

a

AFFILIATED INSTITUTIONS
ANNA UNIVERSITY : : CHENNAI 600 025

REGULATIONS - 2009

II TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

M.E. MANUFACTURING ENGINEERING

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MF9221	<u>Robot Design & Programming</u>	3	0	0	3
2	MF9222	<u>Manufacturing Metrology and Quality Control</u>	3	0	0	3
3	MF9223	<u>Metal Forming Processes</u>	3	0	0	3
4	MF9224	<u>MEMS & Nanotechnology</u>	3	0	0	3
5	E3	Elective III	3	0	0	3
6	E4	Elective IV	3	0	0	3
PRACTICAL						
7	MF9225	<u>Automation Lab</u>	0	0	4	2
TOTAL			18	0	4	20

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	E5	Elective V	3	0	0	3
2	E6	Elective VI	3	0	0	3
3	E7	Elective VII	3	0	0	3
PRACTICAL						
4	MF9231	Project Work (Phase I)	0	0	12	6
TOTAL			9	0	12	15

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MF9241	Project Work (Phase II)	0	0	24	12
TOTAL			0	0	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE:

$$21+20+15+12 = 68$$

ELECTIVES FOR M.E.MANUFACTURING ENGINEERING

COURSE CODE	COURSE TITLE	L	T	P	C
MF9250	<u>Finite Element Application in Manufacturing</u>	3	0	0	3
MF9251	<u>Fluid Power Automation</u>	3	0	0	3
MF9252	<u>Design for Manufacture and Assembly</u>	3	0	0	3
MF9253	<u>Materials Management & Logistics</u>	3	0	0	3
MF9254	<u>Advances in Casting and Welding Processes</u>	3	0	0	3
MF9255	<u>Metal Cutting Theory and Practice</u>	3	0	0	3
MF9256	<u>Probability & Statistics</u>	3	0	0	3
MF9257	<u>Manufacturing System Simulation</u>	3	0	0	3
MF9258	<u>Optimization Techniques in Engineering</u>	3	0	0	3
MF9259	<u>Industrial Ergonomics</u>	3	0	0	3
MF9260	<u>Polymers and Composite Materials</u>	3	0	0	3
MF9261	<u>Non-Destructive Evaluation</u>	3	0	0	3
MF9262	<u>Artificial Intelligence</u>	3	0	0	3
MF9263	<u>Lean Manufacturing system and Implementation</u>	3	0	0	3
MF9264	<u>Quality & Reliability Engineering</u>	3	0	0	3
MF9265	<u>Computer Aided Product Design</u>	3	0	0	3
MF9266	<u>Financial management</u>	3	0	0	3
MF9267	<u>Rapid Manufacturing</u>	3	0	0	3
MF9268	<u>Manufacturing Management</u>	3	0	0	3

AIM:

To impart knowledge in the area of Robot designing and programming in Robotic languages.

OBJECTIVES:

To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.

UNIT I INTRODUCTION 9
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II ROBOT KINEMATICS 9
Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING 9
Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES 9
Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V ROBOT SENSORS AND ACTUATORS 9
Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors.

TOTAL: 45 PERIODS

REFERENCES

1. Gordon Mair, 'Industrial Robotics', Prentice Hall (U.K.) 1988
2. Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition, 1988.
3. Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 1996.
4. Saeed.B.Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002

AIM:

To expose the students, the importance of measurement and the various latest measuring techniques using Laser, Coordinate measuring machines and Opto-electronics devices. Also to stress upon the Importance of quality in manufacturing.

OBJECTIVES:

To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices. Also to make the students to understand quality

UNIT I LASER METROLOGY 8

Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometry applications – speckle interferometry – laser interferometers in manufacturing and machine tool alignment testing – calibration systems for industrial robots laser Doppler technique – laser Doppler anemometry.

UNIT II PRECISION INSTRUMENTS BASED ON LASER 9

Laser telemetric systems – detection of microscopic imperfections on high quality surface Pitter NPL gauge interferometer – classification of optical scanning systems – high inertia laser scan technique – rotating mirror technique – laser gauging – bar coding – laser dimensional measurement system.

UNIT III CO-ORDINATE MEASURING MACHINE 10

Co-ordinate metrology – CMM configurations – hardware components – software – Probe sensors – displacement devices – Performance Evaluations – Software – Hardware – Dynamic errors – Thermal effects diagram – temperature variations environment control – applications.

UNIT IV OPTO ELECTRONICS AND VISION SYSTEM 9

Opto electronic devices – CCD – On-line and in-process monitoring in production – applications image analysis and computer vision – Image analysis techniques – spatical feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system.

UNIT V QUALITY IN MANUFACTURING ENGINEERING 9

Importance of manufacturing planning for quality – concepts of controllability – need for quality management system and models – quality engineering tools and techniques – statistical process control – six sigma concepts – Poka Yoke – Computer controlled systems used in inspection.

TOTAL: 45 PERIODS**REFERENCES:**

1. John A. Bosch, Giddings and Lewis Dayton, Co-ordinate Measuring Machines and Systems, Marcel Dekker, Inc, 1999.
2. Juran J.M. and Gyna F.M., Quality Planning and Analysis, Tata-McGraw Hill, New Delhi
3. Zuech, Nello Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000
4. Elanchezhian.C, Vijaya Ramnath.B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.

5. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1983.
6. Marciniak,Z., Duncan J.L., Hu S.J., ‘Mechanics of Sheet Metal Forming’, Butterworth-Heinemann An Imprint of Elsevier, 2006
7. Proc. Of National Seminar on “Advances in Metal Forming” MIT, March 2000
8. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007.

MF9224

MEMS & NANO TECHNOLOGY

**L T P C
3 0 0 3**

AIM:

To inspire the students to expect to the trends in manufacturing micro components and measuring systems to nano scale.

OBJECTIVES:

- To expose the students to the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be award of micro actuators.
- Also to impart knowledge to the students about nano materials and various nano measurements techniques.

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 6

Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.

UNIT II MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 10

Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

UNIT III MICRO DEVICES AND MATERIALS 8

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands displacement sensors, pressure and flow sensors, micro actuators – smart materials – applications.

UNIT IV SCIENCE OF NANO MATERIALS 10

Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

UNIT V CHARACTERIZATION OF NANO MATERIALS**11**

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL: 45 PERIODS**REFERENCES:**

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Mark Madou Fundamentals of Microfabrication, CRC Press, New York, 1997.
3. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
4. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.
5. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
6. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

MF9225**AUTOMATION LAB****L T P C****0 0 4 2****AIM:**

To impart knowledge in the area of hydraulics and pneumatic components and its functions.

OBJECTIVES:

- To make the students to learn the basic concepts of hydraulics and pneumatics and its applications in the area of manufacturing process.
 - To simulate the various hydraulics and pneumatics circuits.
1. Simulation of single and double acting cylinder circuits
 2. Simulation of simple Hydraulic and Pneumatic circuits
 3. Simulation of electro pneumatic and electro hydraulic circuits
 4. Simulation of electro pneumatic sequencing circuits
 5. Simulation of Hydraulic and Pneumatic circuits using PLC circuits
 6. Simulation of Hydraulic and Pneumatic circuits using automation studio
 7. Exercises on linear, angular and speed measurements
 8. Exercises on Vibration measurements
 9. Exercises on Motion controller using AC motor, DC motor, Servo motor and encoder.
 10. Exercises on stepper motor.
 11. Exercises on microprocessor based data acquisition system.
 12. Study of Sensors and Transducer – Potentiometer, Strain gauge, Torque, LVDT, Hall – Effect, Speed, Vibration, Pressure, Optical transducer and Temperature transducer.

TOTAL : 60 PERIODS

AIM:

To impart knowledge in the area of finite element methods and its application in manufacturing.

OBJECTIVE:

To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

UNIT I INTRODUCTION 6

Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Raleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II ONE DIMENSIONAL ANALYSIS 10

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 10

Shape functions for one and two dimensional elements- Three noded triangular and four noded quadrilateral element Global and natural co-ordinates—Non linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV COMPUTER IMPLEMENTATION 9

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

UNIT V ANALYSIS OF PRODUCTION PROCESSES 10

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

TOTAL: 45 PERIODS

REFERENCES:

1. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill, 1985.
2. Rao, S.S., Finite Element method in engineering, Pergamon press, 1989.
3. Bathe, K.J., Finite Element procedures in Engineering Analysis, 1990
4. Kobayashi, S, Soo-ik-Oh and Altan, T, Metal Forming and the Finite Element Methods, Oxford University Press, 1989.
5. Lewis R.W.Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.
6. www.tbook.com
7. www.pollockeng.com

AIM:

To impart knowledge in the area of hydraulics, pneumatic and fluid power components and its functions.

OBJECTIVES:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using ladder diagram.

UNIT I INTRODUCTION 5
Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS 8
Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

UNIT III CONTROL AND REGULATION ELEMENTS 8
Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN 10
Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS 7
Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL:45 PERIODS

REFERENCES:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
2. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
3. Durbey.A.Peace, Basic Fluid Power, Prentice Hall Inc, 1967
4. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
5. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978.
6. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
7. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.

UNIT I TOLERANCE ANALYSIS 8

Introduction – Concepts, definitions and relationships of tolerancing – Matching design tolerances with appropriate manufacturing process – manufacturing process capability metrics – Worst case, statistical tolerance Analysis – Linear and Non-Linear Analysis – Sensitivity Analysis – Taguchi’s Approach to tolerance design.

UNIT II TOLERANCE ALLOCATION 8

Tolerance synthesis – Computer Aided tolerancing – Traditional cost based analysis – Taguchi’s quality loss function – Application of the Quadratic loss function to Tolerancing – Principles of selective Assembly – Problems.

UNIT III GD&T 10

Fundamentals of geometric dimensioning and tolerancing – Rules and concepts of GD&T – Form controls – Datum systems – Orientation controls – Tolerance of position – Concentricity and symmetry controls – Run out controls – Profile controls.

UNIT IV TOLERANCE CHARTING 9

Nature of the tolerance buildup – structure and setup of the tolerance chart – piece part sketches for tolerance charts – Arithmetic ground rules for tolerance charts – Determination of Required balance dimensions – Determination of Mean working Dimensions – Automatic tolerance charting – Tolerance charting of Angular surfaces.

UNIT V MANUFACTURING GUIDELINES 10

DFM guidelines for casting, weldment design – Formed metal components – Turned parts – Milled, Drilled parts – Non metallic parts – Computer Aided DFM software – Boothroyd and Dewhurst method of DFMA – DCS – Vis/VSA – 3D Dimensional control – Statistical tolerance Analysis Software – Applications.

TOTAL: 45 PERIODS**REFERENCES:**

1. C.M. Creveling, “Tolerance Design – A handbook for Developing Optimal Specifications”, Addison – Wesley, 1997.
2. James D. Meadows, ‘Geometric Dimensioning and Tolerancing’, Marcel Dekker Inc., 1995.
3. Alex Krulikowski, “Fundamentals GD&T”, Delmar Thomson Learning, 1997.
4. Oliver R. Wade, “Tolerance Control in Design and Manufacturing”, Industrial Press, NY, 1967.
5. James G. Bralla, “Handbook of Product Design for Manufacturing”, McGraw Hill, 1986.

AIM:

To introduce to the students the various functions of materials management and logistics

OBJECTIVE:

To make the students familiar with the various concepts and functions of material management, so that the students will be in a position to manage the materials management department independently.

UNIT I INTRODUCTION 6

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 7

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

UNIT III MANAGEMENT OF STORES AND LOGISTICS 12

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.

UNIT IV MATERIALS PLANNING 10

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT V INVENTORY MANAGEMENT 10

ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

REFERENCES

1. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 1996.
2. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 1996.
3. Guptha P.K. and Manmohan, Problems in Operations Research, Suttan Chand & Sons, 2003.
4. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management – Eswar Press – 2005.
5. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
6. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.

AIM:

To impart knowledge on basic concepts and advances in casting and welding processes.

OBJECTIVES:

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of welding process.

UNIT I CASTING DESIGN 8

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT II CASTING METALLURGY 8

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8

Shell moulding, precision investment casting, CO₂ moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN 10

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V RECENT TRENDS IN WELDING 11

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

TOTAL: 45 PERIODS

REFERENCES:

1. ASM Handbook, Vol 15, Casting, 2004
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003
3. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
4. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002
5. HEINLOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Jain P.L., Principles of Foundry Technology, Tata McGrawHill Publishers, 2003
7. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002

8. IOTROWSKI – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
9. SCHWARIZ, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
10. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
11. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980

MF9255

METAL CUTTING THEORY AND PRACTICE

L T P C
3 0 0 3

AIM:

To impart the knowledge and train the students in the area of metal cutting theory and its importance.

OBJECTIVE:

- To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

UNIT I INTRODUCTION 9

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II SYSTEM OF TOOL NOMENCLATURE 9

Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

UNIT III THERMAL ASPECTS OF MACHINING 9

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids.

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 9

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index-economics of machining.

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING 9

Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

TOTAL : 45 PERIODS

REFERENCES

1. Shaw.M.C.Metal cutting principles, oxford Clare don press, 1984.
2. Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India, 1984.
3. Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 1989.

AIM:

To introduce the various concepts of manufacturing system simulation.

OBJECTIVES:

- To model manufacturing systems of different kinds.
- To make use of simulation languages for manufacturing systems.

UNIT I INTRODUCTION**8**

Basic concepts of system – elements of manufacturing system - concept of simulation – simulation as a decision making tool – types of simulation – Monte-Carlo simulation - system modeling – types of modeling – Limitations and Areas of application of simulation.

UNIT II RANDOM NUMBERS**10**

Probability and statistical concepts of simulation – Pseudo random numbers – methods of generating random numbers – discrete and continuous distribution – testing of random numbers – kolmogorov-Smirnov test, the Chi-Square test - sampling - simple, random and simulated.

UNIT III DESIGN OF SIMULATION EXPERIMENTS**10**

Problem formulation – data collection and reduction – time flow mechanical – key variables - logic flow chart starting condition – run size – experimental design consideration – output analysis, interpretation and validation – application of simulation in engineering industry.

UNIT IV SIMULATION LANGUAGE**9**

Comparison and selection of simulation languages - Study of GPSS (Basic blocks only) Generate, Queue, Depart, Size, Release, Advance, Terminate, Transfer, Enter and Leave.

UNIT V CASE STUDIES**10**

Development of simulation models using GPSS for queuing, production, inventory, maintenance and replacement systems – case studies.

TOTAL: 45 PERIODS**REFERENCES:**

1. Jerry Banks and John S.Carson, “Discrete event system simulation”, Prentice Hall 1991
2. 1 .John H.Mize and J.Grady Cox, “Essentials of simulation” – Prentice hall 1989.
3. Geoffrey Gordon “System simulation” – Prentice Hall of India, 1992
4. Jeffrey L.Written, Lonnie D, Bentley and V.M. Barice, “System analysis and Design Methods”, Galgotia publication, 1995
5. Averill M.Law and W.David Kelton, “Simulation Modeling and analysis”, McGraw Hill International Editions, 1991
6. Shannon R.E., “System simulation”, Prentice Hall 1993.

MF9259

INDUSTRIAL ERGONOMICS

L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Concepts of human factors engineering and ergonomics – Man – machine system and design philosophy – Physical work – Heat stress – manual lifting – work posture – repetitive motion.

UNIT II ANTHROPOMETRY 9

Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

UNIT III DESIGN OF SYSTEMS 9

Displays – Controls – Workplace – Seating – Work process – Duration and rest periods – Hand tool design – Design of visual displays – Design for shift work.

UNIT IV ENVIRONMENTAL FACTORS IN DESIGN 10

Temperature – Humidity – Noise – Illumination –Vibration – Measurement of illumination and contrast – use of photometers – Recommended illumination levels. The ageing eye – Use of indirect (reflected) lighting – cost efficiency of illumination – special purpose lighting for inspection and quality control – Measurement of sound – Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise – Effects of Noise on performance – annoyance of noise and interference with communication – sources of vibration discomfort.

UNIT V WORK PHYSIOLOGY 8

Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

TOTAL: 45 PERIODS

REFERENCES:

1. Martin Helander, A guide to the ergonomics of manufacturing, East West press, 1996
2. E.J. McCormic, Human factors in engineering design, McGraw Hill 1976
3. R.S. Bridger Introduction to Ergonomics, McGraw Hill, 1995.

MF9260

POLYMERS AND COMPOSITE MATERIALS

L T P C
3 0 0 3

AIM:

To impart on types, physical properties and processing of polymer matrix and composites, metal matrix composites and ceramics matrix composites.

OBJECTIVES:

- To study matrix material, particulates and fibres of polymer matrix composites, MMC and ceramic matrix composites.

AIM:

To stress the importance of NDT in engineering.

OBJECTIVES:

To introduce all types of NNDT and their applications in Engineering.

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING & RADIOGRAPHY 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks.

Principle of Radiography, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography

UNIT V CASE STUDIES, COMPARISON AND SELECTION OF NDT METHODS 9

Case studies on defects in cast, rolled, extruded, welded and heat treated components. Comparison and selection of various NDT techniques. Codes, standards, specification and procedures.

TOTAL: 45 PERIODS

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker, Inc., New York, 2002
4. www.ndt.net

AIM:

To understand the various types and applications of Fuzzy Logics and Artificial Neural Networks.

OBJECTIVE:

This course is intended for learning the basic concepts, Operations and Principles of Fuzzy Logic, applications of various Fuzzy Logic systems, architecture and Taxonomy of Neural Networks. This course is also gives the ideas of ANN Architectures, Genetic Algorithms. Meta Heuristic techniques and Applications in Design and Manufacturing.

UNIT I INTRODUCTION TO FUZZY LOGIC 8

Basic concepts in Fuzzy Set theory – Operations of Fuzzy sets – Fuzzy relational equations – Propositional, Predicate Logic – Inference – Fuzzy Logic Principles – Fuzzy inference – Fuzzy Rule based systems – Fuzzification and defuzzification – Types.

UNIT II FUZZY LOGIC APPLICATIONS 10

Fuzzy logic controllers – Principles – Various industrial Applications of Fuzzy logic control – Adaptive Fuzzy systems – Fuzzy Decision making – Fuzzy classification – Fuzzy pattern Recognition – Image Processing applications – Fuzzy optimization.

UNIT III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 7

Fundamentals of Neural networks – Neural network architectures – Learning methods – Taxonomy of Neural Network Architectures – Standard back propagation Algorithms – Selection of various parameters – Variations.

UNIT IV OTHER ANN ARCHITECTURES 10

Associative memory – Exponential Bidirectional Associative Memory – Adaptive Resonance Theory – Introduction – Adaptive Resonance Theory 1 – Adaptive Resonance Theory 2 – Applications – Kohen Self organizing maps – counter propagation networks – Industrial Applications.

UNIT V RECENT ADVANCES 10

Fundamentals of Genetic Algorithms – Hybrid systems – Meta heuristic techniques like simulated Annealing, Tabu Search, Ant colony optimization, Perpetual self organizing, Artificial immune systems – Applications in Design and Manufacturing.

TOTAL: 45 PERIODS

REFERENCES:

1. Klir, G.J. Yuan Bo, 'Fuzzy sets and Fuzzy Logic: Theory and Applications', Prentice Hall of India Pvt. Ltd., 1997.
2. Jacek M. Zurada, 'Introduction to Artificial Neural Systems' Jaico Publishing House, 1994
3. Simon Haykin, 'Neural Networks – A comprehensive foundation', Prentice Hall, 2nd Edition, 1998.
4. Laurene Fausett, 'Fundamentals of Neural Networks, Architectures, Algorithms and Applications, Prentice Hall, Englewood cliffs, 1994.
5. S. Rajasekaran, GA Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithms', Prentice Hall of India Private Limited, 2003.

AIM:

To introduce the concepts of lean manufacturing system.

OBJECTIVES:

- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.

UNIT I	INTRODUCTION TO LEAN MANUFACTURING	7
Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.		
UNIT II	CELLULAR MANUFACTURING, JIT, TPM	9
Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.		
UNIT III	SET UP TIME REDUCTION, TQM, 5S, VSM	10
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.		
UNIT IV	SIX SIGMA	9
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation		
UNIT V	CASE STUDIES	10
Various case studies of implementation of lean manufacturing at industries.		

TOTAL: 45 PERIODS

REFERENCES:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Rother M. and Shook J, 1999 'Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, Brookline, MA.
3. Mikell P. Groover (2002) 'Automation, Production Systems and CIM.

AIM:

To expose the students to the various quality control techniques and also to understand the importance and concept of reliability and maintainability in industries.

OBJECTIVES:

To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

UNIT I QUALITY & STATISTICAL PROCESS CONTROL 8

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 8

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV CONCEPT OF RELIABILITY 9

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY 11

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

REFERENCES:

1. Amata Mitra “Fundamentals of Quality Control and improvement” Pearson Education, 2002.
2. Bester field D.H., “Quality Control” Prentice Hall, 1993.
3. Patrick D To’ connor, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002
4. Charles E Ebling, An Introduction to Reliability and Maintability Engineering, Tata-McGraw Hill, 2000.
5. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.
6. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.

MF9265**COMPUTER AIDED PRODUCT DESIGN****L T P C
3 0 0 3****AIM:**

To introduce the computer aided modeling and various concepts of product design.

OBJECTIVES:

- To model a product using CAD software.
- To apply the various design concepts and design tools and techniques while designing a product.

UNIT I INTRODUCTION**8**

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL**8**

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves - Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages

UNIT III PRODUCT DESIGN CONCEPTS**9**

Understanding customer needs – Product function modeling – Function trees and function structures – Product tear down methods – Bench marking – Product port folio – concept generation and selection.

UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES**12**

Product modeling – types of product models; product development process tools – TRIZ – Altshuller’s inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment – FMEA – QFD – Poka Yoke - DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

UNIT V PROFIT PLANNING AND ANALYSIS 7

Cost - Volume profit relationship Relevant costs in decision making profit management analysis - Break even analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Presanna Chandra, Financial Management, Tata McGraw Hill, 1998.
2. C.James, Vanhorn, Fundamentals of Financial Management PHI 1996
3. G.B.S. Narang, Production and Costing, Khanna Publishers, 1993.
4. R Kesavan, C.Elanchezian, Vijayaramnath, Process Planning and cost estimation, New Age International Publishers, New Delhi 2004
5. RKesavan, C.Elanchezian, Sundar Selwyn, Engineering Economics and Financial Accounting, Laxmi Publications, New Delhi, 2005.
6. R Kesavan, C. Elanchezian, B.Vijaramnath, Engineering Economics and Cost Analysis Anuratha Publications, Chennai.

**MF9267 RAPID MANUFACTURING L T P C
3 0 0 3**

AIM:

To expose the students the importance of concurrent engineering in the present manufacturing and also the need and importance of rapid prototype tooling in manufacturing.

OBJECTIVES:

To make the students understand the concepts of concurrent engineering such as artificial intelligence, expert system, JIT, automated assembly system etc. Also to impart knowledge in various rapid tooling techniques and processes.

UNIT I INTRODUCTION TO CONCURRENT ENGINEERING 7

Extensive definition of CE – CE design methodologies organizing for CE – CE tool box collaborative product development – IT support – Solid modeling – Product data management – collaborative product – Artificial intelligence – Expert systems – software hardware co – design.

UNIT II DESIGN STATE 9

Life cycle desin of products – opportunity for manufacturing enterprises – modality of concurrent engineering design – Automated Analysis Idealization control – concurrent Engineering in optimal structural design – Real time constraints.

UNIT III MANUFACTURING CONCEPTS AND ANALYSIS 9

Manufacturing competitiveness – checking design process – conceptual design mechanism – qualitative physical approach – An intelligent design ffor manufacturing system – JITsystem – low inventory – modular fixtures modeling and Reasoning for computer based Assembly planning – Design of Automated Manufacturing systems.

UNIT IV RAPID PROTOTYPE TOOLING PROCESSES 10

Ed for coessiomn in product development classification of RP systems – Fused deposition modeling selective laser sintering – stereo lithography systems – laminated object manufacturijg.Solid ground curing – laser engineered net shaping (LENS).

UNIT V MODULAR AND RAPID TOOLING 10

Principle – Thermojet printer, Sander’s model 3D printer, Genisys Xs printer, JP system object yudra system – In direct rapid tooling , silicon rubber tooling – aluminium fitted epoxy tooling – spray metal tooling, direct rapid tooling – quick cast process – copper polyamide, rapid tools sand casting tooling laminated tooling soft tooling Vs hard tooling.

TOTAL: 45 PERIODS

REFERENCES:

1. Anderson M.M and Hein L. Berlin Integrated Product Development Springer Ver Log 1987.
2. Cleetus. J. Design for concurrent Engineering, Concurrent Engineering Research Center, and Mongantown W.V.1992.
3. Andrew Kusaik Concurrent Engineering Automation tools and technology, Wiley John and Sons Inc 1992.
4. Prasad Concurrent Engineering Fundamentals – Integrated Product Development precentice Hall 1996.
5. Pham, D.T. and Dimov, S.S. Rapid Manufacturing, Verlag, London, 2001.
6. Paul P.Jacob, Stereo Lithography and other Rapid Prototyping &Manufacturing Technologies, SME., New York,1996.

WEB REF:

1. www.tm.tu.nl/vace/ce/ce95.html

MF9268

MANUFACTURING MANAGEMENT

**L T P C
3 0 0 3**

AIM:

To introduce the concepts of manufacturing management and various manufacturing management function to the students.

OBJECTIVE:

To train the students on various functions of manufacturing management so that the students will be able to take up these functions as they get in to senior managerial positions.

UNIT I PLANT ENGINEERING 7

Plant location – Factors affecting plant location – Techniques – Plant layout - principles - Types –Comparison of layouts – Materials handling – Principles – Factors affecting selection of Materials handling system – Types of materials handling systems – Techniques.

UNIT II WORK STUDY 8

Method study – Principles of motion economy – steps in method study – Tool and Techniques – Work measurement – Purpose – stop watch time study – Production studies – work sampling – Ergonomics – Value analysis.

UNIT III PROCESS PLANNING AND FORECASTING 9

Process planning – Aims of process planning – steps to prepare the detailed work sheets for manufacturing a given component – Break even analysis – Forecasting – Purpose of forecasting – Methods of forecasting – Time series – Regression and Correlation – Exponential smoothing – Forecast errors.

