AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI

REGULATIONS - 2009

CURRICULUM AND SYLLABUS FOR I TO VI SEMESTERS (PART TIME)

M.E. MANUFACTURING ENGINEERING

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	**MA9222**	Numerical Methods and Graph Theory	3	1	0	4
2	MF9211	Advanced Materials Technology	3	0	0	3
3	MF9212	Automated Computer Integrated Manufacturing Systems	3	0	0	3
PRACTICAL						
3	MF9214	CIM Lab	0	0	3	2
		TOTAL	**9**	**1**	**3**	**12**

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MF9221	Robot Design & Programming	3	0	0	3
2	MF9222	Manufacturing Metrology and Quality Control	3	0	0	3
3	MF9223	Metal Forming Processes	3	0	0	3
PRACTICAL						
4	MF9225	Automation Lab	0	0	4	2
		TOTAL	**9**	**0**	**4**	**11**

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MF9213	Advanced Manufacturing Processes	3	0	0	3
2	E1	Elective I	3	0	0	3
3	E2	Elective II	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MF9224	MEMS & Nanotechnology	3	0	0	3
2	E3	Elective III	3	0	0	3
3	E4	Elective IV	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER V

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 VI

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

9+11+12+9+15+12 = 68

ELECTIVES FOR M.E.MANUFACTURING ENGINEERING

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MF9250	Finite Element Application in Manufacturing	3	0	0	3
2	MF9251	Fluid Power Automation	3	0	0	3
3	MF9252	Design for Manufacture and Assembly	3	0	0	3
4	MF9253	Materials Management & Logistics	3	0	0	3
5	MF9254	Advances in Casting and Welding Processes	3	0	0	3
6	MF9255	Metal Cutting Theory and Practice	3	0	0	3
7	MF9256	Probability & Statistics	3	0	0	3
8	MF9257	Manufacturing System Simulation	3	0	0	3
9	MF9258	Optimization Techniques in Engineering	3	0	0	3
10	MF9259	Industrial Ergonomics	3	0	0	3
11	MF9260	Polymers and Composite Materials	3	0	0	3
12	MF9261	Non-Destructive Evaluation	3	0	0	3
13	MF9262	Artificial Intelligence	3	0	0	3
14	MF9263	Lean Manufacturing system and Implementation	3	0	0	3
15	MF9264	Quality & Reliability Engineering	3	0	0	3
16	MF9265	Computer Aided Product Design	3	0	0	3
17	MF9266	Financial management	3	0	0	3
18	MF9267	Rapid Manufacturing	3	0	0	3
19	MF9268	Manufacturing Management	3	0	0	3

MA9222 NUMERICAL METHODS AND GRAPH THEORY L T P C
3 1 0 4

AIM:
To solve some engineering models and problems by using Numerical Analysis and Graph Theoretical concepts.

OBJECTIVES:
The engineers will have an exposure on various topics such as Systems of Equation, Interpolation and Numerical Integration, Initial and Boundary Value Problems, Fundamentals of Graphs, Graphs Algorithms to understand their applications in engineering problems.

UNIT I SYSTEMS OF EQUATIONS 12
Simultaneous linear equations – Direct method – LU decomposition methods - Gauss elimination, Gauss Jordan methods – Iterative methods – Jacobi and Gauss-Seidel methods.

UNIT II INTERPOLATION AND INTEGRATION 12
Hermite's interpolation – Cubic Spline Interpolation – Gaussian – Numerical Integration – Trapezoidal and Simpson rules – Newton-Cotes formula – Gaussian quadrature – cubature.

UNIT III NUMERICAL METHODS FOR ODE 12
Single step methods – multi step methods – Taylor series and Euler methods – Runge Kutta method of fourth order – Multi step methods – Adams-Bashforth, Milnes Predictor-Corrector methods – Boundary value problems by Finite difference method.

UNIT IV FUNDAMENTALS OF GRAPHS 12
Graphs – sub graphs - Complements – Graph isomorphism – vertex degree: Eulerian graphs – Planar graphs – Hamiltonian paths, tree and Cut-sets.

UNIT V TREES AND ALGORITHMS 12
Kruskal's algorithm – Dijkstra's shortest path algorithm, Prim's algorithm – Transport Networks.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
2. Froberg, C.E. Numerical Mathematics, the Benjamin/Cummings Publishing Co., Inc., 1985.
3. Grimaldi R.P., Discrete and Combinatorial Mathematics, Pearson Education Inc., 1999.

REFERENCES:

1. Froberg, C.E. Numerical Mathematics, The Benjamin/Cummings Publishing Co., Inc., 1985.
2. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific & Engineering computation, Wiley Eastern Ltd., 1987.
3. Bondy, J.A. and Murthy, U.S.R., Graph Theory with Applications, Macmillan,

MF9211 ADVANCED MATERIALS TECHNOLOGY L T P C
3 0 0 3

AIM:

To impart knowledge on advance concepts of material technology

OBJECTIVE:

- To enlight the PG students on elastic, plastic and fractured behaviour of engineering materials.
- To train the PG students in selection of metallic and non-metallic materials for the various engineering applications.

UNIT I ELASTIC AND PLASTIC BEHAVIOR 10

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of non crystalline materials.

UNIT II FRACTURE BEHAVIOUR 10

Griffith's theory, stress intensity factor and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS 10

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS 8

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT V NON METALLIC MATERIALS 7

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al_2O3, SiC, Si_3N_4 CBN and diamond – properties, processing and applications.

TOTAL: 45 PERIODS

REFERENCES:

1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behaviour of Materials, (2nd edition), McGraw Hill, 2000
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (3rd edition), Butterworth-Heiremann, 2001.
4. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 1999.
5. ASM Hand book, Vol.11, Failure Analysis and Prevention, (10th Edition), ASM, 2002.
6. Ashby M.F., Material Selection in Mechanical Design, 3rd Edition, Butter Worth 2005.

MF9212 AUTOMATED AND COMPUTER INTEGRATED MANUFACTURING SYSTEM **L T P C 3 0 0 3**

AIM:
To stress the role of computers in production.

OBJECTIVE:
To teach the role of computers in processing the information knowing across the various stages and various departments in a manufacturing concern.

UNIT I INTRODUCTION 6
Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – Impact of CIM on personnel – CIM status.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 10
Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features.

Automated Guided Vehicle system – Types of vehicles and AGVs applications – Vehicle guidance technology – Vehicle management and safety.

Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system
Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance.

UNIT III GROUP TECHNOLOGY AND FMS 10
Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies.

FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits.

UNIT IV PROCESS PLANNING 10
Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – selecting among casting process, forming process and

machining process. Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study.
Typical process sheet – case studies in Manual process planning.

Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning.

UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE **9**

Introduction to process model formulation – linear feed back control systems – Optimal control – Adaptive control –Sequence control and PLC. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control.

Overview of Automatic identification methods – Bar code technology – Other Automatic data capture technologies.

TOTAL : 45 PERIODS

REFERENCES:

1. Mikell P.Groover, “Automation, Production system and Computer integrated Manufacturing”, Prentice Hall of India Pvt. Ltd., 2008.
2. Radhakrishnan,P., Subramanian,S., and Raju,V., “CAD/CAM/CIM” New Age International Publishers, 2000.
3. James A.Retrg, Herry W.Kraebber, “Computer Integrated Manufacturing”, Pearson Education, Asia, 2001.
4. Gideon Halevi and Ronald D.Weill, “Principles of Process Planning”, Chapman Hall, 1995.
5. Viswanathan,N., and Narahari,Y., “Performance Modeling and Automated Manufacturing Systems”, Prentice Hall of India Pvt. Ltd., 2000.
6. Kant Vajpayee,S., “Computer Integrated Manufacturing”, Prentice Hall of India, New Delhi, 2007.
7. Alavudeen and Venkateshwaran, “Computer Integrated Manufacturing”, PHI Learning Pvt. Ltd., New Delhi, 2008.

MF9214 CIM LAB **L T P C**
0 0 3 2

AIM:
To impart the knowledge on training the students in the area of CAD/CAM.

OBJECTIVE:
To teach the students about the drafting of 3D components and analyzing the same using various CAD/CAM softwares.

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
3. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.
4. Mini project on any one of the CIM elements is to be done. This can be either a software or hardware simulating a CIM element. At the end of the semester, the students has to submit a mini report and present his work before a Committee.

CAD LABORATORY

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

TOTAL : 45 PERIODS

MF9221 ROBOT DESIGN & PROGRAMMING L T P C
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

MF9222 MANUFACTURING METROLOGY AND QUALITY CONTROL L T P C 3 0 0 3

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.

MF9223 METAL FORMING PROCESSES L T P C

3 0 0 3

AIM:

To impart knowledge on plasticity, surface treatment for forming of various types of metal forming process.

OBJECTIVES:

- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress-strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

UNIT II HEORY AND PRACTICE OF BULK FORMING PROCESSES 8

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III SHEET METAL FORMING 8

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion and hot and cold forging.

Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

TOTAL: 45 PERIODS

REFERENCES:

1. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 2004
2. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
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 Elesevier, 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.

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

MF9213 **ADVANCED MANUFACTURING PROCESSES** **L T P C**
3 0 0 3

AIM:

To expose the students in the art of manufacturing new products due to the development of new materials and processes. The students will totally get a feel of the relevant suitable process while evaluating and deciding.

OBJECTIVES:

- To inform the students about the various alternative manufacturing processes available.
- To develop an altitude to look for the unconventional manufacturing process to machine
- To make them to understand and appreciate the latest manufacturing process for micro fabrication and devices.

UNIT I NEWER MACHINING PROCESSES - I 9

(Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining – chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .

UNIT II NEWER MACHINING PROCESS – II 9

Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.

UNIT III NEWER MACHINING PROCESS – III 9

Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT IV FABRICATION OF MICRO DEVICES 9

Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT V MICROFABRICATION TECHNOLOGY 9

Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing.– steriolithography SAW devices, Surface Mount Technology,

TOTAL: 45 PERIODS

REFERENCES:

1. Serope kelpekijian & stevan r. schmid- manufacturing process engg material – 2003
2. Micro senors Mems & smart devices- Julian W.Hardner – 2002
3. Brahem T. Smith, Advanced machining I.F.S. UK 1989.
4. Jaeger R.C., Introduction to microelectronic fabrication Addison Wesley, 1988.
5. Nario Taniguchi – Nano technology – Oxford University Press 1996.
6. Pandey P.C. & Shan HS Modern Machining Processes, Standard Publishing Co., 1980
7. More Madon, Fundamentals of Microfabrication, CRC Press, 1997.

MF9224 MICRO ELECTRO MECHANICAL SYSTEMS AND 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, Galium 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 epitoxy – 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.

MF9250 FINITE ELEMENT APPLICATIONS IN MANUFACTURING L T P C
3 0 0 3

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 nodded 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, Pergammon 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

MF9251 FLUID POWER AUTOMATION L T P C
3 0 0 3

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. Dudbey.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.

MF9252 DESIGN FOR MANUFACTURING AND ASSEMBLY L T P C
3 0 0 3

UNIT I TOLERANCE ANALYSIS 8

Introduction – Concepts, definitions and relationships of tolerancing – Matching design tolerances with appropriate manufacturing process – manufacturing process capability metrics – Worst care, 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.

MF9253 MATERIALS MANAGEMENT AND LOGISTICS L T P C
3 0 0 3

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.

MF9254 ADVANCES IN CASTING AND WELDING PROCESSES L T P C
3 0 0 3

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, CO_2 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. HEINELOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Jain P.L., Principles of Foundry Technology,Tata McGrawHill Publishers, 2003
7. Carrry 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.

MF9256 PROBABILITY AND STATISTICS L T P C
3 0 0 3

AIM:

To introduce the concepts of probability, sampling techniques, estimation to the students.

OBJECTIVE:

To train the students so that students will be able to design experimental designs and use these concepts for research design.

UNIT I1 PROBABILITY THEORY 14

Random variables – probability density and distribution functions-moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications.

UNIT II SAMPLING THEORY 9

Sampling distributions – Standard error – t, F, Chi square distributions – applicatio

UNIT III ESTIMATION THEORY 5

Interval estimation for population mean, standard deviation, difference in means, ratio of standard deviations – point estimation.

UNIT IV TESTING OF HYPOTHESIS AND ANOVA 12

Hypothesis testing – Small samples – Tests concerning proportion, means, standard deviations – Tests based on chi square – Non parametric methods – Sign test – Rank sum test One, two factor models-Design of experiments.

UNIT V CORRELATION, REGRESSION AND TIME SERIES ANALYSIS 5

Correlation analysis, estimation of regression line – Time series analysis – Trend analysis – cyclical variations – Seasonal variations – Irregular variations

TOTAL : 45 PERIODS

REFERENCES:

1. Levin and Rubin, Statistics for Management, Prentice Hall of India, 2001
2. Hooda, Statistics for Business and Economics, Macmillan India, 2001
3. John.E.Freunds, “Mathematical statistics with applications”, Pierson Educations, 2004
4. Gupta and Kapoor, Fundamentals of Mathematical Statistics, Sultanchand, 2002.

MF9257 MANUFACTURING SYSTEM SIMULATION L T P C
3 0 0 3

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.

MF9258 OPTIMISATION TECHNIQUES IN ENGINEERING L T P C
3 0 0 3

AIM:
To introduce the various optimization techniques and their advancements.

OBJECTIVES:
- To make use of the above techniques while modeling and solving the engineering problems of different fields.

UNIT I INTRODUCTION 5
Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT II CLASSIC OPTIMIZATION TECHNIQUES 10
Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT III NON-LINEAR PROGRAMMING 9
Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES 12
Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

UNIT V ADVANCES IN SIMULATION 9
Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 45 PERIODS

REFERENCES:

1. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005
2. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994
3. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992
4. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
5. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997

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.
- To develop knowledge on processing, interfacial properties and application of computers.

UNIT I PROPERTIES OF POLYMERS 8

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics – Applications – Merits and Disadvantages.

UNIT II PROCESSING OF POLYMERS 9

Extrusion – Injection Moulding – Blow Moulding – Compression and Transfer Moulding – Casting – Thermo Forming General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Mechanical Fasteners – Thermal bonding – Press Fitting.

UNIT III INTRODUCTION TO FIBRES AND COMPOSITE MATERIALS 9

Fibres – Fabrication, Structure, properties and applications - Glass, Boron, carbon, organic, ceramic and metallic fibers whiskers– Matrix materials structure – polymers, – metals and ceramics – Physical and chemical properties

UNIT IV PROCESSING OF POLYMER MATRIX COMPOSITES 9

Open mould process, bag moulding, compression moulding with BMC and SMC filament winding – pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites - Interfaces – Properties – recycling of PMC.

UNIT V PROCESSING OF - METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES 10

Solid state fabrication techniques – diffusion bonding – powder metallurgy techniques plasma spray, chemical and physical vapour deposition of matrix on fibres Chemical vapour infiltration – Sol gel – liquid state fabrication methods – infiltration – squeeze, casting – rheo casting – compocasting - Interfaces properties– application of MMC and ceramic matrix composites.

TOTAL: 45 PERIODS

REFERENCES:

1. Krishnan K Chawla, Composite Materials Science and Engineering, International Edition, Springer, 2006
2. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.
3. Bera.E and Moet.A, High performance polymers, Hanser Publishers, 2001.
4. Rauwendaal,C., Polymer extrusium, Hanser publishers, 2000.
5. Rosatao, D.V. Blow moulding HandBook, Hanser Publishers, 1989.
6. Seamour, E.B. Modern Plastics Technology, Prentice Hall, 2002
7. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers, 2003

MF9261 NON-DESTRUCTIVE EVALUATION L T P C
3 0 0 3

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**

MF9262 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

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.

MF9263 LEAN MANUFACTURING SYSTEM AND IMPLEMENTATION L T P C
3 0 0 3

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.

MF9264 QUALITY AND RELIABILITY ENGINEERING L T P C
3 0 0 3

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, covarient 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 PRODUCT DATA MANAGEMENT 8

Product Data Management – concepts – Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2000

REFERENCES:

1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
3. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.
4. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990

MF9266 **FINANCIAL MANAGEMENT** **L T P C**
3 0 0 3

AIM:

To introduce the concepts of financial and various functions of financial management so that the students will be able to handle higher level financial decisions.

OBJECTIVES:

To train students in various functions of finance such as working capital management, current assets management so that students will be able to make high investment decisions when they take up senior managerial positions.

UNIT I FINANCIAL ACCOUNTING 8

Accounting principles - Basic records - Preparation and interpretation of profit and loss statement - balance sheet - Fixed assets - Current assets.

UNIT II COST ACCOUNTING 12

Elements of cost - cost classification - material cost - labour costs - overheads - cost of a product - costing systems - cost determination - process - costing - Allocation of overheads - Depreciation - methods.

UNIT III MANAGEMENT OF WORKING CAPITAL 10

Current assets - Estimation of working capital requirements - Management of accounts receivable - Inventory - Cash - Inventory valuation methods.

UNIT IV CAPITAL BUDGETING 8

Significance of capital budgeting - payback period - present value method - accounting rate of return method - Internal rate of return method.

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 Enginering 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 – aliminium 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.

UNIT IV SCHEDULING AND PROJECT MANAGEMENT 12
Scheduling – Priority rules scheduling – sequencing – Johnson's algorithm for job sequencing – n job M machine problems – Project Network analysis – PERT/CPM – Critical path –Floats – Resource leveling – Queuing analysis.

UNIT V PERSONNEL AND MARKETING MANAGEMENT 9
Principles of Management – Functions of personnel management – Recruitment – Traiing – Motivation – Communication – conflicts – Industrial relations – Trade Union – Functions of marketing – Sales promotion methods – Advertising – Product packaging – Distribution channels – Market research and techniques.

TOTAL: 45 PERIODS

REFERENCES

1. Dr. R. Kesavan, C.Elanchezian and B.Vijayaramnath, Production Planning and Control, Anuratha Publications, Chennai – 2008
2. Dr. R. Kesavan,C. Elanchezian and T.Sundar Selwyn, Engineering Management – Eswar Press, Chennai – 2005
3. Dr. R. Kesavan, C. Elanchezian, and B.Vijayaramnath, Principles of Management – Eswar Press – Chennai – 2004
4. R. Panneerselvam, Production and Operations Management, Prentice Hall of India, 2002
5. Martand T. Telsang, Production Management, S.Chand & Co., 2005
6. Thomas E Mortan, Production and Operations Management, Vikas Publications, 2003.