

MEWAR UNIVERSITY CHITTORGARH (RAJASTHAN)

Faculty of Engineering and Technology

Course Scheme and Syllabus

of

Master of Technology

Manufacturing System Engineering

Effective from 2012-13

MEWAR UNIVERSITY CHITTORGARH (RAJASTHAN)

Faculty of Engineering and Technology

Two – Year M Tech: MSE

Eligibility for Admission: A candidate for being eligible for admission to the Master of Technology in *MSE* in the faculty of engineering and technology should have passed B.Sc. (Engg.)/ B.Tech/ B.E. / or any other equivalent degree in the relevant discipline / branch from any recognized Indian or foreign University.

A candidate should have at least 55% marks or equivalent CGPA in the qualifying examination (50% marks or equivalent CGPA for Scheduled Caste/Scheduled Tribes Candidates) on the basis of which the admission is being sought.

Overview of the Programme: The normal duration of programme shall be four Semesters The complete programme comprises of 12 theory courses (10 Core and 02 elective) and 02 Labs also dissertation with one international paper published by the student with the help of chosen suitable supervisor according to the norms of the university. Student has to obtain at least D Grade to pass the examination (both internal and external examination separately) for all the courses specified in the scheme of the programme. The degree will be awarded on the basis of cumulative marks obtained in all the four semesters and the division obtained will be as under:

MEWAR UNIVERSITY CHITTORGARH (RAJASTHAN)

Scheme of Two – Year M Tech: MSE

First Semester

Course Code	Course Title	Contact Hours Per Week		Credit Hours	Internal Assessment/Examination		External Examination /Viva-Voce	Total Marks
		L	P		Assignments /Lab Record	Teacher's Evaluation		
MSE -411	Computer Integrated Manufacturing Systems	4	-	4	30	10	60	100
MSE -412	Production Planning and Control	4	-	4	30	10	60	100
MSE -413	Advanced Manufacturing Processes	4	-	4	30	10	60	100
MSE -414	Industrial Robotics	4	-	4	30	10	60	100
MSE - 511/512/513	Elective – I	4	-	4	30	10	60	100
MSE -415	Computer Integrated Manufacturing Systems (CIMS) Lab		2	2	10	10	30	50
Total Semester Credits=				22	Total Semester Marks=			550

Second Semester

Course Code	Course Title	Contact Hours Per Week		Credit Hours	Internal Assessment/Examination		External Examination /Viva-Voce	Total Marks
		L	P		Assignments /Lab Record	Teacher's Evaluation		
MSE -421	Product Design and Development	4	-	4	30	10	60	100
MSE -422	Mechatronics	4	-	4	30	10	60	100
MSE -423	Maintenance and Reliability Engineering	4	-	4	30	10	60	100
MSE -424	Materials Management	4	-	4	30	10	60	100
MSE - 521/522/523	Elective – II	4	-	4	30	10	60	100
MSE -425	Product Design and Development (PDD) Lab		2	2	10	10	30	50
Total Semester Credits=				22	Total Semester Marks=			550

Third Semester

Course Code	Course Title	Contact Hours Per Week		Credit Hours	Internal Assessment/Examination		External Examination /Viva-Voce	Total Marks
		L	P		Assignments /Lab Record	Teacher's Evaluation		
MSE -431	Total Quality Management	4	-	4	30	10	60	100
MSE -432	Design of Experiments & Research Methodology	4	-	4	30	10	60	100
MSE -433	Seminar		6	6	-	-	150	150
MSE -434	Minor Project		8	8	-	-	200	200
Total Semester Credits=				22	Total Semester Marks=			550

Fourth Semester

Course Code	Course Title	Contact Hours Per Week		Credit Hours	Internal Assessment/Examination		External Examination /Viva-Voce	Total Marks
		L	P		Report	Teacher's Evaluation		
MSE -441	Dissertation	-	16	16	50	-	350	400
Total Semester Credits=				16	Total Semester Marks=			400

LIST OF ELECTIVES

ELECTIVE – I

- 1 MSE -511- Modeling and Simulation
2. MSE -512- Numerical Analysis and Optimization
3. MSE -513- Industrial Inspection and Non Destructive Testing

ELECTIVE – II

1. MSE -521- Productivity Management
2. MSE -522- Supply Chain and Logistics
3. MSE -523 – Network Analysis and Project Management

Internal Assessment/Examination: The internal evaluation for all theory courses (40% of the total marks) will be based on the evaluation of **two assignments** provided during the semester and assessment of the teacher concerned. Similarly, the internal evaluation for all Lab courses (50% of the total marks) will be based on the evaluation of lab record and assessment of the teacher concerned.

External Examination/Viva -voce: For all the theory courses, there will be **08 (Eight)** questions to be set by the external paper setter (nominated /approved by the competent authority) out of which the candidate will have to attempt **05 (Five)** questions all carrying equal marks. Duration of each external examination will be three hours. Similarly, the external evaluation for all Lab courses (50% of the total marks) will be based on the evaluation/viva-voce conducted by an external examiner (from the relevant field) nominated/approved by the competent authority.

Submission and Evaluation of Dissertation:

a) A dissertation supervisor (s) having at least post- graduate qualification, from industry/research organization shall be assigned to the student approved by the competent authority. *In no case, the candidate can have more than two dissertation supervisors.*

b) The final dissertation external examination in 4th semester shall be taken by a panel of examiners comprising of concerned Supervisor (s), one external examiner (from the relevant field) nominated/approved by the competent authority. Hard copies of dissertation, one for each supervisor (s), examiner and the university/ department, are required to be submitted by the student before the final dissertation external examination. The candidate shall appear before the examining committee for oral examination and presentation on the scheduled date.

MSE -411 - Computer Integrated Manufacturing Systems

Introduction: CAD/CAM defined; Design activities for manufacturing systems; Planning and control activities for manufacturing system; Manufacturing control; Types of production –low; Medium and high production; Reasons of automation; Automation strategy.

Process Planning and Cellular Manufacturing: Introduction; Manual process planning; Computer aided process planning – variant; generative; Decision logic- decision tables; decision trees; Introduction to Artificial intelligence. Part families; Parts classifications and coding; Production flow Analysis; Cellular Manufacturing- composite part concept; Machine cell design; Applications of group technology; Grouping parts and machines by Rank order clustering technique; Arranging machines in a G.T. cell.

Automated Material Handling and Flexible Manufacturing Systems: Material handling function; Types of material handling equipments; Conveyor systems; Types of conveyors; automated guided vehicle system; applications; Components of a FMS; Types; Where to apply FMS technology; FMS workstation; Planning FMS.

CNC Basics and Part Programming: Conventional Numerical Control: Basic components of NC system; NC motion control; Applications of NC; Computer Numerical control; advantages of CNC; Functions of CNC; Direct Numerical Control; Components of a DNC system; Functions & advantages of DNC; NC part programming: Introduction; Punched tapes in NC; Tape coding and format; NC words; Manual part programming; Computer assisted part programming; The APT language; Types of statements.

Computer Integrated Manufacturing Systems: Introduction; Types of manufacturing system; Machine tools and related equipments; Material handling system; Computer control system; Functions of a computer in CIMS; Benefits of CIMS.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Automation; Productions systems and Computer-Integrated Manufacturing by M.P. Groover; Prentice Hall
- Approach to computer integrated design and manufacturing: Nanua Singh (John Wiley and sons)
- Computer Aided Manufacturing by Chang; Wang & WySK
- Numerical Control and Computer Aided Manufacturing by Kubdra; Rao and Tiwari; Tata Mc Graw Hill.
- Ranky P.G. Computer Integrated Manufacturing; Prentice Hall

MSE -412- Production Planning and Control

Introduction to Production System: Generalized model of production systems; types of production systems and its impact on system design; Lifecycle concepts in production systems.

Forecasting: Requirements of forecasting for operations; Extrapolative methods; Moving average; exponential smoothing; causal methods; Regression analysis; Qualitative methods: Delphi method; Market surveys; Accuracy of forecasting methods.

Facility Location Planning: Factors affecting; Factor and location ratings; Break even analysis for facility location planning; Transportation model in plant location; Centre of gravity method; Ardalan method for location planning of service industries; Case studies.

Capacity and Capacity planning: Decision tree analysis; facility layout planning; Assignment model in layout planning; cellular layouts; load distance analysis in process layouts; Role of templates in plant layout.

Aggregate Planning: Nature of aggregate planning; decision process for aggregate planning: graphic methods; mathematical optimization methods; introduction to aggregate planning under uncertainty and for non-manufacturing systems.

MRP and JIT Production systems: Bill of materials; demand dependence; forecasting versus requirements; inventory planning systems: lot size decision policies; capacity requirement planning; MRP benefits; manufacturing resource planning; optimized production technology; Just-in-time manufacturing; push versus pull systems; MRP versus JIT system; requirements for implementing JIT; JIT production process; benefits and evaluation of JIT production; Hybrid MRP-JIT production system.

Operations Scheduling: Single processor scheduling; flow shop scheduling; general job shop scheduling; scheduling for batch shops; scheduling for high volume continuous system; scheduling for service systems.

Inventory Control: Definition; classification; objectives of inventory control; functions; economic order quantity various inventory models; Numericals on inventory control. Inventory carrying costs; factors affecting inventory costs; V.E.D. analysis; S-D-E analysis; F-S-N analysis H-M-L analysis and ABC analysis; Safety stocks and their objectives; Service levels.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Modern Production/Operations Management; Buffa; E.S. and Sarin; R. K.; John Wiley & Sons.
- Production and Operations management by Kanishka Bedi; Oxford.
- Production and Operations Management- Concepts; Models and Behavior; Adam Jr.; Everette E. and Ebert; Ronald J.; Prentice-Hall of India.
- Production Planning and control by Samuel Eilon
- Production Management by Buffa.
- Production Planning control & Integration by Daniel Sipper & Robert Bulfin; TMH.
- Production & Inventory control by Wallace Hopp and Mark Spearman.

MSE -413- Advanced Manufacturing Processes

Non Conventional Machining Processes: Introduction and need of Non-conventional machining Processes; Principle; theory of material removal; Process Parameters; Advantages; Limitation and applications of ultrasonic machining; Electro discharge machining; Laser beam machining & Electro chemical Machining.

Plastic Materials & Processes: Different thermosetting and thermoplastic compounds; compression molding; Transfer molding; Injection Molding Film and Sheet forming; Thermo forming; Use of reinforced & laminated plastics; Applications of different processes.

Rapid Prototyping: Product development cycle and importance of prototyping; Types of prototypes; Principles and advantages and different types of generative manufacturing processes; viz; Stereolithography; FDM; SLS etc.; Factors concerning to RP; Consideration for adoptions; Advantages; Accuracy; Economic considerations.

Powder Metallurgy: Important characteristics and methods of producing powders; Different techniques to form the shape viz. pressing; Extruding; Isostatic molding; Fibre metal process; Sintering Hot pressing.

Electronic Fabrication: Fabrication of wafers and micro electronic circuits Machines: component Sequencing; Insertion; PCB Staffing wave soldering.

Special Processes: Abrasive floor machining; Magnetic abrasive finishing; Wire EDM; Electro Chemical Grinding; Honing; Lapping and Super finishing; Principle Elements; Process; Advantages; Applications & surface preparation etc. of physical vapor deposition; chemical vapor deposition; Electroless coating and thermal metal spraying.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Advanced Manufacturing Processes – G.F. Benidict; Marcel Deker publisher.
- Non-conventional Machining Processes – P.K. Mishra; Narosa Publication.
- Manufacturing Processes – B.H. Amstee; Philip F. Ostwald & Myron L. Bengeman; John Wiley & Sons; eighth edition.
- Manufacturing Analysis – N. Cook.

MSE -414 Industrial Robotics

Introduction to Robotics: Evolution of Robots and Robotics; Laws of Robotics; Progressive advancement in Robots; Robot anatomy; Human Arm Characteristics; Design and Control issue; Manipulation and Control; Programming Robots.

Coordinate Frames Mapping and Transforms: Coordinate Frames; Description of objects in space; Transformation of Vectors; Inverting a Homogeneous Transform; Fundamental Rotation matrices; Robot End-Effector; Mechanical; Vacuum; Magnetic grippers and specialized tools; considerations in gripper's selection and design.

Kinematic Model and Inverse Kinematics: Mechanical structure and notations; Kinematic modeling of the manipulator; Denavit Hartenberg Notation; Manipulator Transformation Matrix; Manipulator workspace; Solvability of Inverse kinematics model; Solution techniques; Closed form solution.

Manipulator Differential Motion and Dynamic Modeling : Linear and angular velocity of a rigid body; relationship between transformation matrix and angular velocity; manipulator Jacobian; Jacobian Inverse; Jacobian Singularities; Static Analysis; Lagrangian Mechanics; Two Degree of Freedom manipulator-Dynamic Model; Lagrange-Euler formulation Newton-Euler formulation; Inverse Dynamics.

Control of Manipulators: Open and Close loop control; linear control schemes; linear second order SISO model of a manipulator joint. Joint Actuators; Computed Torque Control; force control of Robotics; Manipulators; Hybrid position/force control; Impedance Force/Torque Control.

Robotic Sensors: Sensors in Robotics; classification of Robotic sensors; kinds of sensors used in robotics-Acoustic sensors optic; Pneumatic; force/Torque sensors.

Robot Languages and Programming and Applications: The Textual Robot Languages; Generations of Robot Programming Languages; Methods of Robot Programming; Industrial Applications-Material Handling; Processing Applications; Assembly applications; inspection application; Principles for Robot application and application planning; Robot safety; Non-Industrial Application.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Industrial Robotics by M.P. Groover; McGraw Hill
- Industrial Robotics and Automation by S.R. Deb Tata McGraw Hill

- Fundamental of Robotics by Robert J. Shilling Prentice Hall of India.
- Robotics and Industrial automation By R.K. Rajput S Chand and Co.
- Introduction to Robotics Analysis; systems and applications by Saeed Nikku; Pearson Education

MSE -511- Modeling and Simulation

Introduction: Nature of simulation; Advantages and disadvantages; Areas of application; System and system environment; Component of a system; Discrete and continuous system; Types of model; Steps in a simulation study; Simulation examples.

General Principles of Simulation: Concepts in discrete-event simulation; Event-scheduling/time advance algorithm; Manual simulation using event scheduling; simulation softwares; classification; Desirable software features and General purpose simulation packages.

Statistical Models In Simulation: Terminology; Useful statistical models: discrete distributions; Continuous distributions; Poisson's process.

Random Number and Random-Variate Generation: Properties of random numbers; Generation of Pseudo-random numbers; Techniques of generating random numbers; Inverse transform technique; Acceptance-rejection technique; Direct transformation of generating random numbers.

Modeling; Verification and Validation: Data collection; Identifying the distribution with data: histograms; Selecting the family of distributions; Parameter estimation; Selecting input models without data; Model building; Verification of simulation models; Calibration and validation of models.

Output Analysis: Types of simulation with respect to output analysis; Stochastic nature of output data; Measures of performance and their estimation; Output analysis for terminating simulation and steady state simulation; Case studies of simulation of manufacturing systems.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Simulation Modeling and Analysis; Averal M. Law and W. David Kelton; McGraw Hill.
- Discrete-Event System Simulation; J. Banks; J. S. Carson & B. L. Nelson; Prentice Hall.
- Theory of Modeling & Simulation; B.P. Zeigler; Taq gon Kim and Herbert Praehofer; Academic Press.
- Handbook of Simulation: Principles; Methodology; Advances; Applications & Practice; Jerry Banks.
- Discrete Systems Simulation; Khoshnevis.

MSE -512- Numerical Analysis and Optimization

System of linear algebraic equations and Eigen value problems: Elimination method; Gauss method; Gauss-Jordan method; Eigen values and Eigen vectors; bounds on Eigen values; Jacobi methods for symmetric matrices; Householder's method for symmetric matrices.

Interpolation and approximation: interpolation problem; linear interpolation; Lagrange interpolation; Newton interpolation; interpolation with equidistant points; spline interpolation; least square approximation.

Numerical differentiation and integration: Differentiation of continuous functions; forward difference quotient; central difference quotient; error analysis; derivatives from differences table; higher-order derivatives; Richardson extrapolation techniques; Newton-Cotes method; trapezoidal rule; Simpson's rule; higher order rules; Romberg integration; Numerical solution of ordinary differential equations; Taylor's series method; Euler and modified Euler method; Runge-Kutta methods; Milne's method; Adam-Bashforth-Moulton method.

Optimization: Basic concept of optimization; classification of optimization; optimization techniques; engineering applications of optimization; Classical optimization techniques; unconstrained optimization single-variable optimization; multivariable optimization; multivariable optimization with equality constraints; solution by direct search method; solution by Lagrange-multipliers method; multivariable optimization with inequality constraints; Kuhn-Tucker conditions.

Non-linear optimization: general non-linear programming problem; classification of non-linear programming problem; unconstrained optimization techniques: direct search method; gradient method.

Dynamic programming: Multistage decision process: representation of a multistage decision process; conversion of nonserial system to a serial system; types of multistage decision problems; principle of optimality; computational procedure in dynamic programming; linear programming as a case of dynamic programming; applications of dynamic programming.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Engineering Optimization; by SS Rao; New Age International Ltd.
- Numerical Method; by E. Balaguruswamy; Tata McGraw Hill.
- Numerical methods for Scientific & Engineering Computation; by MK Jain; SRK Iyengar

- Operations Research; by Taha H Hamidi; Prentice Hall of India; New Delhi
- Operations Research; by Philips; Revindran; Solgebey; Wiley ISE
- Applied Numerical Analysis; by Curtis F Gerald & Patrick G Whealley; Pearson Education Ltd.

MSE -513- - Industrial Inspection and Non Destructive Testing

Magnetic Particle Testing: Magnets and magnetic materials; Magnetization and its methods; Magnetic fields; Detection media; Application of magnetic particles testing; Testing equipments machines and accessories; Inspection and interpretation; Application in industry.

Liquid Penetrant Testing: Principle of liquid penetrant testing; Methods; Their advantages and disadvantages; Equipment used; Penetrant materials; Testing procedures; Inspection and interpretation; Applications in industry.

Electromagnetic Methods:; Eddy current theory; Magnetic flux leakage theory; Eddy current sensing probes; Flux leakage sensing probes; Principle of electromagnetic testing; Mathematical analysis; Flaw detection in conductors; Various types of eddy current techniques used and advantages of various electromagnetic methods for crack detection etc.

Radiography: Principle of radiography; Types of radiography; Equipments for neutron radiography; X-ray radiography; Equipments for X-ray radiography; Advantages and applications of fluoroscopy and photo fluoroscopy.

Ultrasonic Methods: Physical principle of sound; Ultrasonic waves propagation and their characteristics; Generation of ultrasonic waves; Ultrasonic transducers; Ultrasonic testing equipment; Ultrasonic flaw detector; Fundamental of ultrasonic testing; Contact and immersion testing; Merits and demerits; Defect location in angle beam testing; Immersion testing techniques; Ultrasonic signal display; Detection of defects and their characterization; DGS methods; Time of flight diffraction method (TOFD).

Hardness Testing: Brinell hardness testing; Rockwell hardness tests; Micro hardness testing; Vicker hardness testing; Theory behind hardness testing methods.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Malhotra; “*Handbook on Non-destructive Testing of Concrete*”; Publisher: CRC Press; 2002.
- Mix; Paul E; “*Introduction to Nondestructive Testing: A Training Guide*”; John Wiley and Sons Ltd; 1999.
- Blitz and Jack; “*Electrical and Magnetic Methods of Nondestructive Testing*”; Institute of Physics Publishing; 2001.
- Henrique L M; “*Non Destructive Testing and Evaluation for Manufacturing and Construction*”; Hemisphere Publishers; New York; 2001.

MSE -415 Computer Integrated Manufacturing Systems (CIMS) Lab

LIST OF EXPERIMENTS

1. To study general features of Machining Center.
2. To prepare the CNC part program for machining a prismatic component on CNC machining centre.
3. To study general features of a CNC Turning center.
4. To prepare the CNC part program for machining of a cylindrical centre.
5. Study and Applications of Robotic system in automated storage and Retrieval system.
6. Application and Control of robotic system in Flexible manufacturing System.
7. To study general features of Automated Guided Vehicle.
8. To study general configuration of CMM and its application in a CIM system.
9. Machine Vision and Quality Control in a CIM system.
10. Study and Applications of Conveyer system in CIM system.
11. Study and applications of CIM software.
12. To study the hardware of a retrofit and CNC machine tools.
13. To convert a manual machine tool/system into an automatic machine tool/system.
14. To write a programme with G code and M code for a component.
15. To design an automated part feeder.

Note: The student is required to perform at least TEN Experiments out of the above list.

MSE -421 Product Design and Development

Introduction: Definitions; What is industrial design; Assessing the need for ID; Product and process cycles; Ethics; Societal and economic considerations in engineering; Technological forecasting; Technological innovation and design process. Importance of product design; Considerations of a good design; Detailed descriptions of design process; Role of marketing; Organization for design and role of computers in design; Product development process.

Concept generation & concept selection: Concept generation process; Basic methods; Information gathering and brain storming; Conventional aids; brain ball; C-Sketch/6-3-5 method: advanced methods: Direct search; Systematic search with physical principles and classifying schemes: Morphological analysis; Factors that determine effective decision making; Estimating technical feasibility; Concept selection process- basic and advanced methods.

Product Planning: The product planning process; Identifying customer needs; product specification; standardization; Concept of generation; Concept of selection; Concept of Testing; Product Architecture; Industrial Design: Assessing the need for Industrial design; Impact of Industrial Design; Industrial design process; Management of the Industrial Design; Assessing the quality of Industrial design.

Product Modeling: Model preparation & selection method; Construction of product models; Physical models/ prototypes; Types of prototypes; Uses of prototypes; Rapid prototyping techniques; Dimensional analysis; Similitude and scale models; Geometrical modeling on the computer; Computer visualization.

Design for Robustness: Quality design theory; General robust design model; Robust design model construction; Taguchi's method; Noise variable matrix; Design variable matrix; Experimental matrix; Signal to noise ratio; Selection of target design; Optimization methods; Evaluation considerations in optimization; Design optimization.

Design for Manufacturing: Estimation of manufacturing costs; Reducing the cost of components and assemblies; Design for assembly; Design for piece part production; Cost driver modeling and manufacturing cost analysis; Human factors in design; anthropometry; ergonomic considerations.

Product Development Economics: Product Development Economics; Elements of Economic analysis; Cost analysis; Cost reduction and value analysis techniques; Patents and Intellectual property.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Ulrich Karl T and Eppinger Steven D; “*Product design and Development*”; McGraw-Hill Inc; 2000.
- Trott Paul; “*Innovation Management and New Product Development*”; Financial Times Professional Ltd; London; 2000.
- Otto Kelvin and Wood Kristen; “*Product Design*”; Pearson Education; Delhi; 2001.
- Bruce M and Cooper Rachel; “*Creative Product Design*”; John Wiley & Sons Ltd.; New York; 2000
- R. Paneerselvam; “*Engineering Economics*”; Prentice Hall of India (PHI); New Delhi; 2004.
- Hartman; “*Engineering Economy and Decision Making Process*”; Pearson Education Asia; 2007.

MSE -422- Mechatronics

Introduction: Scope; Evolution; Measurement Systems; Control Systems; Open and Closed loop systems and its various elements; Sensor and transducers; Performance terminology; Displacement; Position; Proximity sensors; Force measurement; Flow measurement.

Electrical components; Electronic devices and Digital technology: Basics of electrical technology such as resistors; inductors; capacitors; impedance; semiconductor devices; diodes and transistors such as bipolar; junction field; V-I characteristics; Number System; Boolean algebra; Logic Functions; Karnaugh Maps; Timing Diagrams; Flip-Flops; Applications.

Signal Conditioning: Basic definition; multi domain representation; representation and analysis of periodic/non periodic analog signal; signal conditioning process; types of amplifiers; Operational amplifier; inverting; Non-inverting Summing amplifiers; comparators; amplifier errors; temperature compensation; A/D conversion; D/A conversion.

Actuation Systems: Pneumatic and hydraulic systems; Directional control valves; pressure control valves; cylinders; process control valves; rotary actuators. Mechanical actuation system involving; linkages; Cams; Gears; Belt and chain drives etc.; Electrical Actuation systems; mechanical switches; Stepper motor; AC and DC motors.

Control Systems: Basic structure of a microprocessors and micro controllers; Architecture; Pin Configuration; Basic structure of PLC's; Input/Output Processing; Programming; Prediction of behavior of systems with proportional (P); Integration (I); derivatives (D); PI; PD and PID controllers; Selection of a PLC; Case studies of Mechatronics systems;

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Bolton W.; "Mechatronics"; Pearson Education.
- Histan Michael B. and Alciatore David G.; "Introduction to Mechatronics and Measurement Systems"; McGraw Hill International Editions; 2003.
- Nitaigour Premchand Mahalik; "Mechatronics Principles; Concepts and Applications"; Tata McGraw-Hill publishing company Ltd; 2003.
- Introduction to Mechatronics by Alciatore and Michael B. Histan; TMH.
- Mechatronics; systems design by Devdas; Thomson Learning.

MSE -423 Maintenance and Reliability Engineering

Introduction to Maintenance Systems: Importance of maintenance engineering; Objectives; Duties and policies of maintenance; Organization and structure of a maintenance system. Types of industrial maintenance systems; Preventive; corrective and breakdown maintenance systems; their merits; demerits and applications etc.

Maintenance Policies and Planning: Maintenance strategies; Planned maintenance procedure; Maintenance schedule and maintenance programme; benefits of planned maintenance; Scientific maintenance safety aspects in maintenance; Simulation of various maintenance systems; Development of planned maintenance schedule; Budgeting and cost control; Production maintenance integration.

Replacement Policies and Models: Economic models; Maintenance man power planning; Maintenance down time analysis; Mathematical models; Simulation models; Introduction to Repair Discard Decisions; factors affecting repair –discard decisions; cost-analysis and optimum module size; Spare Parts Management Material and store control; consideration of spare provisioning on operational availability.

Reliability: Introduction; Factor effecting Reliability; Failure and its types; Failure curve; Majors of reliability; MTBF; MTTF; Relationship b/w reliability failure rate and MTBF and its characteristics; System reliability (components in series and parallel) System reliability with stand by components; Redundancy; Operating characteristics curve; Reliability and life testing plans; Types of test; Maintainability; Availability Quantitative estimation of reliability economics; Optimal design configuration of series/parallel system.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Maintenance Planning and Control by Enthory Kelly; P.H.E EWP-NWP; N. Delhi 1984.
- Fundamental of Quality Control and Improvement by Amitava Mitra.
- Reliability Engineering by A.W. Von; Prentice Hall; N.D.; 1982.
- Principles of Planned Maintenance by Clifton R.H.; McGraw Hill; 1986.
- Handbook of Maintenance Management by Heintzelman; P.H.E.
- Reliability; Availability and Maintainability by Faster Phillips & Rayers; M/A Press.
- Queues; Inventories and Maintenance by P.M. Morse; Prentice Hall; NY.

MSE -424- Materials Management

Integrated approach to Materials Management: Introduction; Materials productivity and role of materials management techniques for improving materials productivity; Cost reduction and value improvement; value analysis for right choice and rationalization of materials.

Purchasing function: Objectives; purchase requisitions; types of specification; centralized versus decentralized purchasing; timing of purchases; Purchasing research; identification of right sources of supplies; Make or buy decisions; vender selection and vender rating; Negotiations; purchase price analysis and price determination; Purchasing organization; procedures; forms; records and reports; Purchasing as a dynamic profession; transition to supply management.

Inventory management: Inventory concepts; reasons for holding inventory; types of inventory; inventory reduction tactics. Inventory turnover ratio; Selective Inventory management: ABC; VED; and FSN analysis etc.; identifying critical items with selective inventory management.

Operating policies: Continuous review system; periodic review system; comparative advantages and disadvantages of continuous and periodic review systems; hybrid systems; Inventory management across the organization.

Optimising Inventory: Assumptions for Wilson's lot size model; inventory costs; hidden costs; composition of costs; estimation of inventory related costs; lead time; stock out point; number of time periods; calculating Economic Order Quantity (EOQ); sensitivity analysis of EOQ model.

Special inventory models: Finite replenishment rate model; lot size models with planned backlogging; generalized model with uniform replenishment rate; inventory model with lost sales; quantity discount model; one period decisions; Determination of safety stock; service level and uncertainty in demand; Information systems for inventory management.

Stores management: Introduction; stores functions; stores organization; stores systems and procedures; stores accounting and verification systems; stores address systems; stores location and layout; store equipment.

Standardization and codification: Classification of materials; Codification; objectives of codification; essential features of codification system; Brisch and Kodak systems; Colour coding systems; Standardisation; Variety reduction.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Arnold and Chapman “*Introduction to Materials Management*”; Pearson Education Asia; Fourth Edition; (2001)
- Narsimhan, Mcleavey & Billington; “*Production Planning & Inventory Control*”; Prentice Hall of India; Second Edition (2003)
- Dobler Donald W.; Burt David N.; “*Purchasing and Supply Management*”; Tata McGraw Hill; Sixth Edition (2001)
- Menon K S; “*Purchasing and Inventory Control*”; Wheeler Publishing New Delhi; Third Edition (1997)
- Krajewski L J and Ritzman L P; “*Operations Management*”; Pearson Education Asia; Sixth Edition (2004).

MSE -521- Productivity Management

Introduction: Concern and the Significance of Productivity Management; the Rationale of Productivity Measurement; Productivity: Some Perspectives; Productivity Measurement: A Case for Re-appraisal.

Productivity Measurement: A Conceptual Framework: Objectives of Productivity Measurement; Management by Objectives (MBO) and Productivity Measurement; Systems Approach to Productivity Measurement; Performance Objectives – Productivity (PO-P): The Concept; PO-P: The Model; PO-P: The Methodology.

Productivity Measurements in Manufacturing Sector: Productivity Measurement in Manufacturing Sector; Productivity Measurement in a Medium Sized Organisation; Productivity Measurement in a Large Sized Organisation.

PO-P Application: Productivity Measurement in Service Sector: Need for measuring Productivity in Service Sector; Difficulties in measuring productivity; Productivity of an R&D System; Productivity of an Educational Institution.

The Role of External Environment: External Environment and Organisation; Impact of external Environment; External Environment: Its Sub-systems; Approaches to measure Impact of External Environment.

Productivity Management and Implementation Strategies: Productivity Management System; Productivity Policy; Productivity: Organisation & Planning; Productivity Measurement; Productivity Measurement Evaluation; Productivity Improvement Strategies; Productivity Audit and Control.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Productivity Management by Prem Vrat; G.D.Sardana and B.S.Sahai
- Production and Operations Management by S.A.Chunawalla and D.R.Patel

MSE -522- Supply Chain and Logistics

Supply Chain and its Performance: Objectives of a supply chain; Stages of supply chain; Supply chain process cycles; Customer order cycle; Replenishment cycle; Manufacturing cycle; Procurement cycle; Push/pull view of supply chain processes; Importance of supply chain flows; Examples of supply chain; Supply chain strategies; Achieving strategic fit; Product life cycle; Minimize local cost view; The minimize functional cost view; The maximize Company profit view; The maximize supply chain surplus view.

Supply Chain drivers and Obstacles: Four drivers of supply chain – inventory; transportation; facilities; and information; A framework for structuring drivers; Role of each driver in supply chain; Obstacles to achieve strategic fit.

Planning Demand and Supply in a Supply Chain: Role of forecasting in a supply chain; Forecasting methods in a supply chain; Basic approach to demand forecasting; Time series forecasting methods; Role of aggregate planning in a supply chain; Aggregate planning resources.

Managing economies of scale in a supply chain: Role of cycle inventory in a supply chain; Economies of scale to exploit fixed costs; Economies of scale to exploit quantity discounts; Short term discounting; Estimating cycle inventory related costs; Determining appropriate level of safety inventory.

Transportation in a supply chain: Facilities affecting transportation decisions; Modes of transportation and their performance characteristics; Design options for a transport network; trade-offs in transportation decision; Tailored transportation; Routing and scheduling in transportation; Making transportation decisions in practice.

Coordination in a Supply chain: Lack of supply chain coordination and the Bullwhip effect; Effect of lack of coordination on performance; Obstacles to coordination; Managerial levers to achieve coordination; Achieving coordination in practice.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Christopher Martin; “*Logistics and Supply Chain Management*”; Pearson Education Asia; (2002).
- Meindl Peter; “*Supply Chain Management – Strategy; planning and operation’s*”; Pearson Education; Asia (2002).
- Kapoor K K; Kansal Purva; “*Marketing logistics: A Supply Chain Approach*”; Pearson Education Asia (2003).
- Monks T.G.; “*Schaum’s Outlines Operations Management*”; Tata McGraw Hill (2001).

- Buffa; “*Modern production/operations Management*”; Wiley Eastern Ltd. (2000)

MSE -523- Network Analysis and Project Management

Project Management Concepts: Introduction; project characteristics; taxonomy of projects; project identification and formulation; Establishing the project and goals; Nature & context of project management; phases of PM; A framework for PM issues; PM as a conversion process; Project environment & complexity Organizing human resources; organizing systems & procedures for implementation; Project direction.

Project Organization & Project Contracts: Introduction; functional organization; project organization; matrix organization; modified matrix organization; pure project organization; selection of project organization structure; project breakdown structures; project contracts; types of contracts; types of payments to contractors.

Project Appraisal & Cost Estimation: Introduction; technical appraisal; commercial appraisal; economic appraisal; financial appraisal; management appraisal; social cost/benefit analysis; project risk analysis; Cost analysis of the project; components of capital cost of a project; modern approach to project performance analysis.

Project Planning & Scheduling: Introduction to PERT & CPM; planning and scheduling networks; time estimation; determination of critical path; CPM model; event slacks & floats; PERT model; expected time for activities; expected length of critical path; calculating the project length and variance; PERT & CPM cost accounting systems; lowest cost schedule; crashing of networks; linear programming formulation of event oriented networks; updating of networks; LOB technique.

Modification & Extensions of Network Models: Complexity of project scheduling with limited resources; resource leveling of project schedules; resource allocation in project scheduling – heuristic solution; Precedence networking- examples with algorithm; decision networks; probabilistic networks; Computer aided project management- essential requirements of PM software; software packages for CPM; Enterprise- wide PM; Using spread sheets for financial projections.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Practical Project Management by Ghattas and Mckee; Pearson Education Asia.
- Principles of Project Management; NPC publication
- Project Management; Tata McGraw Hill – S.Choudhury
- Project Management by K. Nagarajan

- Project Management by Harvey Maylor

MSE -425- Product Design and Development (PDD) Lab

LIST OF EXPERIMENTS

1. To study and conduct exercises on PLC Simulator.
2. Control of Conveyor manually and through Programming also Programming using Sensors and Conveyor.
3. Control of X-Y Position table manually and through Programming.
4. To study and conduct exercises on RoboX.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. To study and conduct exercises on Simulation Software for Pneumatic Components (P-Simulator)
7. To study and conduct exercises on Hydraulics and Electro-Hydraulics Training System.
8. To study and conduct exercises on Simulation Software for Hydraulic Components (H-Simulator)
9. To fabricate the developed model using injection moulding machine.
10. To prepare a CAD model of a given product structure and build a prototype of the model using RAPID PROTOTYPING equipment.
11. A comprehensive study of innovative “Fused Deposition Modeling” techniques such as 3D printing, direct digital manufacturing.
12. To construct a design model of a consumer product using SOLIDTHINKING CAE software.
13. Exercises of FE analysis of different problems using Hyperworks.

Note: The student is required to perform at least TEN Experiments out of the above

MSE -431- Total Quality Management

Introduction: Definition; core concepts of TQM; Cost of quality; Guru's of TQM; Leadership: Definitions; Characteristics of Quality Leaders; Leadership Concepts; The Deming Philosophy; Role of TQM Leaders; Implementation; Quality control Circles (QCC); Objectives and its organizational structure; QCC in Indian industries; Strategic quality management.

Customer Satisfaction and Employee Involvement: Introduction; customer focus; Customer perception of Quality; customer satisfaction Feedback; Using Customer Complaints; Service Quality; measuring service industry and quality using SERVQUAL; Customer Retention; Motivation; Benefits of Employee Involvement.

Continuous Process Improvement and Benchmarking: Process; The Juran Trilogy; Improvement Strategies; PDCA Cycle; Kaizen; Kaizen vs Innovation; Management oriented Kaizen; Group oriented and individual oriented Kaizen; Re-engineering; Six Sigma; Six Sigma and TQM; Benchmarking; Definition; Reasons to benchmark; Pitfalls and Criticisms of Benchmarking; Quality Function Deployment (QFD).

Quality Management Systems(QMS): Quality systems; requirements; ISO 9000 series of standards; quality management principles; benefits of ISO Registration; Sector Specific Standards; Business excellence models; Quality Awards; Software quality Management; Quality audit and its types; purpose and scope etc.

Environmental Management System (EMS): ISO 14000; Requirements of ISO 14000; benefits; integrating ISO14000 and ISO9000; Relationship to Health & Safety.

Failure Mode and Effect Analysis: Reliability; Requirements of Reliability; Failure Rate; Stages of FMEA; Design and Process of FMEA; Cause and Effect Diagram; Process Capability analysis & its benefits; process capability indices and its procedures.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Total Quality Management by Besterfield Dale H; Pearson Education
- Total Quality Control by AV Feigenbaum; McGraw Hill.
- Total Quality Management by Poornima M Charantimath; Pearson education
- Total Quality Management by Oakland; Butterworth - Heinemann Ltd.
- Quality Control and improvement By Amitava Mitra Pearson education.

MSE -432- Design of Experiments & Research Methodology

Introduction: Objectives for experimental designs; Basic design concepts; Steps for the design of experiments; types of experimental designs; Analysis of Means; Experimental designs and six sigma.

Statistical Inference: Generation of hypotheses; Testing of hypotheses; OC curve; Tests on means; Tests on variances; Assessing normality; ANOVA rationale; Confidence limits on means; Components of variance.

Completely Randomized Design: Model for a completely randomized design with a single factor; ANOVA for a completely randomized design; Randomized block design; Incomplete block design; Latin square design; One way; Two way ANOVA; Balanced ANOVA.

Full and Fractional Factorial Designs with Two Levels: Nature of Factorial Designs. Deleterious effects of Interactions; Effect Estimates; The 2^3 Design; Built-in-Replication; Role of expected mean squares in experimental design; 2^{k-1} Designs; Effect Estimates and Regression Coefficients; 2^{k-2} Designs; Basic Concepts; Design Efficiency; John's 3/4 Designs.

Robust Designs: DOE and Taguchi Approach; Experimental Design using orthogonal arrays; Experimental Designs with Two-Level Factors only; Experimental Designs with Three and Four Level Factors; Analysis using Signal to Noise Ratios; Some case studies; Response Surface Methodology; Response surface experimentation; Process improvement with Steepest Ascent; Analysis of Second-order response surfaces; Central Composite Designs; Box -Behnken Designs; Analyzing the fitted surface; Design-Expert Software.

Research Methodology: Methods of Research; Descriptive research design - survey; case study; content analysis; Ex-post Facto Research; Co relational and Experimental Research; Tests; Questionnaires; checklists; observation schedules; selecting a standardized test; Data collection methods; approaches to data collection; interpretation of statistical analysis; Procedure for writing a research proposal; types and components of research proposal; Procedure for writing a research report; Audiences and types of research reports; Format of research report and journal articles.

Note: The examiner is required to set EIGHT questions in all carrying equal marks covering the entire syllabus. The candidate is required to attempt FIVE questions.

Recommended Books:

- Modern Experimental Design by Thomas P Ryan; John Wiley Publishers; NY; 2003.
- Design of Experiments using the Taguchi Approach by Ranjit K Roy; John Wiley; NY; 2006.
- Fundamental Concepts in Design of Experiments; Charles R. Hicks; Oxford University Press; NY; 1999.

- Modern Experimental Design by Thomas P Ryan. John Wiley
- Response Surface Methodology by Myers R H and Montgomery Dc. John Wiley
- Borg; W and Gall; M. Educational Research: An Introduction; New York; Longman.2003
- Cohen; L. Educational Research in Classrooms and Schools! A Manual of Materials and Methods NY: Harper and Row Publishers.2000
- CPSC: Developing Skills in Technician Education Research Modules 1 to 11 Singapore; Colombo Plan Staff College for Technician Education
- Garrett; HE and Woodworth; RS. Statistics in Psychology and Education; Educational Research; Bombay: Vakils Fetter and Simons Ltd. 2003
- Gay; LR; Educational Research; Ohio: Charles E. Merrill Publishing Company2000
- Wiersma William Research Methods in Education – An Introduction London; Allyn and Bacon; Inc.2000

MSE – 433 SEMINAR

The student is required to deliver a seminar on some emerging topics of concern Engineering. Senior faculty will supervise the students in selecting and preparation of the same. The student will submit one copy of seminar report and shall make oral presentation as per time schedule decided by the faculty concerned. Internal Evaluation will be made on the basis of report, presentation and the discussion during the presentation.

MSE – 434 MINOR PROJECT

The student is required to deliver a seminar on some emerging topics of concern Engineering. Senior faculty will supervise the students in selecting and preparation of the same. The student will submit one copy of Minor project seminar report spiral binding and shall make oral presentation as per time schedule decided by the faculty concerned. Internal Evaluation will be made on the basis of report, presentation and the discussion during the presentation.

MSE – 441 DISSERTATION

The primary objective of this course is to enhance the student ability to analyze and carry out independent investigations etc. Each student will carry out independent work which should involve creativity, innovation and ingenuity. A dissertation supervisor (s) having at least post- graduate qualification, having minimum three experience after post graduation and published papers in international journal of repute in his/her credentials OR Doctorate degree with published papers in international journal of repute in his/her credentials, may be from industry/research organization shall be assigned to the student approved by the competent authority. *In no case, the candidate can have more than two dissertation supervisors.* Dissertation work shall comprise of literature survey, problem formulation, methodology used, S/W, H/W tools used, Results and discussion followed by the conclusions & further scope of work in that area. Industry oriented projects may be encouraged for the purpose. Finally, student must have published at least one international paper before submission of dissertation.

The submission of dissertation shall be allowed only after ensuring that the research work carried out by the candidate has attained the level of satisfaction of the ‘Dissertation Supervisor (s)’ and proof of communication/acceptance of the research paper (if any, and certified in the report) in the relevant refereed journal/ conference. The final dissertation external examination in 4th semester shall be taken by a panel of examiners comprising of concerned Supervisor (s), one external examiner (from the relevant field) nominated/approved by the competent authority. Hard copies of dissertation, one for each supervisor (s), examiner and the university/ department, are required to be submitted by the student before the final dissertation external examination. The candidate shall appear before the examining committee for oral examination and presentation on the scheduled date.