

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY,
UTTAR PRADESH, LUCKNOW**



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)**

Semester -I

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTME 101	Simulation, Modelling & Analysis	3	0	0	3	20	10	70	--	--	100
2	MTPE 101	Advanced Manufacturing	3	0	0	3	20	10	70	--	--	100
3		Departmental Elective-I	3	0	0	3	20	10	70	--	--	100
4		Departmental Elective -II	3	0	0	3	20	10	70	--	--	100
5		Research Process & Methodology	3	0	0	3	20	10	70	--	--	100
6	MTME 151	Simulation Modeling & Analysis Lab	--	--	3	2	--	--	--	20	30	50
7	MTPE 151	Advanced Manufacturing Lab	--	--	2	1	--	--	--	20	30	50
		Total				18						600

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

Semester –II

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
	MTPE 201	Modern welding & Casting process	3	0	0	3	20	10	70	--	--	100
1	MTPE 202	Advanced Industrial Engineering	3	0	0	3	20	10	70	--	--	100
3		Departmental Elective-III	3	0	0	3	20	10	70	--	--	100
4		Departmental Elective-IV	3	0	0	3	20	10	70	--	--	100
5		Elective-V	3	0	0	3	20	10	70	--	--	100
6	MTPE 251	Modern welding & Casting process Lab	--	--	3	2	--	--	--	20	30	50
7	MTPE 252	Seminar-I	--	--	--	1	--	--	--	50	--	50
		Total				18						600

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

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTPE 352	Seminar-II	0	0	6	3	--	--	--	100	--	100
2	MTPE 351	Dissertation	0	0	30	15	--	--	--	200	300	500
		Total				18						600

Semester – IV

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTPE 451	Dissertation (Final)	0	0	36	18	--	--	--	200	400	600
		Total				18						600

SIMULATION, MODELLING & ANALYSIS

MTME 101

L T P
3 0 0

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 $G/G/1/\infty/\infty$ queues, server utilization in $G/G/C/\infty/\infty$ 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:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design & execution by Fishwick, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.

ADVANCED MANUFACTURING

MTPE 101

L T P

3 0 0

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

1. Metal Cutting Principles, M.C. Shaw, Oxford Clarendon Press
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. Boothroy and W.A. Knight, Marcel Dekker, NY
6. Fundamentals of Metal Casting, H. Loper and Rosenthal, Tata McGraw Hill
7. Metal forming-Fundamentals and Applications, T Altan, Soo-Ik-Oh and H.L. Gegel, American Society of Metals, Metal Park, 1983

SIMULATION, MODELLING & ANALYSIS LAB

MTME 151

L T P
0 0 3

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

L T P
0 0 2

1. Exercises on Manual CNC Part programming using G& M codes.
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
3	0	0

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:

1. Computer Graphics D Hearn & M P Baker Prentice Hall
2. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramanian Tata McGraw-Hill
3. Mathematical Elements for Comp. Graphics D F Rogers and J A Adams McGraw-Hill International
4. Computer Aided Engineering & Design Jim Browne New ATC International
5. The Engineering Database D.N. Chorafas and S.J. Legg Butterworths
6. Principles of CAD J Rooney & P Steadman Longman Higher Education
7. CAD/CAM H P Groover and E W Zimmers Prentice Hall
8. Computer Integrated Design and Manufacture D Bedworth, M Henderson & P Wolfe MacGraw Hill Inc.

MACHINE TOOL DESIGN

MTPE 011

L	T	P
3	0	0

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

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 Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws.

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

Books:

1. Machine Tool Design, N.K. Mehta, Tata McGraw Hill.
2. Machine Tool design Handbook, CMTI, Bangaluru.

METROLOGY AND COMPUTER AIDED INSPECTION

MTPE 012

L	T	P
3	0	0

Metrology and Techniques: Standards in metrology, definitions, Traceability, Characteristics Length & Angular measurements-Review of standard instruments, GD and tolerance procedure-Review of dimension & form tolerance and methods of measurement, Tolerance analysis, Surface metrology-Instruments, Methods and new approaches.

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
3. Sensors and Control systems in Manufacturing Sabne Soloman McGraw Hill Book
4. Measurement systems: Applications & Design Doebelin International Student Edition
5. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India
6. Interface Technology for Computer Controlled Manufacturing processes Ulrich-Rembold, Armbruster and Ulzmann Marcel Dekker Publications, NY
7. Optoelectronics J. Watson Van Nostrand Rein Hold (UK) Company

MAINTENANCE ENGINEERING

MTPE 013

L	T	P
3	0	0

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
3. Mishra, R. C. and Pathak, K., Maintenance Engineering and Management, Second Edition, Prentice Hall of India, New Delhi, 2004.
2. Dhillon B.S., Engineering Maintenance: A Modern Approach, Taylor & Francis Group, 2002.
3. Mobley R. K., An Introduction to Predictive Maintenance, Second Edition, Butterworth-Heinemann, 2002
4. Scheffer C. and Girdhar P., Machinery Vibration Analysis & Predictive Maintenance, IDC Technologies, 2004.
5. Taylor J. L., The Vibration Analysis Handbook, Vibration Consultants, 2003.
6. Baldev Raj, Jayakumar T. and Thavasimuthu M., Practical Non-destructive Testing, Narosa, 2002

DEPARTMENT ELECTIVE II
RAPID PROTOTYPING & TOOLING

MTPE 021

L T P
3 0 0

INTRODUCTION

Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission. The cost and effects of design changes during conceptual modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and its role in modern manufacturing mechanical design.

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 through quick tooling.

RP INTERFACING WITH MANUFACTURING PROCESSES

Investment Casting, Vacuum Casting, Laser Additive Manufacturing. Rapid manufacturing processes like - Vacuum Casting Processes via RP Processes, Electroplated Prototypes, RTV Silicon Moulds, Direct Inkjet SL Tooling, Electron Beam Melting , 3D scanning, 3D digitizing and Data fitting,. High speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies.

REFERENCES

1. Chua Chee Kai, Leong Kah Fai, Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2. Ian Gibson, David W Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006. Burns. M, "Automated Fabrication", PHI, 1993.
4. Chua. C.K, "Rapid Prototyping", Wiley, 1997.
5. Jacobs P.F., "Stereolithography and other Rapid Prototyping and Manufacturing Technologies", ASME, 1996.
6. Pham D.T. and Dimov S.S., "Rapid Manufacturing; the technologies and application of RPT and Rapid tooling", Springer, London 2001.

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).

Estimation Theory: Statistical Inference, Random sampling, Properties of Estimators, Sampling distribution, Sampling distribution of means, variance and proportion, Introduction to confidence intervals.

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:

1. Applied statistics and Probability for Engineers Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5
2. Statistics for Management - Richard I Levin, David S Rubin, 6th Edn, Prentice Hall India, ISBN-81-203-0893-X

SUPPLY CHAIN MANAGEMENT

MTPE 023

L T P
3 0 0

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- Role of network Design in Supply Chain, Framework for network Decisions.

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 co-ordination - 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 – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

Books:

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, Strategy, Planning, and Operation”, Pearson Education
2. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury
3. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management”, PHI,
4. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics” PHI
5. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press

INDUSTRIAL TRIBOLOGY

MTPE 024

L T P
3 0 0

SURFACES AND FRICTION: Topography of engineering surfaces, contact between surfaces, sources of sliding Friction Energy dissipation mechanisms Friction Characteristics of metals, Friction of non metals. Friction of lamellar solids friction of Ceramic materials and polymers Rolling Friction, Source of Rolling Friction, Stick slip motion, Measurement of Friction.

WEAR: Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

LUBRICANTS AND LUBRICATION: Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

FILM LUBRICATION THEORY: Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

BOOKS:

1. A. Harnoy “ Bearing Design in Machinery “Marcel Dekker Inc, New York
2. M.M.Khonsari & E.R.Booser, “ Applied Tribology”, John Willey & Sons, New York
3. E.P.Bowden and Tabor.D., " Friction and Lubrication ", Heinemann Educational Books Ltd.,
4. A.Cameron, “Basic Lubrication theory ", Longman, U.K..
5. M.J.Neale (Editor), “Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K.

MODERN WELDING & CASTING PROCESS

MTPE 201

L T P

3 0 0

Friction welding: Concepts, types and applications. Friction stir welding: Metal flow phenomena, tools, process variables and applications and induction pressure welding: Process characteristics and applications.

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

Welding Metallurgy: Heat flow - temperature distribution-cooling rates - influence of heat input, joint geometry, plate thickness, preheat, significance of thermal severity number.

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

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

Cast Metals and Alloys, Family of cast irons, Melting and casting technology; Inoculation. Technology of steel and non-ferrous cast metals. Gases in metals. Melting furnaces and refractories.

Casting defects Inspection, diagnosis and rectification. Mechanization and Automation(Use of robots) of Foundries,. Casting Design, Wear net shape castings, Numerical modeling applied to castings. Pollution Control, Energy and waste management in foundries.

References

1. Schwartz M.,, Materials and Applications - Metal Joining Manual□, McGraw-Hill, 1979
2. Nadkarni S.V., „Modern Arc Welding Technology□, Oxford IBH Publishers, 1996
3. Christopher Davis, „Laser Welding - A Practical Guide□, Jaico Publishing House, 1994
4. Parmar R S, Welding Engineering and Technology, Khanna Publishers, 1997
5. Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing, ASM,2007
6. ScropeKalpakjian, „Manufacturing processes for Engineering Materials”, Addison, Wesley, 1997.
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

ADVANCE INDUSTRIAL ENGINEERING

MTPE 202

L T P

3 0 0

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.

Systems Engineering: Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.

References:

1. Prokopenko, J. "Productivity Management, A Practical Handbook", International Labour Organisation, 1992.
2. ILO, "Introduction to Work Study", George Kanaway, 4th revised edition, Universal Book Corporation 2007.
3. Apple, J.M. "Plant layout and materials handling", Ronald Press Company, Newyork, 1977.
4. Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.

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.

DEPARTMENT ELECTIVE III

MATERIALS MANAGEMENT

MTPE 031

L T P

3 0 0

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

1. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
2. Guptha P.K. and Heera, Operations Research, Suttan Chand & Sons, 2007.
3. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 2006.
4. G. Reghuram, N. Rangaraj, Logistics and supply chain management - cases and concepts, Macmillan India Ltd., 2006.
5. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management Eswar Press 2005.
6. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 2005.

INDUSTRIAL AUTOMATION AND ROBOTICS

MTPE 032

L	T	P
3	0	0

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
5. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
6. Robotics J.J. Craig Addison-Wesely
7. Robot Engineering: An Integrated Approach R.D. Klafter, t.a. Chmielewski and M. Negin Prentice

INDUSTRIAL DESIGN & ERGONOMICS

MTPE 033

L	T	P
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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

MTPE 034

L	T	P
3	0	0

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.

Safety Aspects: Importance of safety, Factors affecting safety, Safety aspects of site and plant, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.

Books:

1. Concepts in Reliability Engineering L.S. Srinath Affiliated East West Press
2. Maintainability and Reliability Handbook Editors: Ireson W.A. and C.F. Coombs McGraw Hill Inc.
3. Failure Diagnosis and Performance Monitoring L.F. Pau Marcel Dekker
4. Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd.
5. Management of Industrial Maintenance Kelly and M.J. Harris Butterworth and Co.
6. Maintenance, Replacement and Reliability A.K.S. Jardine Pitman Publishing
7. Engineering Maintainability: How to Design for Reliability and Easy Maintenance B.S. Dhillon Prentice Hall of India

DEPARTMENTAL ELECTIVE-IV

OPTIMIZATION TECHNIQUES & DESIGN OF EXPERIMENTS

MTME 041

L T P
3 0 0

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

Multi Variable Non-Linear Unconstrained Optimization: Direct search method – Univariant Method – pattern search methods – Powell’s – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. Variable metric method.

Geometric Programming: Polynomials – arithmetic – geometric inequality – unconstrained G.P - constrained G.P

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.

Simulation: Introduction – Types – Steps – application – inventory – queuing – thermal system.

Integer Programming: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

Stochastic Programming: Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, covariance, joint probability distribution – stochastic linear, dynamic programming.

REFERENCES:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia
7. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia.

TOTAL QUALITY MANAGEMENT

MTPE 041

L T P
3 0 0

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.

Tools and Techniques of TQM: Statistical method in quality control, Process control chart, Acceptance sampling plan, Statistical Productivity control (SPC).

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
6. Out of Crisis W.E Dming Centre of Advance Engineering Study, Cambridge

HYBRID MANUFACTURING

MTPE 042

L T P
3 0 0

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 Micromachining 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 -
4. Manufacturing Processes Kalpakjian Tata McGraw-Hill International
5. Amitabh Gosh and A.K. Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., 1985

COMPOSITE MATERIAL

MTPE 043

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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:

1. Composite Science and Engineering, K. K. Chawla Springer Verlag 1998.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.
3. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker, Inc
4. Mechanics of Composite Materials, Robert M. Jones, McGraw Hill Kogakusha Ltd. 1998

ELECTIVE-V

FLEXIBLE MANUFACTURING SYSTEM

MTME 051

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

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

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

- FMS planning problems: Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems.
- Operational & Control problems: Part scheduling, Machines robots & AGVS, Process monitoring & control.
- FMS Implementation: Objectives, acceptance testing, Performance goals and expectation maintenance concerns.

Books:

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

MACHINE VISION

MTME 052

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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:

1. Image Processing, Analysis and Machine Vision Milan Sanka, Vaclav Hlavac and Roger Boyle Vikas Publishing
2. Digital Image Processing Kenneth & Castleman Prentice Hall India
3. Digital Image Processing Gonzalez RC & P Wint Addison Wesley
4. Digital Image Processing & Analysis Chandra and Mazumdar Prentice Hall India

ADDITIVE MANUFACTURING AND TOOLING

MTME 053

L	T	P
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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:

1. Rapid Prototyping Of Digital Systems: A Tutorial Approach Hamblen James O Kluwer Aca
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

ADVANCED POWER PLANT ENGINEERING

MTTE 054

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Introduction to Power Plants and Boilers : Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection, Load duration Curves Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidised Bed Boilers.

Steam Power Plant: Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers.

Nuclear and Hydel Power Plants: Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor, Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments.

Diesel And Gas Turbine Power Plant: Types of diesel plants, components , Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles-reheating – Regeneration and intercooling – combines cycle.

Other Power Plants and Economics Of Power Plants: Geo thermal- OTEC- tidal- 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:

1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai, 2001
2. Nag P.K ,”Power Plant Engineering”. Third edition Tata McGraw- Hill ,2007