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Second Year

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### Elective subject list

#### Open Elective - 1

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<tr>
<td>1</td>
<td>MPET-391 Computer Aided Engineering</td>
</tr>
<tr>
<td>2</td>
<td>MPET-392 Computer Aided Processes Planning &amp; Control</td>
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#### Open Elective - 2

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<td>MPET-393 Industrial Design &amp; Ergonomics</td>
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<td>2</td>
<td>MPET-394 Operation Research</td>
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#### Major Elective - 1

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<td>MPET-211 Finite Element Method</td>
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<td>MPET-212 Production &amp; Operation Management</td>
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#### Major Elective - 2

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<td>MPET-222 Welding Science</td>
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#### Major Elective - 3

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<tr>
<td>1</td>
<td>MPET-321 Production Design &amp; Development</td>
</tr>
<tr>
<td>2</td>
<td>MPET-322 Metal Casting</td>
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Solution of Algebraic and Transcendental Equation: Newton-Raphson method including method of complex roots, Graeffe’s root square method (Computer based algorithm and programme for these methods)

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

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

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


Books:
5. An Introduction to Numerical Analysis K.E. Atkinson John Wiley & Sons, NY
6. Introduction Methods of Numerical Analysis S.S. Sastry Prentice Hall of India

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


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


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

Books:
3. System Modelling and Control J. Schwarzenbach and K.F. Gill Edward Arnold
4. Modelling and Analysis of Dynamic Systems Charles M Close and Dean K. Frederick Houghton Mifflin
5. Simulation of manufacturing Allan Carrie John Wiley & Sons
Introduction, Definition of quality, Dimensions of quality planning, Quality cost analysis, techniques for quality costs, basic concepts of TQM, historical Review, Principle of TQM, Leadership Concepts, role of senior management, Quality council, Quality statements, Strategic planning, Deming Philosophy, Barriers of TQM implementations.


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

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

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

Books:

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

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

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

Books:
1. Advanced Welding Processes Nikodaco & Shansky MIR Publications
2. Welding Technology and Design VM Radhakrishnan New Age International
5. Manufacturing Technology (Foundry, Forming and Welding) P.N. Rao Tata McGraw Hill
Advance machining theory and practice: Review of orthogonal cutting – Mechanism of chip formation, Shear and angle relation, Theoretical Determination of cutting forces, analysis of turning drilling and milling operation, mechanics of grinding dynamometry, Thermal aspects of machining, tool wear and extended tool life equation, Machinability, Economics of machining.

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

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

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

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

Books:
1. Manufacturing Process & system Ostwald Willey India Pvt. Ltd
4. Queuing Theory in Manufacturing Systems Analysis and Design Papadopoulos H T Chapman
5. Performance Analysis of Manufacturing Systems AltioK Tayfur Springer-V


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


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


Books:
1. Computer Control of Manufacturing Systems Koren -
2. CAD/CAM Groovers Prentice Hall
3. NC Machine Tools S J Martin -
**Introduction to Process Planning:** Principles and scope, Manual process planning, Experienced based process planning, Decision table and decision trees, process capability analysis, Tolerance analysis, Variant process planning, Generative approach, Forward and Backward planning.

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

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

**Books:**
1. Computer Control of Processes M Chidanbaram Narosa Publishing House
2. Computer Aided Process Control SK Singh Prentice Hall of India
3. Computer Processing of Remotely Sensed Images: An Introduction
Introduction to Ergonomics and Industrial Design: An approach to industrial design- elements of design, Structure for industrial design in engineering; Application in modern manufacturing systems; General approach to the man-machine relationship, Work station design, Working position.

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

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

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

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

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

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

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


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

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

**Waiting Line Models (Queuing Model):**
- Taxonomy
- Probability distribution
- Single server and multi server problems

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

**Books:**
1. Ravindra A. Et.AI, Operation And Research Principles And Practice By John Wiles & Sons
2. Wagner MII “ Principles Of OR
4. H A Hillier And G I Lieberman
5. S D Sharma “Operation Research”

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

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

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

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

| MPET-212 | PRODUCTION & OPERATION MANAGEMENT | L  | 3  | T | 1  | P | 0  | Credit 04 |

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

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

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

**Design of Facilities & Jobs**: Strategic capacity planning concepts, determining capacity requirements, Planning service capacity, JIT production systems, JIT implementation requirements, Facility location, Plant location methods, Facility, Process and Product layout, GT layout, Retail service layout, Computer aided layout techniques. Job design and work measurement, Considerations in job design, Work measurements and standards, Financial incentive plans, Learning curves and its applications.
**Product Design & Process Selection:** Product design process, Designing for the customer QFD, Value analysis, designing products for manufacturer & assembly. Process selection, product process matrix, Choosing from alternative processes & equipment, Virtual factory, Waiting line management & models, Quality management, Quality specifications & costs, Tolls and procedures for continuous improvement, Shingo system of fail-safe design, Review of SQC models.

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

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

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

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

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

Books:
1. Automation, Production System & Computer Integrated Manufacturing Groover Englewood
2. Design and Operation of SMS Rankey IFS
3. Flexible Manufacturing System Wernecks Spring-Verlag
4. FMS in Practice Bonetto Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India


Books:

**Welding Engineering And Technology By R S Parmar**
Stages in design process: introduction to various stages of the design process. Formulation of problem generation of alternatives, evaluation, guided redesign, case study.


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

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

Material selection: materials in design, the evolution of engineering materials, design tools, and material data, function, material, shape and process, materials selections strategy, attributes limits, selections process, computer aided materials selections, case study.
**Process selections:** introduction, process selection: shaping, joining, and finishing, system process selection, ranking, process cost, computer aided process selection.

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

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

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

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

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

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

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

**Special casting methods:** Review and critical comparison of various established processes, recent developments e.g. low pressure and ferrous die casting, High pressure moulding, Full mould process, Flaskless moulding, Hot and cold box moulding, Ceramic shell moulding, V-process, Continuous casting, Squeeze and pressed casting, Centrifugal casting, Investment casting, shell mold casting, CO₂ casting.
Melting and Fluidity: Selection and control of melting furnaces; molting, refining and pouring; Coupla design, Measurement of fluidity, Effect of various parameters on fluidity, Methods of elimination and control of gases in casting.

Casting of Sand, Design Considerations: Recent developments, e.g., Mulling index; Mouldability index, Compactability; deformability etc. Foundry Practice: Casting of different Cast Irons, Steel, Aluminum, Zinc, Brass etc., Mechanization in Foundry, Use of Computers in foundry, Inspection and Quality Control. Non distract testing of casting.

Books:
1. Bronze Sculpture Casting and Patination: Mud Fire Metal Steve Hurst Schiffer Publishing
2. Fine Art Metal Casting Richard Rome -
3. Casting Technology and Cast Alloys Chakraborty Prentice Hall of India