Syllabus

For

M.Tech. (Production Engineering)

(Effective from the Session: 2016-17)
### COURSE STRUCTURE AND EVALUATION SCHEME FOR
### M.TECH - PRODUCTION ENGINEERING
### (EFFECTIVE FROM THE SESSION: 2016-17)

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### Departmental Elective – I
- MTME 011 CAD/CAM
- MTPE 011 Machine Tool Design
- MTPE 012 Metrology & Computer Aided Inspection
- MTPE 013 Maintenance Engineering

### Departmental Elective – II
- MTPE 021 Rapid Prototyping
- MTPE 022 Statics For Engineers
- MTPE 023 Supply Chain Management
- MTPE 024 Industrial Tribology
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**Departmental Elective – III**
- MTPE 031 Material Management
- MTPE 032 Industrial Automation And Robotics
- MTPE 033 Industrial Design & Ergonomics
- MTPE 034 Reliability Engineering

**Departmental Elective – IV**
- MTME 041 Optimization Techniques & Design of Experiments
- MTPE 041 Total Quality Management
- MTPE 042 Hybrid Manufacturing
- MTPE 043 Composite Materials

**Elective – V**
- MTME 051 Flexible Manufacturing System
- MTME 052 Machine Vision
- MTME 053 Additive Manufacturing And Tooling
- MTTE 054 Advanced Power Plant Engineering
### Semester – III

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MTME 101

Introduction: Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation.

General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

Models In Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Binomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,

Queueing Models: Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.

Random Number Generation: Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers.

Random Variate Generation: Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.

Input Modelling And Validation: Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.

Books:
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.
UNCONVENTIONAL MACHINING PROCESSES: Need for unconventional processes, Classifications of Unconventional Manufacturing Processes, Construction and working principal of unconventional machining processes such as USM, WJM, AJM, Chemical Machining, Electrolytic Grinding, EDM, LBM, EBM, Plasma Arc Cutting.

HIGH SPEED MACHINING: Introduction to high speed machining process, economics of high speed machining, material properties at high strain rates, influence of increasing speed on chip formation on stainless steel, aerospace aluminum and titanium and process parameter recommendations.

GENERATIVE MANUFACTURING PROCESSES (GMP) FOR RAPID PROTOTYPING General features and classification, issues related to CAD and GMP software, Overviews of generative manufacturing processes, two dimensional layer-by-layer techniques and direct three-dimensional techniques for RP.

GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEM: Group Technology-part families, Parts classification and coding, Production flow analysis, Machine cell design, Benefits of group technology, Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.

COMPUTER INTEGRATED MANUFACTURING: Introduction, Evaluation of CIM, CIM hardware and software, to be used in CIM system, Database requirements. Concurrent engineering-Principles, design and development environment, advance modeling techniques.

Books

2. Metal Cutting Theory and Practice, Bhattacharya, New Central Book Agency
3. Fundamentals of Metal Cutting and Machine Tools, B.L. Juneja and G.S. Sekhon, New Age International
4. Principles of Metal Cutting, G. Kuppuswamy, Universities Press
5. Fundamentals of Machining and Machine Tools, D.G. Boothroyd and W.A. Knight, Marcel Dekker, NY
SIMULATION, MODELLING & ANALYSIS LAB

MTME 151

1. Study of simulation software Like ARENA , MATLAB.
2. Simulation of translational and rotational mechanical systems
3. Simulation of Queuing systems
4. Simulation of Manufacturing System
5. Generation of Random number
6. Modeling and Analysis of Dynamic Systems
7. Simulation mass spring damper system
8. Simulation of hydraulic and pneumatic systems.
9. Simulation of Job shop with material handling and Flexible manufacturing systems
10. Simulation of Service Operations

ADVANCED MANUFACTURING LAB

MTPE 151

2. Machining of parts on CNC Machines including preparation of part program, after simulation of tool path using suitable CAM software package.
3. Part Programming using CAM software like MASTERCAM
4. CNC programming on Turning and Milling process
5. Experiments on micro-machining
6. Study and experimentation with CMM
7. Experiments with NDT techniques
8. Experiments with non conventional machining processes such as EDM,USM, Abrasive Machining etc...
9. Use of Surface roughness meter and related experiments
10. Use of 3D scanner and experiments
DEPARTMENTAL ELECTIVE-I

CAD/CAM

MTME 011          L    T    P
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Mathematical Elements, CAD, Solid modeling methods, Database structures for CAD, CSG formulation, B-rep and wire frame methods, Intersection surface generation methods, Boundary file generation methods, Feature based modeling systems, Surface modeling, B-splines, Coons and Bezier surfaces, NURBS and surface patches, fitting surfaces for arbitrary digested points, Offset surfaces, Fillet surfaces, Sewn surfaces.

Features recognition from the databases, IGES, STEP, PDES, and DXF data exchange formats, Graphic standards for CAD/CAM such as GKS, PHIGS and VDI.

Concurrent engineering integration of manufacturing principles and analytical principles in design, Manufacturing information generation from CAD data, Planar sectioning, Penalty functions, cavity milling, Optimization of cutter path, Effect of tool profile geometry, Methods for multi-axis machining, Methods for software design for CAD/CAM system, use of software libraries, Development of software package for a specific problem as part of course using software libraries.

Introduction to automation, CAM/CIM, Part programming, Interpolator & Control.

Books:
2. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramanian Tata McGraw-Hill
4. Computer Aided Engineering & Design Jim Browne New ATC International
5. The Engineering Database D.N. Chorafas and S.J. Legg Butterworths
7. CAD/CAM H P Groover and E W Zimmers Prentice Hall

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


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

Books:


Laser Applications in Metrology: LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, On-line and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements.

Special Measuring Instruments and Techniques: Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalisation, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.

Co-ordinate Measuring Machine: Types of CMM, Probes used, Applications, Non-contact CMM using electro optical sensors for dimensional metrology, Non-contact sensors for surface finish measurements, statistical evaluation of data using computer, Data integration of CMM and data logging in computers.

Sensors in Inspection: Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor technology-Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.

Books:
1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e
2. Engineering Metrology G. Thomas and G. Butter Worth PUB
5. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India
7. Optoelectronics J. Watson Van Nostrand Rein Hold (UK) Company
Maintenance – Key to reliability & productivity. Basic elements of maintenance system – inspection, planning & scheduling, job execution, record keeping, data analysis, learning & improvement. Preventive, operating and shutdown maintenance; Condition based maintenance and Application of preventive maintenance for system of equipment.

Vibration and signature analysis; causes; remedy in rotating machinery. Fluid analysis for condition monitoring, various methods of fluid analysis. Vibration monitoring – Data acquisition, Transducers, Time domain and frequency domain analysis, Phase signal analysis, Fault diagnosis of rotating equipments, antifriction bearings and gears.

Non-destructive testing – Visual examination – optical aids, liquid penetrate testing, magnetic particle testing, eddy current testing, radiography, ultrasonic testing, acoustic emission testing, thermography, leak testing, corrosion monitoring, standards for NDT.

Lubrication: Introduction to lubrication engineering, types, classification of lubricants with their properties and characteristics. Bearing lubrication technique for minimization of friction and wear.

Science of friction and wear; Different types of wear, such as abrasive, corrosive, seizure, scoring, scuffing, pitting, spalling, adhesive, etc. and techniques for minimization of wear. Data collection and analysis, Introduction to computer-aided maintenance management system.

References:
1. Industrial Maintenance – H.P.Garg
2. Industrial Maintenance Management – S.K.Srivastava
INTRODUCTION

LIQUID AND POWDER BASED RP PROCESSES
Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

SOLID BASED RP PROCESSES
Principles and typical processes such as fused deposition modeling laminated object modeling and others.

RAPID TOOLING
Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.

RP INTERFACING WITH MANUFACTURING PROCESSES

REFERENCES
The Role of Statistics in Engineering (Data Summary and Presentation): Statistical Thinking, Collecting data, Statistical Modeling Frame work, measure of central tendency and variance, Importance of Data summary and Display, Practical problems solving through tools like Tabular and Graphical display, Pie charts, Constructions of Box Plots, S curves, Frequency polygon, Pareto Graph.

Discrete Random Variables and Probability Distributions: 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, Applications.

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, Applications. Chi-square Distributions, Exponential distribution Weibull Distribution (Underlined Distributions - Exposure limited to theoretical concepts).


Statistical Inference for a Single Sample and Two Samples: Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion.

Statistical Inference for a Single Sample and Two Samples: 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.

Books:

SUPPLY CHAIN MANAGEMENT

MTPE 023                                   L T P
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INTRODUCTION: Role of Logistics and Supply chain Management: Scope and Importance-
Evolution of Supply Chain Decision Phases in Supply Chain - Competitive and Supply chain Strategies
Drivers of Supply Chain Performance and Obstacles.

SUPPLY CHAIN NETWORK DESIGN: Role of Distribution in Supply Chain, Factors influencing
Distribution network design, Design options for Distribution Network Distribution Network in Practice-

LOGISTICS IN SUPPLY CHAIN: Role of transportation in supply chain, factors affecting
transportations decision, Design option for transportation network, tailored transportation, Routing and
scheduling in transportation.

SOURCING AND COORDINATION IN SUPPLY CHAIN: Role of sourcing supply chain supplier
selection assessment and contracts- Design collaboration sourcing planning and analysis - supply chain
coordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles –
Building strategic partnerships and trust within a supply chain.

SUPPLY CHAIN AND INFORMATION TECHNOLOGY: The role IT in supply chain- The supply
chain IT frame work Customer Relationship Management – Internal supply chain management –

Books:
3. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management”, PHI,


BOOKs:

Explosive, diffusion and ultrasonic welding, principles of operation, process characteristics and applications.

EBW: Concepts, types and applications.
LBW: Physics of lasers, types of lasers, operation of laser welding setup, advantages and limitations, applications


Design requirements, allowable stress values, workmanship and inspection, introduction to welding codes and standards, AWSD.

Casting Processes, classification, characteristics of sand casting processes, Solidification, Gating and Risering, Nucleation and grain growth, Solidification of pure metals, short and long freezing range alloys. Rate of solidification, macrostructure and microstructure. Solidification contraction; gating and risering design calculations. Fluidity and its measurement. Mould-metal interface reactions.


References
7. Fundamentals of metal casting technology - P.C. Mukherjee, Oxford and IBH.
8. Mechanical Metallurgy, Dieter, Me Graw Hill, Kogakusha
9. Casting properties of metals and alloys - V. Korolkove.
10. Metal Casting-B.Ravi PHI
Productivity: Concept, Productivity improvement factors, Productivity appraisal, productivity analysis in the enterprise- The Kurosawa structural approach, Lawlor’s approach, Gold’s approach, Quick Productivity Appraisal approach (QPA), Inter-Firm Comparison (IFC).

Work Design: Work study, Method study, Work measurement, Standard output, Time study, Work sampling, Process analysis. Facility Layout: Principles of layout and facilities planning,

Material flow patterns, Material handling systems, Types of material handling equipment. Value Engineering: Fundamental concepts and applications of value engineering, Function Analysis System Technique.


References:
Note: Conduct any Three Experiments/Study in each Part

Part I: Welding:

1. Study of arc characteristics in simulated MMA welding; arc gap-arc voltage relationship; recording of voltage oscillograms and its study.
2. Study of heat flow and temperature distribution in welding
3. Study of characteristics of TIG/MIG welding
4. Ultrasonic/dye penetrant inspection or computer simulation of welding heat flow/analysis of arc-voltage pattern.

Part II: Casting:

1. Practice on CAD of gating and risering
2. Experiment to determine the effect of moulding variables in sand moulds
3. To determine the effect of mould additive on the properties of castings
4. To determine the characteristics of base sands.
INTRODUCTION: Overview of materials management - Objectives Functions Operating Cycle Value analysis Make or buy decisions.

MANAGEMENT OF PURCHASE: Purchasing policies and procedures Selection of sources of supply Vendor development Vendor evaluation and rating Methods of purchasing Imports Buyer Seller relationship Negotiations.

MANAGEMENT OF STORES AND LOGISTICS: Stores function Location Layout Stock taking Materials handling Transportation Insurance Codification Inventory pricing stores management safety warehousing Distribution linear programming Traveling Salesman problems Network analysis Logistics Management.

MATERIALS PLANNING: Forecasting Materials requirements planning Quantity Periodic Deterministic models Finite production.

ERP and JIT system.

REFERENCES
INDUSTRIAL AUTOMATION AND ROBOTICS

MTPE 032

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**Introduction to Automation:** Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation.

**High Volume Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines.

**Programmable Manufacturing Automation:** CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.

**Flexible Manufacturing Automation:** Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system.

**Assembly Automation:** Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems.

**Robotics:** Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic, Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission method-Rotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.

**Robot Applications:** Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.

**Books:**
1. Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Automation in Production Engineering Oates and Georgy Newness
4. Stochastic Models of Manufacturing Systems Buzacott & shanty Kumar Prentice Hall India
6. Robotics J.J. Craig Addison-Wesely
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.

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 -
Reliability Engineering: System reliability - series, parallel and mixed configuration, Block diagram, r-out-of-n structure, Solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability, Reliability – Cost trade off, Prediction and analysis, Problems.

Maintainability, Availability & Failure Analysis: Introduction, Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability and analysis. Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

Maintenance Planning and Replacement: Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement.

Maintenance Systems: Fixed time maintenance, Condition based maintenance, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terrotechnology.

Condition Monitoring: Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, concept of S/N ratio, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis.


Books:

3. Failure Diagnosis and Performance Monitoring L.F. Pau Marcel Dekker
7. Engineering Maintainability: How to Design for Reliability and Easy Maintenance B.S. Dhillon Prentice Hall of India


Dynamic Programming: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

Linear Programming: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.


REFERENCES:
1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia
Introduction and Components of TQM: Concept and Philosophy of TQM, Value and Quality assurance, Total Quality Control, Quality policy, Team-work and participation, Quality cost measurement, Quality Circle, Customer/Supplier integration, Education and training.


Reliability: Failure analysis, System reliability and redundancy.

TQM implementation: Steps in promoting and implementing TQM in manufacturing industries, Industrial Case studies.

ISO 9000 Quality Systems: Concepts, designation Standards, Quality system documentation, Quality manual, Quality procedures and work inspection.

Books:
1. Total Quality Control F. Ammandev Tata McGraw Hill
2. Total Quality Management Besterfield, et. al. Prentice Hall of India
3. Total Quality Management: Text and Cases B. Janakiraman & RK Gopal Prentice Hall of India
4. What is Total Quality Control? K. Ishikawa Prentice hall
5. Total Quality Management: The Route to Improving Performance J.S. Oakland Butterworth Heineman Oxford
Hybrid Machining Processes: Introduction, Needs of Hybridization of the machining process, Challenges and feasibility of process.

Chemical and Electro-chemical Type Material Removal Processes: Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing. Mechanical and Thermal interaction, Electrical Hybrid Machining Processes(ECDM, ECAM) , Electrical Discharge Machining with Ultrasonic Assistance (EDMUS),

Abrasive Hybrid Machining (AHM) Processes, Abrasive Electrochemical Machining processes, Electrochemical assistance of Ultrasonic Machining (USMEC), Abrasive Electrical Discharge Grinding

Laser Assisted Micromachining: Laser-assisted etching (LAE), Electrochemical Micromaching with Laser Assistance (ECML),

Methods of Metal Deposition: Thermal Spray Coating: Vapor Deposition Chemical Vapor Deposition

Books:
1. Advance Machining Processes V.K. Jain New Age
2. Modern Machining Processes P.C. Pandey New Age
3. Manufacturing Processes Degarmo -
COMPOSITE MATERIAL

**Introduction to Composite Materials**: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.

**Applications**: Automobile, Aircrafts, Missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

**Metal Matrix Composites**: Reinforcement materials, types, characteristics and selection of base metals. Need for production MMC’s and its application.

**Fabrication Process For MMC’s**: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

**Polymer matrix composites (PMC)**: Reinforcement materials, types, characteristics and selection base matrix, process design of PMC’s and applications.

**Processing of Thermoplastic composites**: Types of processing methods, solution, film, lamination, sandwich etc., Advantages and limitations of each method.

**Processing of Thermoses composites**: Hand layup method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding of thermoses, SMC and DMC, Advantages and limitations of each method.

**Mechanical testing of composites**, Tensile testing, Compressive testing, impact, bending strength. Basic concepts of fracture mechanism, Inter laminar shear testing, Fracture testing

**Thermal Methods**: Introduction, principle, theory, applications, advantages and limitations of Differential scanning calorimeter (DSC), thermo gravimetric analysis (TGA), Dynamic mechanical analysis (DMA), and thermo mechanical analyzer (TMA).

**Morphological studies**: Introduction, principle, theory, applications, advantages and limitations of - Optical microscopy, Scanning Electron Microscopy (SEM), TEM and AFM.

**Introduction**: Hybrid polymer composite, Green composites and Nano composites - fabrication, Characterization and applications.

**REFERENCE BOOKS**:
3. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker, Inc
FLEXIBLE MANUFACTURING SYSTEM

MTME 051

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3 0 0

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 Boncett Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India
6. Performance Modelling of Automated Manufacturing Systems Vishwanathan
MACHINE VISION

MTME 052

Image capture and digitization; Image transforms; Digital Fourier transform; Fast Fourier transform; Other transforms; Convolution; Image enhancement; Spatial methods; Frequency domain methods; Image restoration.

Geometric transformation; Image compression; error free and lossy compression; Edge detection; Hough transform; Region based segmentation; image feature / region representation and descriptors; Morphological operators.

Feature based matching; Baye’s classification; Low level vision; Introduction to stereopsis, Shape from shading; Optical flow; Rule based picture segmentation; tutorial exercise will emphasize development and evaluation of image algorithms.

Books:
2. Digital Image Processing Kenneth & Castleman Prentice Hall India
3. Digital Image Processing Gonzalez RC & P Wint Addision Wesley
4. Digital Image Processing & Analysis Chandra and Mazumdar Prentice Hall India

ADDITIVE MANUFACTURING AND TOOLING

MTME 053

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

RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seikis’ solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc., Power based rapid prototyping systems, selective Laser sintering, Soligen Diren’s shell production casting (DSPC), Fraunhofer’s multiphase jet solidification (MJS) and MIT’s 3D printing (3DP) etc.

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

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

Books:
2. Rapid Prototyping: Principles And Applications Kai Chua Chee World Scie
3. Rapid System Prototyping With Fpgas: Accelerating The Design Process R C Cofer Newnes
4. Rapid Prototyping of Digital Systems James O Hamblen Springer


Other Power Plants and Economics Of Power Plants: Geo thermal- OTEC- tidel- Pumped storage – Solar central receiver system Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

TEXT BOOKS: