Tata Mcgraw Hill Pub	1995
6	Value Engineering	Arther E Mudge	McGraw Hill Book Comp	1981

(Group-2): Course Code: 20MPY321 Course Title: Applied Probability & Statistics

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction to statistics: Statistical Thinking, Collecting data, Statistical Modeling Framework, measure of central tendency and variance, Importance of Data summary and Display, Tabular and Graphical display.**08 Hrs**

Module-2

Discrete Random Variables and Probability distribution: Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Poisson distribution, Applications. **08 Hrs**

Module-3

.
Continuous Random Variables and Probability Distributions: Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Exponential distribution. **08 Hrs**

Module-4

Testing of Hypothesis: Estimation theory, Hypothesis testing, Inference on the mean of apopulation (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion, Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions. **08 Hrs**

Module-5

Simple Linear Regressions and Correlation: Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Transformations to a straight line, Correlation.

Multiple linear regressions: Multiple linear regressions model, least square estimation of parameters, Matrix approach to multiple linear regression, properties of least square estimators and estimation of variance. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Applied statistics and Probability for Engineers	Douglas C Montgomery, George C Runger	2nd Edn, John Wiley and Sons, ISBN-0-471-	1999

2	Statistics for Management	Richard I Levin, David S Rubin	6thEdn, Prentice Hall India, ISBN-81-203-	
3	Probability and Statistics in Engineering	William W Hines, Douglas C Montgomery	John Wiley and Sons	
4	Business Statistics for Management and Economics	Daniel, Terrell	Houghton Mifflin Company – 6Edn, ISBN-0-395-62835-0	
5	Probability and Statistics	Walpole & Mayer	MacMillan Publishing Company	1989

(Group-3): Course Code: 20MPT22	Course Title: Quality Assurance & Reliability
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Basic Concepts: Definitions of quality, Quality of design, Quality of conformance, and Quality of performance, Dimensions of quality, Quality characteristics, Quality control, Statistical quality control and cost of quality.

Fundamentals of Probability and Statistics: Events, Sample space, Probability rules, Dependent and Independent events, Statistical tools in quality control, Concept of variation, Graphical tools for data representation and analysis, Discrete and continuous probability distributions and their applications in quality control, numerical problems. **10Hrs**

Module-2

Control charts for Variables: Variation, Causes of variation, Objectives of control charts, Choice of variable, Subgroup size and subgrouping, frequency of sampling, control limits. Process capability analysis, Relationship of a process in control to specification limits, Variable charts - X bar chart, R chart, σ chart, revision of control limits and RPI, Introduction to cusum chart and moving range charts, numerical problems. **10Hrs**

Module-3

.
Control charts for Attributes: Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control limits, numerical problems.

Failure Data Analysis : Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, numerical problems, Introduction to Failure Mode and Effect Analysis. **10Hrs**

Module-4

Acceptance Sampling: Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL. Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Average Total Inspection, comparison amongst sampling plans, numerical problems.
. **10 Hrs**

Module-5

System Reliability: Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Reliability-Cost trade off, Prediction and Analysis, numerical problems.

Maintainability and Availability: Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems.
. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Statistical Quality Control	Montgomery D.C	John Wiley & Sons, Inc	
2	Statistical Quality Control	Grant and Leavenworth		
3	Quality Planning and Analysis	Juran, J.M and Gryna, F.M.	Tata McGraw Hill publishing Coimpany Ltd., New Delhi, India	1982
4	Concepts in Reliability Engineering	Srinath K.S.	Affiliated East-West Press Private Limited, New Delhi, India	1985
5	Statistical Quality Control	R C Gupta	Khanna Publishers	

(Group-3): Course Code **:** 20MPE242	Course Title: Non-Destructive Testing
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction to ND Testing: Selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation. **10 Hrs**

Module-2

Magnetic Particle Inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations.

Eddy Current Inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method. **10 Hrs**

Module-3

.
Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks. **10 Hrs**

Module-4

Radiography Inspection: principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications. **10 Hrs**

Module-5

Optical Holography: Basics of Holography, recording and reconstruction - Acoustical Holography: systems and techniques applications. Indian standards for NDT.

Microwave Inspection: Microwave holography, applications and limitations. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Non Destructive Testing	Mc Gonnagle JJ	Garden and reach New York.	
2	Non Destructive Evolution and Quality Control		volume 17 of metals hand book 9edition	Asia internal 1989
3	The Testing instruction of Engineering materials	Davis H.E Troxel G.E wiskovilC.T	McGraw hill	

(Group-3): Course Code **:** 20MPD22	Course Title: Design for Manufacturing
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Material and process selection – Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Selection of materials.

Engineering Design features. – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances, Datum features. **10Hrs**

Module-2

Component design – Machining Considerations – Drills, Milling cutters, Drilling, Keyways, Dowels, Screws, Reduction in machining areas, Simplification by separation and amalgamation, work piece holding, surface grinding, Examples. **10Hrs**

Module-3

.
Component design – Casting Considerations – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores. Examples. **10 Hrs**

Module-4

Design for Injection molding and Sheet metal working – Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules. **10 Hrs**

Module-5

Design for Die casting and Powder metal processing – Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Product Design for Manufacture and Assembly	Geoffrey Boothroyd, Peter Dewhurst	Winston Knight	
2	Designing for Manufacturing	Harry Peck	Pitman Publications	1983
3	Dimensioning and Tolerancing for Quantity Production	Merhyle F Spotts – Inc. Englewood Cliffs	New Jersey - Prentice Hall, 5thedition	

(Group-3): Course Code: 20MEM253	Course Title: Robust Design
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Quality by Experimental Design : Quality, western and Taguchi quality philosophy, Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions.

Robust Design :Steps in robust design : parameter design and tolerance design, reliability improvement through experiments, illustration through numerical examples. **10Hrs**

Module-2

Experimental Design: Classical experiments: factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment deigns for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples. **10Hrs**

Module-3

.
Measures of Variability : Measures of variability, Concept of confidence level, Statistical distributions : normal, log normal and Weibull distributions. Hipothesis testing, Probability plots, choice of sample size illustration through numerical examples.

Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and ploting method, Analysis of variance (ANOVA), in factorial experiments : YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples. **10Hrs**

Module-4

Taguchi's Orthogonal Arrays : Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays.

Signal to Noise ratio (S-N Ratios) : Evaluation of sensitivity to noise, Signal to noise ratios for static problems, Smaller – the – better types, Nominal – the – better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical examples. **10Hrs**

Module-5

Parameter Design and Tolerance Design : Parameter and tolerance design concepts, Taguchi's inner and outer arrays, Parameter design strategy, Tolerance deign strategy, Illustrations through numerical examples.

Reliability Improvement Through Robust Design : Role of S-N ratios in reliability improvement ; Case study; Illustrating the reliability improvement of routing process of a printed wiring boards using robust design concepts. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Quality Engineering using Robust Design	Madhav S. Phadake Prentice Hall	Englewood Clifts New Jersey 07632	1989
2	Design and analysis of experiments	Douglas Montgomery	Willey India Pvt. Ltd., V Ed	2007
3	Techniques for Quality Engineering	Phillip J. Ross: Taguchi 2nd edition	McGraw Hill Int. Ed	1996
4	Quality by Experimental Design	Thomas B. Barker	Marcel Dekker Inc ASQC Quality Press	1985
5	Experiments planning, analysis and parameter design optimization	C.F. Jeff Wu, Michael Hamada	John Willey Ed	2002

(Group-3): Course Code: 20MSE324 Course Title: Precision Engineering

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

CONCEPTS OF ACCURACY AND MACHINE TOOLS: Part Accuracy – errors, accuracy of machine tools – spindle accuracy – displacement accuracy – errors due to numerical interpolation – definition of accuracy of N.C system – errors in the NC machines – feed stiffness – zero stability. **08 Hrs**

Module-2

STIFFNESS, THERMAL EFFECTS AND FINISH MACHINING: Overall stiffness of Lathe – compliance of work piece – errors caused by cutting forces – deformation in turning – boring – milling – heat sources – thermal effects – Finish Turning, boring, grinding – Surface roughness. **08 Hrs**

Module-3

.
DIMENSIONING: Definition of terms – Key dimension – Superfluous dimension – dimensional stepped shaft – assigning tolerances in the constituent dimensions – dimensional chains. **08 Hrs**

Module-4

MICRO-MACHINING MICRO-FABRICATION: Micro Machining – Photo resist process – Lithography – LIGA Process – Optical, processing of materials – electron beam machining – beam machining – micro forming, diamond turning – micro positioning devices – etching – physical vapour deposition – Chemical vapour deposition. **08 Hrs**

Module-5

S**MART STRUCTURES, MATERIALS AND MICRO ACTUATORS**: Smart structures – Smart materials types and applications – smart sensors – micro valves –MEMS – Micro motors – Micro pumps – micro dynamometer – micro machines – microoptics – micro nozzles. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Precision Engineering in Manufacturing	Murthy R.L.	New Age International Pvt,	2005
2	Micro sensors, MEMS and Smart Devices	JuliarW.Gardner. Vijay K. Varadan	John Wiley and sons	2001
3	The Science and Engineering of Microelectronic Fabrication	Stephen A.Campbell	Oxford University Press	1996
4	Understanding Smart Sensors	Raady Frank	Artech. House, Boston	1996
5	MEMS Hand Book		CRC Press	2001

(Group-3): Course Code: 20MPM321	Course Title: Rapid Prototyping
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. **08 Hrs**

Module-2

Selective Laser Sintering and Fusion Deposition Modeling: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter, Path generation, Applications.

Solid Ground Curing: Principle of operation, Machine details, Applications. **08 Hrs**

Module-3

.
Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems. **08 Hrs**

Module-4

Rapid Tooling: Indirect Rapid tooling -Silicone rubber tooling – Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. **08 Hrs**

Module-5

RP Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Stereo lithography and other RP & M Technologies	Paul F. Jacobs	SME, NY	1996
2	Rapid Manufacturing	Flham D.T &Dinjoy S.S	Verlog London	

(Group-3): Course Code **:** 20MPY331 Course Title: Maintenance Engineering & Management	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

MAINTENANCE CONCEPT: Need for maintenance-Challenges in maintenance-Objectives of maintenance-Maintenance organization- Scope of maintenance department-Maintenance management-Tero Technology- Five zero concept-Maintenance performance measurement- Maintenance costs-Maintenance audit. **08 Hrs**

Module-2

MAINTENANCE POLICIES: Planned vs unplanned maintenance- Preventive maintenance vs Breakdown maintenance-Predictive maintenance-Corrective maintenance-Opportunistic maintenance- Design out maintenance-Condition Based Maintenance (CBM) - Analysis of downtime-Repair time distribution (exponential, lognormal) - MTTR-System repair time-Maintainability prediction. **08 Hrs**

Module-3

MAINTENANCE LOGISTICS: Proactive and Reactive maintenance-Minimum vs Extensive maintenance-Work order form- Maintenance planning-Maintenance scheduling-Spare parts control & inventory management-Human factors in maintenance- Maintenance crew size-Replacement models**.** **08 Hrs**

Module-4

FAULT DIAGNOSIS: Non destructive and destructive testing-Shock pulse monitoring-Condition monitoring-Lubrication practices-Wear Debris Monitoring (WDM)-Vibration monitoring-Corrosion control- Signature analysis- Computerized Maintenance Management System- Use of Fault Trees. **08 Hrs**

Module-5

TOTAL PRODUCTIVE MAINTENANCE: TPM Philosophy- Chronic and sporadiclosses- Six big losses- Overall Equipment Effectiveness- Autonomous Maintenance-TPMPillars-Reliability prediction-MTBF, MTTF-Reliability of series & parallel systems- Reliability Centered Maintenance. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Maintenance Management and Engineering	Tanmoy Deb	Ane Books Pvt.Ltd	2011
2	"An Introduction to Reliability and Maintaibaility Engineering	Charles E.Ebeling	McGraw Hill Education (India) Pvt.Ltd	2013
3	Introduction to Total Productive Maintenance	Seiichi Nakajima	Productivity Press	1988
4	Autonomous Maintenance in seven steps	MasajiTajiri and Fumio Gotoh	ProductivityInc. , Oregon	1999

(Group-3): Course Code: 20MEM22	Course Title: Human Resource Management
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

HRM in perspective, competitive challenges, uses of HR information, Demographics and employee concerns, social issues, diversity in. HRM,

Relationship of Job Requirements and HRM functions, Job Analysis, Job Description, Job Design, Designing work for groups, flexible work schedules, Industrial engineering and ergonomic consideration, HR Planning, Effective HRP, Forecasting and balancing supply and demand of HR, recruiting from inside and outside, Recruiting protected class, Recruiting older people. **10Hrs**

Module-2

Selection, Matching people and job, sources of information about job candidate, The US Employee Polygraph Protection Act, graphology, Medical examination, Drug test, Interview methods Guidelines for interviewers, appropriate and inappropriate interview questions, selection decision. **10 Hrs**

Module-3

.
Developing effectiveness in HR, Investment in Training, System approach, Conducting the .needs assessment, designing training programs, trainee readiness and motivation, principles of learning, characteristics of trainees, training methods for non-managerial employees, OJT, Technology for training, training methods for MDP, Evaluating, benchmarking HR training. **10 Hrs**

Module-4

Career development and Appraisal, identifying career opportunity and requirements, gauging employee potential, career development initiative, Mentor check list, career development for women and minorities, dual career couples, personal career development, Behavioural methods of appraisal, balanced score card, personal score card appraisal interviews; performance diagnosis. **10Hrs**

Module-5

International HRM, Managing across borders, International staffing, Skills of a global manager, content of training program. Non-verbal communications, developing local resources, compensation of host country employees, managers and expatriate managers. Case studies on appraisal system, developing a training session, evaluating a given training program. Preparation of structured and unstructured interviews. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Managing Human Resources	Wayne F Cascio	Tata McGraw Hill, New Delhi	
2	Managing Human Resources	George Bohlander and Scot Snell	Thompson South western	
3	Human Resource Management	Biswajeet Pattanayak	Prentice Hall of India Pvt. Ltd.	
4	Human Resource Management	K. Ashwathappa		
5	Personnel Management	C.B.Memoria	Himalaya Publishing	

(Group-4): Course Code : 20MPT13 Course Title: CIM & Automation	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Production development through CIM: Computers in Industrial manufacturing, Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping**.**
Computer Process Monitoring: Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control. **10Hrs**

Module-2

Computer Aided Quality Control: The computer in Q.C, automated inspection principles and methods, Contact inspection methods, non- contact inspection methods, machine vision system, optical inspection method, sensors, coordinate, measuring machine, Computer-Aided testing, Integration of CAQL with CAD/CAM. **10Hrs**

Module-3

.
Computer Integrated Manufacturing: Fundamentals of CAD/CAM, Computerized Manufacturing planning systems, shop floor control & automatic identification techniques. Computer Network for manufacturing, and the future automated factor. **10Hrs**

Module-4

Detroit type of Automation: Flow lines, Transfer Mechanisms, work pattern transfer, Different methods, & Problems. Analysis of Automated flow lines: Analysis of transfer lines without storage with storage buffer single stage, Double stage, Multistage with problems, Automated assembly systems, Design for automated assembly, parts feeding devices, analysis of Multi station assembly machine, Analysis of Single stage assembly machine. . . **10Hrs**

Module-5

Automated material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	CAD/CAM	Zimmers& Grover	PHI	
2	CAD/CAM/CIM	P.Radhakrishna	New Age International	
3	CAD/CAM	Zeid	Mc-Graw Hill	
4	CAD/CAM	P.N.Rao	TMH	
5	Robotics for Engineering	Koren.Y	Mc-Graw Hill	

(Group-4): Course Code: 20MPE331 Course Title: Nano Technology

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Metal Based Nanocomposites - Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Metalmetal nanocomposites, some simple preparation techniques and their new electrical and magnetic properties. **08 Hrs**

Module-2

Design Of Super Hard Materials- Super hard nano composites, its designing and improvements of mechanical properties. **08 Hrs**

Module-3

.
Mechanics Of Polymer Nanocomposites- Interfacial adhesion and characterization, factors influencing the performance of nano composites, physical and functional properties. **08 Hrs**

Module-4

Polymer-Carbon Nanotubes Based Composites- Processing methods and characterization using SEM, XRD, TEM. **08 Hrs**

Module-5

Characterization Of Polymer Nanotubes Based Composites - Mechanical, Electrical and Thermal Properties and their applications - Polymer / nanofillers (metallic nanopowders) systems, Rheological measurements, processing characteristics.

Testing of Nanocomposites - Thermal analysis such as TGA, TMA, DSC, DMTA Biggest Obstacle to Business Breakthrough, Integration of Ideas. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	"Nanophysics and Nanotechnology -An Introduction to Modern Concepts in Nano science	Edward L. Wolf	Second Edition, John Wiley & Sons,	2006
2	Surface Science: Foundations of Catalysis and Nano science	K.W. Kolasinski	Wiley	2002
3	Nanoparticulates as Drug Carriers	Vladimir P. Torchilin	Imperial CollegePress	2006
4	Nanomaterials and Nano systems for Biomedical Applications	M Reza Mozafari	Springer	2007
5	Nanotechnology –Basic Science & Emerging Technologies	Chapman & Hall		2002

(Group-4): Course Code: 20MPD242	Course Title: Advanced Manufacturing Practice
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Need of CPC for a company, what CPC can do, CPC-getting the right tool.

JIT – Introduction – The spread of JIT Movement, some definitions of JIT, core Japanese practices of JIT, Creating continuous Flow Manufacture, Enabling JIT to occur, Basic elements of JIT, Benefits of JIT.

Just in Time Production – Primary purpose, profit through cost reduction, Elimination of over production, Quality control, Quality Assurance, Respect for Humanity, Flexible work Force, JIT Production Adapting to changing production Quantities, process layout for shortened lead Times, Standardization of operation, Automation.

Sequence and Scheduling Used by Suppliers: Monthly and daily Information. Sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system tosub contractors. . . **12Hrs**

Module-2

Toyota Production System-The philosophy of TPS, Basic Frame work of TPS, Kanbans. Determining the Number of Kanbans in Toyota Production System. a) Kanban Number under Constant Quantity Withdrawal System. b) Constant Cycle, Non-constant Quantity Withdrawal System.

Supplier Kanban and the Sequence Schedule for Use by Suppliers.
a) Later Replenishment System by Kanban.
b) Sequenced Withdrawal System.
c) Circulation of the Supplier Kanban within Toyota.

Production Smoothing in TPS, Production Planning, Production Smoothing, Adaptability to Demand Fluctuations Sequencing Method for the Mixed Model Assembly Line to Realize Smoothed Production of Goal. **12Hrs**

Module-3

.
Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Scrap/Quality Improvements, Motivational effects, Responsibility effects, small Group improvement Activities, withdrawal of Buffer Inventory, the total Quality Control Concept. **06Hrs**

Module-4

Total Quality Control- Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, Goals, Habit of improvement, perfection, Basics, process control, Easy to see Quality control as facilitator, small lot sizes, Housekeeping, Less than full capacity scheduling, Daily machine checking, Techniques and Aids, Exposure of problems, Fool proof Devices, Tools of Analysis, QC Circles, TQC in Japanese-owned US Electronics plant, TQC in Japanese-owned Automotive plants. **10Hrs**

Module-5

Plant Configurations: Introduction-ultimate Plant configuration, job shop Fabrication, Frame Welding, Forming Frame parts from Tubing, Dedicated production lines, overlapped production, the daily schedule, Forward Linkage by means of Kanban, physical merger of processes, Adjacency, mixed Models, Automated production Lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker Cranes, Automatic Quality Monitoring. **10 Hrs**

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- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Japanese Manufacturing Techniques	Richard Schonberger	Pearson Higher Education ISBN:00292910 031982	
2	Just In Time Manufacturing	Kargoanker		
3	An Integrated Approach To Just In Time	Yasuhiro Monden	Toyota Production system	
4	Lean Thinking	James Womack	Simon & Schuster Adult - ISBN:	
5	The machine that changed the World	James P. Womack, Daniel T Jones, and Daniel Roos	Harper Perennial edition	1991

(Group-4): Course Code: 20MEM254	Course Title: Industrial Robotics
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

FUNDAMENTAL CONCEPTS OF ROBOTICS: History, present status and future trends, Robotics. Robot, Definition. Robotics Systems and Robot Anatomy, Specification of Robotics. Resolution, Repeatability and Accuracy of a Manipulator.

ROBOT DRIVES: Power transmission systems and control Robot drive mechanisms, hydraulic-electric-pneumatic drives. Mechanical transmission method – Rotary-to-Rotary motion conversion. Rotary-to- linear motion conversion end effectors – types-grip and problem Remote-Centered compliance Devices- Control of Actuators in Robotic Mechanisms. **10Hrs**

Module-2

SENSORS AND INTELLIGENT ROBOTS: Sensory devices – Non-optical-Position sensors – Optical position sensors – velocity sensors – proximity sensors: Contact and non-contact type- Touch and slip sensors – Force and Torque Sensors – AI and Robotics.

COMPUTER VISION FOR ROBOTICS SYSTEMS: Robot vision systems – Imaging components – Image representation – Hardware aspects-Picture coding – Object Recognition and Categorization- Visual inspection – software considerations – applications – commercial – Robotics vision systems. **10Hrs**

Module-3

.
COMPUTER CONSIDERATIONS FOR ROBOTIC SYSTEMS: Computer architecture for robots, hardware, Computational elements in robotic applications – Robot programming – sample programs path planning – Robot's computer system. **10Hrs**

Module-4

TRANSFORMATIONS AND KINEMATICS: Homogeneous Co- ordinates – Co-ordinate Reference Frames – Homogeneous Transformations for the manipulator – the forward and inverse probleme of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D.H.Matrices controller architecture. **10Hrs**

Module-5

ROBOT CELL DESIGN AND CONTROL: Specifications of Commerical Robots – Robot Design and Process specifications – motor selection in the design of a robotic joint – Robot Cell layouts – Economic and Social aspects of robotics.

APPLICATIONS OF ROBOTS: Capabilities of Robots – Robotics Applications – Obstacle avoidance – Robotics in India – The future of Robotics. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Robotics Engineering An integrated approach	Richard D Klafter, Thomas A Chmielewski Michael Negin	Prentice Hall of India Pvt. Ltd	
2	Robotics: Control Sensing, Vision, intelligence	Fu KS Gomaler R C, Lee C S G	McGraw Hill	
3	Handbook of Industrial Robotics	Shuman Y. Nof - John Wiley & Sons		1985
4	Robotics Technology and Flexible Automation	Deb SR	McGraw Hill BookCo	1984

(Group-4): Course Code : 20MSE323 Course Title: Smart Materials	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Closed loop and Open loop Smart Structures. Applications of Smart structures, Piezoelectric properties. Inchworm Linear motor, Shape memory alloys, Shape memory effect- Application, Processing and characteristics.

Shape Memory Alloys: Introduction, Phenomenology, Influence of stress on characteristic temperatures, Modelling of shape memory effect. Vibration control through shape memory alloys. Design considerations, multiplexing embedded NiTiNOL actuators. **08 Hrs**

Module-2

Electro rheological and Magneto rheological Fluids: Mechanisms and Properties, Characteristics, Fluid composition and behaviour, Discovery and Early developments, Summary of material properties. Applications of ER and MR fluids (Clutches, Dampers, others). Fibre Optics: Introduction, Physical Phenomenon, Characteristics, Fibre optic strain sensors, Twisted and Braided Fibre Optic sensors, Optical fibres as load bearing elements, Crack detection applications, Integration of Fibre optic sensors and shape memory elements. **08 Hrs**

Module-3

.
Vibration Absorbers: Introduction, Parallel Damped Vibration Absorber, Analysis, Gyroscopic Vibration absorbers, analysis & experimental set up and observations, Active Vibration absorbers. Control of Structures: Introduction, Structures as control plants, Modelling structures for control, Control strategies and Limitations. Biomimetics: Characteristics of Natural structures. Fibre reinforced: organic matrix natural composites, Natural creamers, Mollusks. Biomimetic sensing, Challenges and opportunities. **08 Hrs**

Module-4

MEMS: History of MEMS, Intrinsic Characteristics, Devices: Sensors and Actuators. Micro fabrication: Photolithography, Thermal oxidation, Thin film deposition, etching types, Doping, Dicing, Bonding. Microelectronics fabrication process flow, Silicon based, Process selection and design. Piezoelectric Sensing and Actuation: Introduction, Cantilever Piezoelectric actuator model, Properties of Piezoelectric materials, Applications. Magnetic Actuation: Concepts and Principles, Magnetization and Nomenclatures, Fabrication and case studies, Comparison of major sensing and actuation methods. **08 Hrs**

Module-5

Polymer MEMS& Micro fluidics: Introduction, Polymers in MEMS (Polyimide, SU8,LCP,PDMS, PMMA, Parylene,Others) Applications(Acceleration, Pressure, Flow, Tactile sensors). Motivation for micro fluidics, Biological Concepts, Design and Fabrication of Selective components. Channels and Valves. Case Studies: MEMS Magnetic actuators, BP sensors, Microphone, Acceleration sensors, Gyro,
MEMS Product development : Performance, Accuracy, Repeatability, Reliability, Managing cost, Market uncertainties. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
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- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Smart Structures –Analysis and Design	A.V.Srinivasan	Cambridge University Press,New York	2001
2	"Smart Materials and Structures	M.V.Gandhi and B.S.Thompson	Chapmen & Hall,London	1992
3	Smart Materials, "Structures and Mathematical issues"	Rogers, C. A.,	TechnomicPublishing Co., U.S.A,	1989
4	Encyclopaedia of Smart Materials	Mel Schwartz	Volume –I and II, John Wiley &Sons, Inc.	2002

(Group-4): Course Code **:** 20MPM334	Course Title: Computer Application in Design
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction to CAD/CAM/CAE Systems: Overview, Definitions of CAD. CAM and CAE, Integrating the Design and Manufacturing Processes through a Common Database-A Scenario, Using CAD/CAM/CAE Systems for Product Development.

Components of CAD/CAM/CAE Systems: Hardware Components ,Vector-Refresh (Stroke- Refresh) Graphics Devices, Raster Graphics Devices, Hardware configuration, Software Components. **08 Hrs**

Module-2

Basic Concepts of Graphics Programming: Graphics Libraries, Coordinate Systems, Window and Viewport, Output Primitives - Line, Polygon, Marker Text, Graphics Input, Display List, Transformation Matrix, Translation, Rotation, Mapping, Other Transformation Matrices, Hidden-Line and Hidden-Surface Removal, Back-Face Removal Algorithm, Depth-Sorting, or Painter.s, Algorithm, Hidden- Line Removal Algorithm, z-Buffer Method, Rendering, Shading, Ray Tracing, Graphical User Interface, X Window System. **08 Hrs**

Module-3

.
Basic Concepts of Graphics Programming: Graphics Libraries, Coordinate Systems, Window and Viewport, Output Primitives - Line, Polygon, Marker Text, Graphics Input, Display List, Transformation Matrix, Translation, Rotation, Mapping, Other Transformation Matrices, Hidden-Line and Hidden-Surface Removal, Back-Face Removal Algorithm, Depth-Sorting, or Painter.s, Algorithm, Hidden- Line Removal Algorithm, z-Buffer Method, Rendering, Shading, Ray Tracing, Graphical User Interface, X Window System. **08 Hrs**

Module-4

CAD and CAM Integration : Overview of the Discrete Part Production Cycle, Process Planning, Manual Approach, Variant Approach, Generative Approach, Computer-Aided Process Planning Systems, CAM-I CAPP, MIPLAN and Multi CAPP, Met CAPP, ICEM- PART, Group Technology, Classification and Coding, Existing Coding Systems, Product Data Management (PDM) Systems. **08 Hrs**

Module-5

Standards for Communicating Between Systems: Exchange Methods of Product Definition Data, Initial Graphics Exchange Specification, Drawing Interchange Format, Standard for the Exchange of Product Data. Tutorials, Computational exercises involving Geometric Modeling of components and their assemblies. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
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- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Principles of CAD/CAM/CAE systems	Kunwoo - Lee Addison Wesley		1999
2	CAD/CAM/CIM	Radhakrishnan P. et al	New Age International	2008
3	CAD/CAM – Theory & Practice	Ibrahim Zeid	McGraw Hill	1998
4	Computer Integrated Design and Manufacturing	Bedworth, Mark Henderson &Philip Wolfe	McGraw hill inc	1991
5	Part modeling Users Guide	Pro-Engineer		1998

(Group-5): Course Code: 20MPT14	Course Title: Theory of Metal Cutting
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Mechanics Of Metal Cutting: Mechanism of chip formation, Orthogonal & Oblique cutting, types of chips, built-up edge, Determination of shear plane angle, forces on the chips, forces in orthogonal cutting, Merchant circle diagram and analysis, Theory of Lee & Shaffer, coefficient of friction, power & energy relationship, velocity relationship, shear-strain, factors affecting forces and power, problems

Geometry Of Cutting Tools: Single point and multi point cutting tools, tools nomenclature, tool point reference systems, tool signature, Recommended tool angles, Effect of cutting parameters on tool geometry. **10 Hrs**

Module-2

Tool Materials And Their Properties: Characteristics of tool materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, SIALON, CBN, UCON, recommended cutting speeds for the above tools, discussion on die steels, air, water, oil hardening of tools and their applications.

Tool Wear, Tool Life: Mechanisms of tool wear, Sudden & gradual wear, crater wear, flank wear, tool failure criteria, tool life equations, effect of process parameters on tool life, tool life tests, conventional & accelerated tool wear measurement, machinability index. **10 Hrs**

Module-3

.
Measurement Of Cutting Forces: Reasons for measuring cutting forces, Classification of cutting force dynamometers – mechanical, hydraulic, pneumatic, optical, inductance, piezoelectric, and strain gage type dynamometers.

Dynamometers For Machine Tools: Dynamometers for lathe, drilling, grinding and milling, Calibration of dynamometers**.** **10 Hrs**

Module-4

Thermal Aspects In Metal Cutting: Heat sources in metal cutting, temperature in chip formation, temperature distribution, and experimental determination of tool temperatures.

Cutting Fluids: Basic actions of cutting fluids, properties of cutting fluids, selection of cutting fluids, application of cutting fluids, filtration of fluids, recommended cutting fluids. **10 Hrs**

Module-5

Economics Of Machining: Introduction, elements of total production cost, optimum cutting speed and tool life for minimum cost, optimum cutting speed and tool life for maximum production, problems.

Advanced Machining Techniques: Cryo machining & high speed machining. Causes of vibration and chatter in machining, and their remedy. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.

- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Metal Cutting Principles	M.C. Shaw	Oxford Publication	1985
2	Fundamentals of metal cutting & Machine Tools	B.L.Juneja& G.S–Sekhar	Wiley Eastern.	

(Group-5): Course Code: 20MPE31	Course Title: Theory of Metal Forming
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction to Forming process: Introduction to metal forming, Effect of temperature on forming process-hot working, cold working. Effect of Metallurgical structure, Effect of speed of deformation work of Plastic deformation, Friction in forming operation. **10 Hrs**

Module-2

Forging: Classification, various stages during forging, Forging equipment, brief description, deformation in compression, forging defects. Residual stresses in forging. **10 Hrs**

Module-3

.
Rolling of Metals: Classification, forces and geometrical relationships in rolling.

Variables in Rolling: Deformation in rolling, Defects in rolled products, Residual stresses in rolled products. Torque and Horsepower. **10 Hrs**

Module-4

Extrusion: Classification, Extrusion equipment, variables in extrusion, Deformation in extrusion, Extrusion defects, Work done in extrusion.

Drawing: Principles of Rod and wire drawing, variables in wire drawing, Residual stresses in rod, wire and tube drawing, Defects in Rod and wire drawing. **10 Hrs**

Module-5

Sheet Metal Forming: Introduction, Forming methods, shearing and Blanking, Bending, stretch forming, Deep drawing, redrawing operations, Defects in formed products. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Mechanical MetalIurgy	Dieter G.E.	Mc Graw Hill Publications	
2	Principles of Metal Working			
3	Metals Handbook	ASM - Volume II		

(Group-5): Course Code : 20MPD12 Course Title: Product Design & Development	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. **10Hrs**

Module-2

Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.

Concept Generation: The activity of concept generation, clarifies the problem, search externally, search internally, explore systematically, reflect on the results and the process. **10Hrs**

Module-3

.
Concept Selection: Overview of methodology, concept screening, and concept scoring,

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. . . . **10Hrs**

Module-4

Industrial design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes. **10Hrs**

Module-5

Product Development Economics: Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.
. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Product Design and Development	Karl.T.Ulrich, Steven D Eppinger	Irwin McGrawHill	2000
2	Product Design and Manufacturing	A C Chitale and R C Gupta	PH1	2003
3	New Product Development	Timjones. Butterworth Heinmann	Oxford. UCI	1997
4	Product Design for Manufacture and Assembly	GeofferyBoothroyd	Peter Dewhurst and Winston Knight	2002

(Group-5): Course Code: 20MEM252 **Course Title:** Product Life Cycle Management

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Product life cycle management – Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change, The PLM Strategy, Developing a PLM Strategy, a Five-step Process**.** **10HRs**

Module-2

Strategy Identification and Selection, Strategy Elements, Implications of Strategy Elements, Policies, Strategy Analysis, Communicating the Strategy. **10HRs**

Module-3

.
Change Management for PLM, Configuration management, and cost of design changes, schemes for concurrent engineering, Design for manufacturing and assembly, robust design. **10HRs**

Module-4

Modeling, Current concepts, part design, sketching, use of datum's construction features, free ovulation, pattering, copying, and modifying features, reference standards for datum specification, Standards for Engineering data exchange. **10HRs**

Module-5

Tolerance mass property calculations, rapid prototyping and tooling, finite modeling and analysis, general procedure, analysis techniques, Finite element modeling. Applicability of FEM, Static analysis, dynamic analysis. . **10HRs**

Question paper pattern:

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- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Product Lifecycle Management Paradigm for century Product Realization	John Stark, Springer-Verlag	21st, London	2006
2	CAD/CAM Theory and Practice	Zeid, McGraw Hill		1991
3	Computer Integrated Design and Manufacturing	Mark Henderson & Philip Wolfe	Bedworth McGraw hill inc	1991
4	Part modeling Users Guide Engineer			1998

(Group-5): Course Code: 20MSE331	Course Title: Composite Materials
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction to Composite Materials: Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, prepegs, sandwich construction. **08 Hrs**

Module-2

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli – Rule of mixture, Macro mechanics of a lamina: Hooke's law for different types of materials, number of elastic constants, Laminate code, Failure criterion. **08 Hrs**

Module-3

.
Manufacturing: Lay Up and Curing – open and closed mould processing – Hand lay up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance Introduction, material qualification, types of defects, NDT methods. **08 Hrs**

Module-4

Fabrication of Composites: Cutting, machining, drilling, mechanical fasteners & adhesive bonding joining computer aided design manufacturing tooling fabrication equipment Design of Fibre Reinforced Composite Structures: Introduction, Composite structural design, Design criteria, Laminate design, Mathematical analysis of the laminate, Design of composite stiffeners. **08 Hrs**

Module-5

Application Developments – Aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites. Metal Matrix Composites: Re-inforcement materials, types, Characteristics & Selection, base metals-selection, applications. Powder metallurgy technique, liquid metallurgy technique. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Composite Materials Handbook	Mein Schwartz	McGraw Hill Book Company	1984
2	Mechanics of Composite Materials	AutarK.Kaw	CRC Press New York - 1st edi	1997

(Group-5): Course Code: 20MPM13	Course Title: Lean Manufacturing System
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies. **10 Hrs**

Module-2

Kanban system:-Kanban rules supplier Kanban and sequence schedule used by supplier. Monthly information & daily information. Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table - problems & counter measures in applying Kanban system to subcontractors - Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office. **10 Hrs**

Module-3

.
The rise of lean production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production.
Shortening of production lead times: reduction of setup times, practical procedures for reducing setup time. . . **10 Hrs**

Module-4

Standardization of operations: Machine layout, multi function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements.

Elements of lean production viz G M Framingharn: Toyota Takaoka Mass Production V /s lean production, diffusing lean production. **10 Hrs**

Module-5

Managing lean enterprise:-Finance, Career ladders, geographic spread and advantages of global enterprise.

Prospects for catching up. Simplicity in the natural state: institutional factors -life time employment - educational commodities -quality & productivity in full circle. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Productions and Operations Management	ChaselAquilino– Dreamtechlatesteditio		
2	Toyoto Production System -An integrated approach to Just in Time – Yasuhiro Monden	Engineering aild Management Press	Institute of Industrial EngineersNorcr oss Georgia	1983
3	The Machine that changed the World The Story of Lean Production	Daniel TJones - and Daniel Roos	Harper Perennial – editionpublished	1991

(Group-5): Course Code: 20MPY252	Course Title: Industrial Design & Ergonomics
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: An approach to industrial design - elements of design structure for industrial design in engineering application in modem manufacturing systems. Ergonomics and Industrial Design: Introduction - general approach to the man-machine relationship-workstation design-working position. **10 Hrs**

Module-2

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 design of instruments. **10 Hrs**

Module-3

.
Ergonomics and Production: Ergonomics and product design ergonomics in automated systems-expert systems for ergonomic design, anthropomorphic data and its applications in ergonomic design limitations of anthropomorphic data - use of computerized database. **10 Hrs**

Module-4

Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form. Colour: colour and light - colour and objects - colour and the eye colour consistency –colour terms - reactions to colour and colour continuation - colour on engineering equipment's. **10 Hrs**

Module-5

Aesthetic Concepts: Concept of unity - concept of order with variety - concept of purpose style and environment - Aesthetic expressions. Style-components of style - house style, observations style in capital goods. Industrial Design in Practice: General design - specifying design equipments - rating the importance of industrial design – industrial design in the design process. **10 Hrs**

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- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Industrial design for Engineers	Mayall W.H.	London Cliffee Books Ltd.	1988
2	Applied Ergonomics Hand Book	Brien Shakel (Edited)	Butterworth Scientific London	1988

(Group-6): Course Code: 20MPT321	Course Title: Applied Micro-Economics
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Introduction: Circular Flow of Economic Activity, Nature of the firm Concept of Economic Profit. Demand Theory and Analysis: Individual and Market Demand, price Elasticity, income elasticity and cross Elasticity. . . **08Hrs**

Module-2

Production Theory and Analysis: Production Function, Production with one variable Input and two inputs, Economies of Scale and Scope, Estimation of Production Function. **08Hrs**

Module-3

.
Cost Theory and Analysis: The Economic Cost Concept, Opportunity Costs, Explicit & Implicit, Marginal, Incremental and Sunk Cost Function, Short and Long run cost Functions, Profit Contribution Analysis Numerical Problems. **08Hrs**

Module-4

Market Structure: Perfect Competition and Monopoly, Monopolistic Competition, Oligopoly: Numerical Problems. Barriers to Entry. **10Hrs**

Module-5

Pricing Decisions: Price Discrimination, Product Bundling. **06Hrs**

Question paper pattern:

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- Each full question is for 20 marks.
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- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Managerial Economics	H C Peterson and W C Lewis	PHI	
2	Managerial Economics	Samuelson W F, and S G Marks	Dryden Press, Fort Worth	
3	Managerial Economics	William F Samuelson and Stephen G Marks	John Wiley &Sons	
4	Managerial Economics and Strategy	Jeffrey M Perloff	Pearson	
5	Managerial Economics	H L Ahuja	S Chand Publicationsp	

(Group-6): Course Code: 20MPE251	Course Title: Supply Chain Management
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Building a Strategic Frame Work to Analyze Supply Chains: Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains, Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit.

Designing the Supply Chain Network: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. **10Hrs**

Module-2

Facility Location and Network Design: Models for facility location and capacity allocation. Impact of uncertainty on SCN .

Planning and Managing Inventories in a Supply Chain: Review of inventory concepts. Trade promotions, managing multi-echelon cycle inventory, safety inventory determination. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability; importance factors. Managerial levers to improve supply chain profitability. **10Hrs**

Module-3

.
Sourcing, Transportation and Pricing Products: Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration.

Sourcing, Transportation and Pricing Products: Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade - off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation. Analytical problems. Role Revenue Management in the supply chain. **10Hrs**

Module-4

Coordination and Technology in the Supply Chain: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. **10Hrs**

Module-5

Coordination and Technology in the Supply Chain: The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice.

Emerging Concepts: Reverse Logistics; Reasons, Activities, Role. RFID Systems; Components, applications, implementation. Lean supply chains, Implementation of Six Sigma in Supply Chains. **10Hrs**

Question paper pattern:

- The question paper will have ten questions.
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Textbook/Reference Books				
	Title of the book	Author Name	Publisher's Name	Publication year
1	Supply Chain Management- Strategy, Planning & Operation	Sunil Chopra &Peter Meindl	Pearson Education Asia, ISBN: 81-7808-	2001
2	Supply Chain Redesign- Transforming Supply Chains into Integrated Value Systems	Robert B Handfield, Ernest L Nichols	Pearson Education Inc, ISBN: 81-297-0113-8	2002
3	Modeling the Supply Chain	Jeremy F Shapiro, Duxbury	Thomson Learning ISBN 0-534-37363	2002

(Group-6): Course Code **:** 20MPD252	Course Title: Virtual Design & Manufacturing
Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Review of Computer Graphics: Review of computer graphics, 2D graphics.2D primitives and transformations. Algorithm to digitize the graphic entities, rasterization, 3D graphics.3D primitives and transformations, projections and viewing, algorithms for hidden line removals, lighting.Shading and raytracing. **10 Hrs**

Module-2

VR Devices: Input devices-track balls, 3D Mouse, data gloves, Virtual hand and trackers, output devices graph terminal, stereo glasses, head mounting devices, vision dome, caves. **10 Hrs**

Module-3

.
Applications: Virtual prototyping, behavior simulation, digital mockup, walk through/flythrough. Virtual training/simulation, micro electro mechanical systems and nanotechnology. **10 Hrs**

Module-4

Virtual Modeling language: History, Concepts, syntax, basic nodes- group, transform switch, LOD etc, geometry nodes-indexed face set, indexed line set, coordinate, coordindwx, textures etc. sensor nodes- time sensor touch sensor, sphere sensor, cylinder sensor and proximity sensor, scriping- VRML Script and JAVA Script. **10 Hrs**

Module-5

Tutorials and samples: VRML authoring tools-3D studio MAX, cosmo World, VRML Pad (editor) VRML Viewing tools-cosmo player, auto Vue, SGI's open inventor, virtual collaborative tools. **10 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Computer Graphics-Principles and practice	JanesD,Foley et al	Second edition. inC,Addision - Wesley	1997
2	The VRML- 2.0 Hand book	Jed Hartman and Josie wernecke	Addision-Wesley	1997
3	The Annocated VRML 2.0 hand book Addision	R Carey and G Bell	Wesley	1997

(Group-6): Course Code: 20MSE333	Course Title: Operations Management
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
Operations Planning Concepts: Introduction, Operations Functions in Organizations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, The environment of operations, Production systems decisions- a look ahead. **08 Hrs**	
Module-2	
Operations Decision Making : Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology, Decision Tree Problems, Economic models- Break Analysis in operations, P/V ratio, Statistical models. System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning. **08 Hrs**	
Module-3	

Forecasting Demand: Forecasting objectives and uses, forecasting variables, Opinion and Judgmental methods, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing, Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, BIAS, Tracking Signal. Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Three Pure Strategies, Aggregate planning methods, Master scheduling objectives, Master scheduling methods. **08 Hrs**

Module-4

Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. Scheduling and Controlling Production Activities: Introduction, PAC, Objectives and Data requirements, Loading –Finite and Infinite Scheduling methodology, priority sequencing, capacity control. **08 Hrs**

Module-5

Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule. Flow –Shop Scheduling: Introduction, Johnson‟s rule for „n‟ jobs on 2 and 3 machines, CDS heuristic. Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on „m‟ machines. **08 Hrs**

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Operations Management	Monks, J.G	McGraw-Hill International Editions	1987
2	Productions & operations management	Adam & Ebert		
3	Modern Production/Operations	Buffa	Wiely Eastern	
4	Production and Operations Management	Chary, S.N.	Tata- McGraw Hill.	
5	Operations management	James Dilworth.		

(Group-6): Course Code: 20MPM31 **Course Title:** Total Quality Management

Exam Hours: 3 hours	**Exam Marks(Maximum):100**

Module-1

Principles And Practice: Definition of TQM , basic approach, Obstacles to TQM, TQM Framework, benefits of TQM. Business Evolution: Customer Satisfaction, four fitness of Customer Satisfaction, Evolution of Customer Satisfaction Methodology, Leadership vs Empowerment, Four Practical Revolutions in Management thinking , Four Levels of Practice. **10 Hrs**

Module-2

Customer Focus: Change in the Work Concept: Market-in, Philosophy-in and Philosophy out, Evolution of Customer Focus and Its Challenges, Three Stages of Customer Focus, Customer Concerns, Integration of Concerns, Individualizing Customers. **10 Hrs**

Module-3

.

Continuous Improvement: Management by process, WV Model of Continuous Improvement, Three types of improvements, Continuous Improvement of Processes for All Types of Work, Continuous Improvement verses breakthrough, Continuous Improvement and the Scientific Method. **10 Hrs**

Module-4

Managing Existing Processes: Process Discovery and Management: Thinking In Terms of Process, Process Discovery, steps of Process Discovery, benefits of Process Discovery. The 7 QC Tools.

Proactive Improvement: Proactive Improvement concept, Kawakita‟s Five Principles, Language Data and Use of Semantics, Comparison of Affective and Report language, Five principles of Customer Visitation, The purpose of Proactive Improvement to Develop New Products. **10 Hrs**

Module-5

Total Participation: Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, three sets of skills of leader ship. QC Circles.

Inititation Stragies And Mobilization : CEO involvement and the importance of CEO, A General Model for Mobilization, Hoshin Management, Hoshin Management and Its Parts, Proactive , Reactive, and Control phases in Management.

10 Hrs

Question paper pattern:

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- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Four Practical Revolutions in Management: systems for creating unique organizational capability	Shoji Shiba and David Walden	Productivity Press &Center for Quality Management, (USA)	2001
2	Total Quality Management	Besterfield	Pearson Education	2011
3	Management for Total Quality	N Logothetis	Prentice Hall of India, New Delhi	2003

4	Total Quality Management	H D Ramachandra and K R Phanesh		2006

(Group-6): Course Code**:** 20MPY333 Course Title: Project Management	
Exam Hours: 3 hours	**Exam Marks(Maximum):100**
Module-1	
Introduction: Identification of Investment Opportunities, Market and Demand Analysis –Technical Analysis - Investment Outlay. **08 Hrs**	
Module-2	
Means of Financing -Profitability and Breakeven Analysis -Cash Flows of Projects -Taxfactor in investment Analysis -Interest Compounding and Discounting. **08 Hrs**	
Module-3	

.
Appraisal Criteria and Selection of Investment -cost of capital analysis of Risk –Financial Projection, social Cost Benefit Analysis. **08 Hrs**

Module-4

Manpower Management in Projects -Functional Approach to Manpower Management the Element of decision Process Project Team Concepts - Field Autonomy- Policies Governing Projects. **08 Hrs**

Module-5

Networks Techniques in Project Management -PERT/CPM Analysis – Administrative aspects of Capital Investment. **08 Hrs**

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- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbook/Reference Books

	Title of the book	Author Name	Publisher's Name	Publication year
1	Projects - appraisal, preparation, budgeting and implementation	Prasannachandra	Tata McGraw Hill	
2	Handbook of Project Management	Dennis lock		
3	Project Management	Dennis lock	Gower Publishing Ltd - 8th revised edition	