UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M.E.COMPUTER INTEGRATED MANUFACTURING

SEMESTER I

SL.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA9105	Probability and Statistical Methods	3	1	0	4
2	CI9111	Applied Materials Engineering	3	0	0	3
3	CI9112	Competitive manufacturing systems	3	0	0	3
4	CI9113	Computer Aided Design and Manufacturing	3	0	0	3
5	CI9114	Advances in Manufacturing Technology	3	0	0	3
6	E1	Elective I	3	0	0	3
PRACTICAL						
7	CI9115	CIM Laboratory I	0	0	3	2
		TOTAL	**18**	**1**	**3**	**21**

SEMESTER II

SL.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CI9121	Robotics and Artificial Intelligence	3	0	0	3
2	CI9122	Mechatronics in Manufacturing systems	3	0	0	3
3	CI9123	Composite Materials	3	0	0	3
4	CI9124	Advanced Metrology and Computer Aided Inspection	3	0	0	3
5	E2	Elective – II	3	0	0	3
6	E3	Elective – III	3	0	0	3
PRACTICAL						
7	CI9125	Technical Seminar	0	0	2	1
8	CI9126	CIM Laboratory II	0	0	3	2
		TOTAL	**18**	**0**	**5**	**21**

SEMESTER III

SL.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	E4	Elective IV	3	0	0	3
2	E5	Elective IV	3	0	0	3
3	E6	Elective IV	3	0	0	3
PRACTICAL						
4	CI9131	Project Work – Phase I	0	0	12	6
		TOTAL	**18**	**0**	**5**	**21**

SEMESTER IV

SL.No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	CI9141	Project Work – Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS 69

ELECTIVES

Sl. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	ED 9164	Design of Hydraulics and Pneumatic Systems	3	0	0	3
2.	IE 9124	Supply Chain Management	3	0	0	3
3.	CI 9150	Advances in Welding and Casting Technology	3	0	0	3
4.	CI 9151	Reliability and Total Productive Maintenance	3	0	0	3
5.	CI 9152	Computer Aided Process Planning	3	0	0	3
6.	CI 9153	Corrosion and Surface Engineering	3	0	0	3
7.	CI 9154	Tool Engineering	3	0	0	3
8.	CI 9155	Total Quality Systems and Engineering	3	0	0	3
9.	CI 9156	Discrete System Simulation	3	0	0	3
10.	CI 9157	Precision Engineering	3	0	0	3
11.	CI 9158	Design for Manufacturing	3	0	0	3
12.	CI 9159	Rapid Prototyping	3	0	0	3
13.	CI 9160	Electronics Manufacturing Technology	3	0	0	3
14.	CI 9161	Micromachining Methods	3	0	0	3
15.	CI 9162	Nano Technology	3	0	0	3
16.	CI 9163	Techniques of Material Characterization	3	0	0	3
17.	CI 9164	Productivity Management and Reengineering	3	0	0	3
18.	IE 9176	Design of Cellular Manufacturing System	3	0	0	3
19.	CI 9166	Plasticity and Metal Forming	3	0	0	3
20.	CI 9167	Information Systems Analysis and Design	3	0	0	3
21.	CI 9168	Statistical Process Control and Non Destructive Testing	3	0	0	3
22.	CI 9169	Lean Manufacturing	3	0	0	3
23.	CI 9170	Finite Element Analysis in Manufacturing Engineering	3	0	0	3
24.	CI 9171	Manufacturing Information Systems	3	0	0	3
25.	MS 9153	Project Management	3	0	0	3
26.	CI 9172	Manufacturing Management	3	0	0	3

MA9105 PROBABILITY AND STATISTICAL METHODS L T P C
3 1 0 4

AIM: The course aims at providing knowledge for the basic concepts of Probability and Statistics and the techniques for solving mathematical problems for probability analysis which will be useful in solving some Engineering problems.

OBJECTIVES:

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES: 9

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES: 9

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY: 9

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES: 9

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, χ^2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS: 9

Covariance matrix – Correlation Matrix – Multivariate Normal density function – Principal components – Sample variation by principal components – Principal components by graphing

TOTAL : 60 PERIODS

REFERENCE:

1 Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer Prentice – Hall of India, Private Ltd., New Delhi, 7th Edition, 2007.
2. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 5th Edition, 2002.
3. Gupta, S.C. and Kapoor, V.K.”Fundamentals of Mathematical statistical”, sultanan Sons, New Delhi, 2001.
4. Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbbury, Singapore, 2002.
5. Dallas E Johnson et al., “Applied multivariate methods for data analysis”, Thomson and Duxbbury press, Singapore, 1998.

CI 9111 APPLIED MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

AIM: To impart knowledge at an advanced level in applied materials Engineering.

OBJECTIVE: This course provides knowledge in the areas Of Industrial Metallurgy, chemical Properties, heat treatment, advanced materials and selection of materials for important applications.

UNIT I PLASTIC BEHAVIOUR & STRENGTHENING 8

Mechanism of Plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals –Strengthening mechanism, 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.

UNIT II FRACTURE BEHAVIOUR 8

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 8

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**.**

UNIT IV MATERIAL PROCESSING 9

Processing of engineering materials – Primary and Secondary processes – astability, Weldability, forgeability and malleability Criteria – Process induced defects – Monitoring and control.

UNIT V MODERN MATERIALS AND TREATMENT 12

Dual phase steels, high strength low alloy (HSLA) Steel transformation included plasticity (TRIP), Steel, maraging steel, shape memory alloys, properties applications of engineering plastics and composites materials advanced structural ceramics – WC, Tic, Tac, Al_2o_3, Sic, Si_3N_4, CBN diamond, heat treatment alloy and tool steels, vapour deposition – Plasma, PVD- thick and thin film deposition – Nano materials-production of Nano sized materials.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. George E.Dieter, "Mechanical Metallurgy", McGraw Hill, 1988.
2. Charles, J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", (3 rd Edition, Butterworth – Heiremann, 1977.

REFERENCES:

1. The Hand book of Advance Materials, James k.Wessel, Wiley, Intersam,john, Wilson Publishers., 2004.
2. "Surface Engg of Meterials"- Principles of Equipment, Techniques, TadensZ
3. Burakonsa &T.Wierzchan.
   Thoas h.Courtney , "Mechanical Behaviour of Meterials" ,(2nd edition), McGraw Hill, 2000.
4. Flinn,R.A.and Trojan ,P.K.., "Engg Meterials and their Applications" (4th Edition), Jaico, 1999.
5. Metals hand book, vol. 10, "Failure Analysis and Prevention",(10th edition), 1994.

WEB REFERENCES:

1. www.astm.org/labs/pages/131350.htm
2. www.appliedmaterials.com/carrers/agu-ei.html

CI 9112 COMPETITIVE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

AIM

To impart knowledge on the pace of changes in the manufacturing technology.

OBJECTIVE

To emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company.

UNIT I MANUFACTURING IN A COMPETITIVE ENVIRONMENT 9

Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service.

UNIT II GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS 9

Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

UNIT III COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS 9

System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

UNIT IV LEAN MANUFACTURING 9

Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work –Man power reduction – Overall efficiency - Kaizen – Common layouts - Principles of JIT - Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture.

UNIT V JUST IN TIME: 9

Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation issues - Lean manufacture.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Groover M.P., " Automation, Production Systems and Computer Integrated Manufacturing ", Third Edition, Prentice-Hall, 2007.
2. Pascal Dennis, “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York, 2007.

REFERECES:

1. Jha, N.K. “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.
2. Kalpkjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
3. Taiichi Ohno, Toyota, " Production System Beyond Large-Scale production ", Productivity Press (India) Pvt.Ltd. 1992.

CI 9113 COMPUTER AIDED DESIGN AND MANUFACTURING

L	T	P	C
3	0	0	3

AIM :

To impart in depth knowledge in various fields of Computer Aided Design and Manufacture.

OBJECTIVES :

On completion of the course the students are expected to be knowledgeable in 2 dimensional and 3 dimensional transformations, modeling and analysis, CAD/CAM integration, CNC machine tool building, CNC programming using manual method and generation of CNC codes using CAM software.

UNIT I TWO DIMENSIONAL AND THREE DIMENSIONAL TRANSFORMATIONS 9

2D – Representation and Transformations of points – Transformations of Lines – Rotation, Reflection, Scaling and combined transformations, 3D – Scaling – Shearing – Rotation- Reflection – Translation – Projections parametric representation of Ellipse, parabola, Hyperbola- Practice on sate of the art CAD software.

UNIT II MODELLING AND ANALYSIS: 8

Wire frame, surface and solid modeling – solid modeling packages – Finite Element analysis (FEA) – Introduction and procedures – solution Techniques – Introduction to FEA packages.

UNIT III CAD/CAM INTEGRATION: 9

Networking- networking techniques, LAN, components, wiring methods, network interface cards, network standards, Graphics standards – Data exchange format, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP etc., Process planning, Computer Aided process planning(CAPP) - variant, generative approaches

UNIT IV COMPUTER NUMERICAL CONTROL MACHINES: 10

CNC Machine Building, structural details – configuration and design, friction and anti friction LM guide ways, Ball screw, torque transmission elements, Spindle drives, Feed drives, Positional measuring transducers- gratings, encoders, inductosyn, laser interferometer, Spindle, ATC, APC, Tooling – qualified, preset tooling.

UNIT IV CNC PROGRAMMING: 10

Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, sub routines, do loop, mirroring features, Manual part programming for CNC turning and machining centre, Generation of CNC program using popular CAM software.

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw –Hill Ed., 2007
2. HMT, "Mechatronics", Tata McGraw –Hill Ed., 1998
3. P Radhakrishnan, S Subramanyan, "CAD/CAM/CIM", New Age Publishers, 1994.

REFERENCES:

1. David F.Rogers and Alan Adams.J, "Mathematical Elements for Computer Graphics", McGraw –Hill Publishing Company International Edition, 1990.
2. P N Rao, "CAD/CAM: Principles and Applications", Tata McGraw –Hill Ed., 2004
3. Groover M.P., Automation, "Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt.Ltd, New Delhi, 1996.
4. Sadhu Singh, :Computer Aided Design and Manufacturing", Khanna publications, 2000
5. Warren S Seames, Computer Numerical Control : Concepts and Programming, Thomson Delmar, 4th Edition, 2002

CI 9114 ADVANCES IN MANUFACTRURING TECHNOLOGY

L T P C
3 0 0 3

AIM:

The aim of this course is to impart knowledge in various fields of advanced manufacturing technology

OBJECTIVE:

At the end of this course the students are expected to understand metal cutting and cutting tool materials, special machining processes, unconventional machining processes, micro machining process and rapid prototyping.

UNIT I METAL CUTTING AND TOOL MATERIALS 9

Orthogonal and oblique cutting – types of tool wear, abrasion, diffusion, Oxidation. Fatigue and adhesive wear – Prediction of tool life – Monitoring of wear, Cutting forces and Vibration – tool Materials, Cemented Carbide, Coated Carbide, Cermets. Ceramic, CBN and PCD – Selection of Machining parameters and Tools.

UNIT II SPECIAL MACHINING PROCESSES & EXPERIMENTAL TECHINIQUES 9

Deep hole drilling Honing – Lapping – Super finishing – Burnishing – Broaching High speed Machining, Measurement of cutting forces, temperature, Vibration and Tool wear in machining processes.

UNIT III UNCONVENTIONAL MACHINING 9

Principles, Processes. Various influencing parameters and Applications of Ultrasonic Machining, Electro Discharge Machining, Electro Chemical Machining, Electron and Laser Beam Machining, Plasma Arc Machining and Water Jet Machining.

UNIT IV MICRO MACHINING 9

Introduction to MEMS, principle, process capabilities, types, advantages, limitations and applications of bulk micro machining, surface micro machining and tool based micro machining processes.

UNIT V RAPID PROTOTYPING 9

Introduction – Classification – Principle advantages limitations and applications- Stereo lithography – laminated object manufacturing – Selective laser sintering – FDM, SGC, 3D Printing.

TOTAL:45 PERIODS

TEXT BOOK:

1. Shaw Milton.C., "Metal Cutting Principles", Second Edition, Oxford University, Press, 2005.
2. Armarego E.J.A. and Brown R.H., "The Machining of metals", Prentice Hall, 1982.

REFERENCES:

1. Battacharya, " theory of metal cutting", NCB Agency, 1984.
2. HMT Manual, "Non – t5raditional Machining Methods", 1975.
3. Pandley P.S. and shah.N. "Modern Manufacturing Processes", 1980.
4. Sadasivan T.A., and Sarathy.D. "cutting Tools for Productive Machining", Widia (India) Limited 1999.
5. Rich F. and Knight'K., "Artificial Intelligence", McGraw Hill Inc, 1991.
6. Marc J. Madou, Fundamentals of Microfabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267), 2006.

CI 9115 CIM Lab I

L T P C
0 0 3 2

1. Using of Preprocessor and post processor in finite element analysis (Exercise must include importing model from a modeling package, model correction, meshing, and addressing quality of mesh issues).
2. Model analysis of engineering structures (Exercises must include model analysis of simple beams and plates and comparison of FEA and analytical solutions, and model analysis of actual components like brackets, machine tool structures etc).
3. Nonlinear analysis (Exercise must include plastic deformation of simple objects or crash analysis simple structures.
4. 3 Axis CNC code generation for CNC machining.
5. CNC Machining of complex features like machining of hemispherical cavity, tapered hole, hole of parabolic shape etc..

LIST OF EQUIPMENT REQUIRED:

1. Computers 18
2. Preprocessor for FEA (Like Hyper mesh)
3. CAD Workstation
4. FEA Software
5. FEA Software for Nonlinear Analysis I
6. CAM Software for 3 axis machining or more
7. CNC Production type lathe or Milling Machine.

CI 9121 ROBOTICS AND ARTIFICIAL INTELLIGENCE

L T P C
3 0 0 3

AIM:
This course aims at providing advanced knowledge in the field of Industrial Robotics and the associated artificial intelligence.

OBJECTIVE :
On completion of the course the students are expect to the knowledgeable in Robot anatomy, end effectors, sensors, vision systems, kinematics, programming and the application of Artificial Intelligence in Robotics And Artificial Intelligence.

UNIT I INTRODUCTION: 7
Historical Perspective of Robots – Classification by Co-Ordinate system – classification by control method, Major Components of a Robot – Links and joints – Currents and future applications of Robots**.**

UNIT II ROBOT END EFFECT AND SENSORS: 11
Robot End effect and sensors – Grippers – Mechanical, Vacuum, Magnetic Grippers – Drives, Robot Sensors and Controllers – Internal and External Sensors – Non Optical and Optical position sensors – Encodes – Velocity, Acceleration, force, Torque, Proximity touch and slip sensors. Robot Vision – Imaging Components, Image representation Picture wading, Object recognition and categorization software.

UNIT III ROBOT ACTUATORS: 9
Control of actuators in Robots – Robot control Architecture – closed Loop control – effect of friction and gravity – Frequency domain – Robot Joint Control – Adaptive control stepper Motors – Brushless DC Motors – Direct drive actuators, Hydraulic and pneumatic and Actuators – Servo Amplifiers**.**

UNIT IV TRANSFORMATIONS AND KINEMATICS: 8
Translational and Rotational Transformations – Co-Ordinate reference Framer – Homogeneous Transformations – Forward solution – Inverse solution.

UNIT V ROBOT PROGRAMMING & ARTIFICIAL INTELLIGENCE: 10
Robot Programming Languages – characteristics of Languages – Position Specification – Motion Specification. Robot Program synthesis – Programming solution using VAL Robot programming Language ,Artificial Intelligence - search

strategies ,Heuristic search , Rule based problem solving , Knowledge Representation .

TOTAL: 45 PERIODS

TEXT BOOK:

1. R.D.Klafter , Chemieleskio, T.A.and negin .m ., "Robotics Engineering an Integrated approach", Prentice Hall , 1989.

REFERENCES:

1. K.S.FU, R.C. Gonzalez, and C.S.G.Lee., "Robotics control , Sensing, Vision ,and Intelligence" , Prentice Hall , 1987.
2. G.Bekey, Autonomous Robots, MIT Press, 2005.
3. J.J.Craig, "Introduction to Robotics"Addision Wesley Publishers, 2005.
4. M. Nagenevtsky, Artificial Intelligence –a guide to intelligent systems addision – Wesley, 2005, Chapters 2,4,7.

CI 9122 MECHATRONICS IN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

AIM

To impart knowledge in the inter disciplinary field of Mechatronics as related to Manufacturing.

OBJECTIVE:

This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

UNIT I INTRODUCTION 5

Introduction to Mechatronics - Systems- Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics - Measurement Systems - Control Systems.

UNIT II SENSORS AND TRANSDUCERS 12

Introduction - Performance Terminology – Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors - Selection of sensors - Signal processing.

UNIT III ACTUATORS 12

Actuators – Mechanical - Electrical - Fluid Power - Piezoelectric - Magnetostrictive - Shape memory alloy - applications - selection of actuators.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 8

Introduction - Basic structure - Input and output processing - Programming - Mnemonics- Timers, counters and internal relays - Data handling - Selection of PLC.

UNIT V DESIGN AND MECHATRONICS CASE STUDIES 8

Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine – Mechatronics Control in automated Manufacturing – Data Acquisition Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bolton.W, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.

REFERENCES:

1. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007.
2. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.
3. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and applicatlions” Tata McGraw-Hill Publishing Company Limited, 2003.
4. Michael B.Histand and Davis G.Alciatore,”Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition, 1999.
5. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Nelson Thornes Ltd, Eswar press, Indian print, 2004.

CI 9123 COMPOSITE MATERIALS L T P C
3 0 0 3

AIM :

To impart knowledge about the ingredients, properties, manufacturing methods of various types of composite materials.

OBJECTIVE :

The objective of the course is to train the students at an advanced level in the field of composite materials by imparting knowledge about fibers, matrices, their properties, manufacturing methods involved in polymer matrix, metal matrix, ceramic matrix composites and macro mechanics of composite materials.

UNIT I INTRODUCTION: 9

Reinforcement – fibres – Glass fibre, Aramid fibre, Carbon fibre, boron fibre – fabrication – properties, applications – comparison of fibres – particulate and whisker reinforcement. Fabrication of Matrix materials – properties. Wettability- Effect of surface roughness- Interfacial bonding – Methods measuring bond strength.

UNIT II POLYMER MATRIX COMPOSITES: 9

Types – Processing – Thermo sensing matrix composites – Hand layup and sprayup techniques filament winding, pultruion, resin transfer moulding, auctoclave moulding – thermoplastic matrix composites – Injection moulding, film stacking – diaphragm forming – thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications.

UNIT III METAL AND CERAMIC MATRIX COMPOSITES: 15

Types, Important metallic materials, Processing – solid state. Liquid state, deposites insitu.Sic fibre / titanium interface. Mechanical properties.applications. Ceramic matrix materials – Processing – Hot pressing, liquid infiltration techniques lanxide process, Insitu chemical reaction techniques CVD, CVI, solgel process. Interface in CMCs. Mechanical Properties. Thermal shock resistance – Applications. Processing. Properties. Interface. Surface treatment – chemical vapour deposits Applications.

UNIT IV GEOMETRICAL ASPECTS & MICROMECHANICS: 7

Unidirectional laminas – Volumefraction and weight fraction woven roving, inplane range fibres – fibre length and fibre orientation distribution – voids – fibre Orientation

during flow. Micromechanics models for stiffness – micromechanics models for strength – thermal and moister effects.

UNIT V FATIGUE AND CREEP IN COMPOSITE MATERIALS: 05

Fatigue S.N curves – fatigue behaviors of CMCs – fatigue – particle and whisker reinforced composites – Hybrid composites – thermal fatigue – creep.

.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Krishnan K.Chawla, "composite Materials Science and Engineering", Springer, 2001.

REFERENCES:

1. Mathews F.L. and Rawlings R.D, "composite Materials: Engineering and Science", CRC Press and wood head Publish Limited, 2002.
2. Derek Hull, "An Introduction to composite Materials", Cambridge University Press, 1988.
3. Handbook of composites – American society of Metals, 1990.

CI 9124 ADVANCED METROLOGY AND COMPUTER AIDED INSPECTION

L T P C
3 0 0 3

AIM:

To give a thorough knowledge of measurement and instrumentation of increasing importance in industry. The student will be knowledgeable in various standards and proliferation of computerized and automated inspecting techniques along with the classical metrology.

OBJECTIVE:

1. To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries.
2. Expose the students to various modern metrological instruments and the procedure used to operate these instruments.

UNIT I GENERAL CONCEPTS OF MEASUREMENT: 8

Definition – Standards of measurement – Errors in measurement – Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments.

UNIT II MEASUREMENT OF SURFACE FINISH AND MEASURING MACHINES: 9

Definitions – Types of Surface Texture: Surface Roughness Measurement Methods-Comparison, Profilometer, 3D Surface Roughness Measurement – Instruments.

UNIT III INTERFEROMETRY: 8

Interferometry – Introduction, Principles of light interference – Interferometers – Measurement and Calibration – Laser Interferometry.

UNIT IV COMPUTER AIDED AND LASER METROLOGY: 10

Tool Makers Microscope – Microhite – Co – Ordinate measuring machine – Applications – Laser Micrometer, Laser Scanning gauge, Non contact and in-process inspection, Vision system.

UNIT V IMAGE PROCESSING: 10

Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms

TOTAL: 45 PERIODS

TEXT BOOK:

1. GUPTA, I.C, "A Text Book of engineering metrology", Dhanpat Rai and Sons, 1996.

REFERENCES:

1. G.N.GALYER F.W. and C.R.SHOTBOLT, "Metrology for engineers", ELBS, 1990.
2. GRAHAM T.SMITH, "Industrial Metrology", Springer, 2002
3. "ASTE Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
4. R.K.RAJPUT, "Engineering Metrology and Instrumentations", Kataria & Sons Publishers, 2001.
5. MILAN SONKA, VACLAV HLAVAC and ROGER BOYLE, "Image Processing, Analysis, and Machine Vision", Cengage-Engineering; 3 edition (March 19, 2007).

WEB REFERENCES:

1. www.metrologytooling.com
2. www.iuk'tu-harburg.de

		L T P C
CI 9126	**CIM LAB II**	**0 0 3 2**

1. Automated component inspection using vision System.
2. Automation using programmable Logic Control.
3. Dimensional and geometric measurement using CMM.
4. Study on RDBMS and its application in problems like inventory control MRP etc.
5. Robot Programming.

LIST OF EQUIPMENTS REQUIRED:

1. Computers 18 (Same as in CIM Lab I)
2. Vision System
3. Programmable Logic Controller
4. Coordinate Measuring Machine
5. RDMBS Package with relevant modules like Inventory Control and MRP
6. Robot Simulator.

ED 9164 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS L T P C
3 0 0 3

AIM

To impart knowledge on the Design of Hydraulic and Pneumatic Systems as practiced in industries.

OBJECTIVE

To study the principles, practices and techniques of Design of Hydraulic and Pneumatic Systems.

UNIT I. OIL HYDRAULIC SYSTEMS 10

Hydraulic Power Generators - Selection and specification of pumps, pump characteristics - Linear and Rotary Actuators - selection, specification and characteristics - Pressure - direction and flow control valves - relief valves, non-return and safety valves - Hydraulic actuation systems.

UNIT II. HYDRAULIC CIRCUIT DESIGN 10

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits – Design and methodology-Sequential circuits, cascade, circuits - Compound and combination circuit design - selection of components - safety and emergency mandrels.

UNIT III. PNEUMATIC SYSTEMS AND CIRCUITS 8

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions - modules and their integration.

UNIT IV. PNEUMATIC CIRCUIT DESIGN 9

Sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design - hydro pneumatic circuits - Pneumatic equipments - selection of components - design calculations –application.

UNIT V. COMPUTER CONTROL &MAINTENANCE OF FLUID POWER CIRCUITS: 08

Fuzzy logic in fluid power circuits- PLC in fluid powers- PLC ladder diagram – Low cost automation - Robotic circuits - Installation -Fault finding in fluid power circuits.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Antony Espossito, “Fluid power with Applications ", Prentice Hall, 1980.

REFERENCES:

1. Dudleyt, A.Pease and John J.Pippenger, " Basic Fluid Power ", Prentice Hall, 1987.
2. Andrew Parr, " Hydraulic and Pneumatics ", (HB), Jaico Publishing House, 1999.
3. Bolton. W. “Pneumatic and Hydraulic Systems ", Butterworth - Heineman, 1997.

IE 9124 SUPPLY CHAIN MANAGEMENT **L T P C**
3 0 0 3

AIM

To impart knowledge on logistics, supply chain network design, selection and coordination of supply chain.

OBJECTIVE:

At the end of this course the student should be able to understand

1. Importance of supply chain
2. logistics management
3. design factors of supply chain
4. sourcing and revenue management
5. managing the supply chain.

UNIT-I INTRODUCTION: **06**

Definition of Logistics and SCM: Evaluation, Scope Importance & Decision phases – Drivers of SC performance and Obstacles.

UNIT-II LOGISTICS MANAGEMENT: **10**

Factors – Modes of transportation – Design options for transportation Networks - Routing and Scheduling – Inbound and outbound logistics –Reverse Logistics – 3PL – Integrated Logistics concepts- Integrated Logistics Model – Activities – Measuring logistics cost and performance – Warehouse Management – Case Analysis.

UNIT-III SUPPLY CHAIN NETWORK DESIGN: **10**

Distribution in supply chain – Factors in Distribution network design – design Options – Network Design in supply chain – Framework for network Decisions – Managing cycle inventory and safety.

UNIT-IV SOURCING AND PRICING IN SUPPLY CHAIN: **09**

Supplier Selection and contracts – design collaboration – Procurement process. Revenue management in supply chain.

UNIT-V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN : **10**

Supply Chain Coordination – Bullwhip effect of lack of Coordination and obstacles – IT and SCM – supply Chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Supply chain management, Strategy, Planning, and Operation – Sunil Chopra and Peter Meindl – PHI, Second edition, 2004.

REFERENCES:

1. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, PHI 2002.
2. Logistics and Supply Chain Management – Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition.
3. Modeling the supply Chain, Jeremy F.Shapiro, Thomson Duxbury, 2002.
4. Handbook of Supply Chain Management, James B.Ayers, St.Lucle Press, 2000.

CI 9150 ADVANCES IN WELDING AND CASTING TECHNOLOGY L T P C
3 0 0 3

AIM

To impart knowledge on advances in welding and casting technology, cast design and advanced welding and casting processes.

OBJECTIVE: At the end of this course the student should be able to understand

1. Design principles of welding and casting
2. Principles of advanced welding and casting processes
3. Automation of welding and casting plant.

UNIT- I WELDING DESIGN AND METALLURGY: 10

Weld joint design-principle of stresses-weld thermal cycles - Heat Affected Zone (HAZ) - Weldability of steels - Cast iron - Stainless steels, aluminum, copper and titanium alloys - Hydrogen embrittlement - Pre and Post weld heat treatments - Weld defects.

UNIT-II SPECIAL WELDING PROCESSES: 10

Friction welding process - effects of speed and pressure –Types- Explosive welding – Process Parameters-Plasma arc welding - Electron beam welding - High frequency induction welding - Diffusion bonding -Types- Cold pressure welding - Ultrasonic welding - Laser beam welding.

UNIT-III CASTING DESIGN AND METALLURGY: 08

Design of gate,sprue,riser-design of pattterns – design of thin and unequal sections-L,T,V,X,Y junctions-Solidification –Shrinkage – Rapid solidification processing(RSP)-Melt spinning-Roll quenching-Vibratory solidification-Splat cooling.

UNIT-IV SPECIAL CASTING PROCESSES: 08

Evaporative Pattern Casting Process and full mould process –Vaccum sealed moulding- vaccum casting-Magnetic Moulding -Squeeze Casting-types- Plaster mould casting-Ceramic mould casting-Thixoforming or semi solid forming-Single crystal growing.

UNIT-V AUTOMATION OF WELDING AND FOUNDRY : 09

Use of robots in welding- weld positioner and manipulators -weld seam tracking-arc sensing-vision system-automation of foundry-use of robots-moulding machines-Automation of sand plant, moulding and fettling sections of foundry-Dust and fume control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Heine, Loper and Rosenthal, "Principles of Metal casting", Tata McGraw-Hill, 1994.
2. PARMAR,R.S., "Welding Processes and Technology", Khanna Publishers, 1997.
3. JAIN,P.L., "Principles of Foundry Technology", Tata McGraw Hill, 2003.

REFERENCES:

1. KLAS WEMAN, welding processes hand book, CRC press,2003.
2 MINKOFF,J., Solidification and cast structure,wiley.1986.
3. American Society of Metals, "Source Book on Electron beam and laser beam Welding", 1987.
4. American Society of Metals, "Metals Hand Book", 9th Edition, Vol.V, 1989.
5. American Society of Welding, "Hand book of Welding", Vol.I to V.

CI 9151 RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE

L T P C
3 0 0 3

AIM

To impart knowledge about reliability and total productive maintenance

OBJECTIVE

To teach the essentiality of reliability engineering, reliability prediction and the implementation of total productive maintenance.

UNIT – I INTRODUCTION: 09

Reliability function - MTBF - MTTF - mortality curve - availability -Maintainability.

UNIT – II FAILURE DATA ANALYSIS: 09

Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation.

UNIT – III RELIABILITY PREDICTION: 09

Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis – Standby Systems - Complex Systems.

UNIT - I V RELIABILITY MANAGEMENT: 09

Reliability demonstration testing - Reliability growth testing - Duane curve -Risk assessment - FMEA, Fault tree.

UNIT – V TOTAL PRODUCTIVE MAINTENANCE: 09

Causes of Machine Failures - Downtime - Maintenance policies - Restorability predictions - Replacement models - Spares provisioning -Maintenance management – Total Productive Maintenance – Maximizing equipment effectiveness – Organizing for TPM implementation – Implementation – TPM small group activities.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Modarres, "Reliability and Risk Analysi ", Meral Dekker Inc., 1993.
2. Nakajima, Seiich, “Introduction to TPM”, Productivity Press, 1988.

REFERENCES*:*

1. Paul Kales, “ Reliability for technology Engineering and Management ", Prentice Hall, New Jersey, 1998.
2. Gopalakrishnan.P, and Banerji A.K., “Maintenance and Spare Parts Management ", Prentice Hall of India, New Delhi, 1996.

CI 9152 COMPUTER AIDED PROCESS PLANNING L T P C

3 0 0 3

AIM: To provide sound knowledge in process planning in the manufacturing using computers.

OBJECTIVE

To familiarize the students with process planning in the manufacturing cycle, design, drafting, geometric modeling, systems in CAPP and report generation.

UNIT I INTRODUCTION: **05**

The role of Process Planning in the Manufacturing cycle – Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology.

UNIT II PART DESIGN REPRESENTATION: **10**

Design Drafting – Dimensioning – conventional tolerating – Geometric tolerancing, CAD – Input/output devices – topology – Geometric transformation – Perspective transformation – Data structure – Geometric modeling for process planning – GT coding – The opitz system – The MICLASS system.

UNIT III PROCESS ENGINEERING AND PROCESS PLANNING: **10**

Experience based planning - Decision table and decision trees – Process capability analysis – Process Planning – Variant process planning – Generative process planning– Forward and Backward planning, input format.

UNIT IV COMPUTER AIDED PROCESS PLANNING SYSTEMS: **10**

Logical Design of Process Planning – Implementation considerations – Manufacturing system components, production volume, No. of production families – CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

UNITV INGTEGRATED PROCESS PLANNING SYSTEMS: **10**

Totally Integrated process planning systems – An Overview – Module structure – Date Structure, operation – Report Generation, Expert process planning.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gideon Halevi and Roland D.Weill, “Principles of Process Planning”, A logical approach – Springer, 2003.
2. Tien-Chien Chang, Richard A.Wysk, “An Introduction to automated process planning systems”, Prentice Hall, 1985.
3. Chang, T.C., “An Expert Process Planning System”, Prentice Hall, 1985.

REFERENCES:

1. Nanua Singh, “Systems Approach to Computer Integrated Design and Manufacturing”, John Wiley & Sons, 1996.
2. Rao, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Co. 2002.
3. Thomas E. Vollmann and William L.Bery, “Manufacturing Planning and Control Systems, 5th Edn., Galgotia Publications, 2004.

4. WEB REFERENCES:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/englo/027/027.htm

CI 9153 CORROSION AND SURFACE ENGINEERING **L T P C**
3 0 0 3

AIM:To impart knowledge on the corrosion and surface problems in Engineering practices.

OBJECTIVE:

1. To impart knowledge on the scientific principles and methods that underlie the cause, detection, measurement and prevention of corrosion problems in engineering practices.
2. To impart knowledge on the hands-on approaches for matching surface treatments with design and performance requirements.

UNIT- I MECHANISMS AND TYPES OF CORROSION : 09

Principles of Corrosion – classification of corrosion – form of corrosion, general, localized, metallurgical influenced, mechanically assisted, environmentally induced corrosions - Factors influencing corrosion- corrosion damage – corrosion cost.

UNIT – II TESTING AND PREVENTION OF CORROSION: 09

Planning and preparation of corrosion tests – In-service monitoring, simulated service, laboratory testing – Evaluation of corrosion - Prevention of Corrosion, suitable designing and modifications of corrosive environment, corrosion inhibitors -Cathodic Protection - Anodic protection - Protective surface coatings.

UNIT – III CORROSION BEHAVIOR OF MATERIALS : 09

Selection of material for various corrosive environments - Corrosion of Steels, Stainless Steel, Aluminum alloys, Copper alloys, Nickel and Titanium alloys – Corrosion of Polymers, Ceramics and Composite materials.

UNIT – IV SURFACE COATINGS: 09

Solid surface significance ,surface properties, superficial layer – changing surface metallurgy, chemistry and adding a surface layer or coating - Diffusion coatings-Electro and Electro less Plating-Hot dip coating-Hard facing-Metal spraying, Plasma Spraying-Ceramics-APS, VPS, CCAPS – Flames and Arc processes – Conversion coating.

UNIT – V THIN LAYER ENGINEERING PROCESSES: 09

Laser and Electron Beam hardening- Thermal evaporation, Arc Vaporization, Sputtering, Ion plating- Vapor deposition processes, Implantation technique – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating – Properties and applications of thin coatings.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985
2. Kenneth G.Budinski, “Surface Engineering for Wear Resistance”, Prentice Hall, 1988.

REFERENCES:

1. Schweitzer.P.A.”Corrosion Engineering Hand Book”, 3rd Edition, Marcel Decker, 1996.
2. Winston Review, R. Uhlig, Corrosion, Hand Book 2nd Edition, John Wiley ,2000.
3. T.Burakowski and T.Wierzchon, “Surface Engineering of Metals”, CRC press,1999
4. ASM Metals Hand Book – Volume 13 , Corrosion, 1999
5. ASM Metals Hand book – Volume 5, Surface Engineering, 1999.

CI 9154 **TOOL ENGINEERING** **L T P C**
3 0 0 3

AIM
To impart in depth knowledge in various fields of tool engineering.

OBJECTIVES
This course provides knowledge in the areas of design of single point and multi point cutting tools, dies, jigs, fixtures and limit gauges and toll design for CNC machines.

UNIT – I INTRODUCTION : 07
Broad Classification of Tools-Cutting tools, Dies , Holding and Measuring tools, Tool materials and heat treatment- Ferrous, non-ferrous and non metallic materials, tool making practices.

UNIT – II DESIGN OF CUTTING TOOLS: 11
Single Point Cutting Tools: Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc. Design of Form Tools: Flat and circular form tools, their design and applications.

UNIT – III DESIGN OF DIES: 10
Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Moulding, Powder Metallurgy die design.

UNIT – IV DESIGN OF JIGS AND FIXTURES: 09
Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures.

UNIT-V DESIGN OF LIMIT GAUGES AND TOOL DESIGN FOR CNCMACHINES: 8
Fixed gauges, gauge tolerances, indicating gauges, automatic gauges, selection of materials, tool design for CNC machines- fixture design, cutting tools, tool holding, tool pre-setter, automatic tool changers and positioners.

TOTAL: 45 PERIODS

TEXT BOOKS :
1. Cyril Donaldson et al, “Tool Design”, Tata Mc-Graw Hill, 2006
2. Pollack H.W., “Tool Design” Reston Publishing Company, Inc. 1976.

REFERENCES:
1. Joshi P.H., “Jigs and Fixtures, Tata Mc-Graw Hill, 2003
2. Hiram E. Grant, “Jigs and Fixtures, Tata Mc-Graw Hill, 2006
3. Kempster M.H.A., “Principles of Jig and Tool Design”, English University Press Ltd.,1968

CI 9155 TOTAL QUALITY SYSTEMS AND ENGINEERING L T P C
3 0 0 3

AIM

To impart knowledge on the total quality system and engineering as practiced in industries.

OBJECTIVE

To study the principles , practices and techniques of quality systems and engineering.

UNIT – I INTRODUCTION 10

Principles of Quality Management - Pioneers of TQM - Quality costs - Customer Orientation - Benchmarking - Re-engineering - Concurrent Engineering.

UNIT – II PRACTICES OF TQM 10

Quality system - ISO 9001:2000 - QS 9000, ISO 14000 - Quality Auditing - Leadership - Organisational Structure - Team Building - Information Systems and Documentation.

UNIT - III TECHNIQUES OF TQM 10

Single Vendor Concept - J.I.T. - Quality Function deployment - Quality Circles - KAIZEN - SGA - POKA YOKE - Taguchi Methods.

UNIT – IV QUALITY BY DESIGN 08

Introduction – Rationale for implementation – Benefits– Teams – Communication models – Implementation – Tools – Misconceptions and Pitfalls.

UNIT V PRODUCTS LIABILITY 07

Introduction – Product safety law – products liability law – defenses – Proof and the expert witness – Financial Loss – The future of products liability – Prevention.

TOTAL: 45 PERIODS

TEXTBOOK:

1. Besterfield D.H., Besterfield C.M, Besterfield G.H and Besterfield M.S., “Total Quality Management ", Pearson Education, 2002.

REFERENCES:

1. Harvid Noori and Russel, " Production and Operations mangement - Total Quality and Responsiveness ", McGraw-Hill Inc, 1995.
2.. Suresh Dalela and Saurabh, ISO 9000 " A Manual for Total Quality Management ", S.Chand and Company Ltd., 1997.
3.. John Bank, " The Essence of Total Quality Management ", Prentice Hall of India Pvt.Ltd., 1995.
4.. Mohamed Zairi, " Total Quality Management for Engineers ", Woodhead Publishing Limited 1991.

CI 9156 DISCRETE SYSTEM SIMULATION 3 0 0 3

AIM: To teach the various aspects of simulation and its applications.

OBJECTIVE:

1. To understand the importance and advantages of applying simulation techniques for solving various problems on discrete event systems.
2. To teach various random number generation techniques, its use in simulation, tests and validity of random numbers etc. development of simulation models, verification, validation and analysis.
3. Introduction to various simulation languages and comparison.

UNIT-I INTRODUCTION: 03

Systems, modeling, general systems theory, concept of simulation, simulation as a decision making tool, types of simulation.

UNIT-II RANDOM NUMBERS; 05

Pseudo random numbers, methods of generating random variates, discrete and continuous distributions, testing of random numbers.

UNIT-III DESIGN OF SIMULATION EXPERIMENTS: 08

Problem formulation, date collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

UNIT-IV SIMULATION LANGUAGES: 14

Comparison and selection of simulation languages, study of any one simulation language.

UNIT-V CASE STUDIES IN SIMULATION: 15

Development of simulation models using the simulation language studied for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Jerry Banks and John, S.Carson, BarryL. Nelson, David M.Nicol, and P.Shahabudeen, "Discrete event system simulation", 4th edition Prentice Hall, India, 2000.

REFERENCES:

1. Shannon, R.E. "systems simulation – The art and Science", Prentice Hall, 1975.
2. Thomas, J. Schriber, "simulation using GPSS", John Wiley, 1991.
3. Law of Kelton, "Simulation Modeling and Analysis", 3rd edition by Averill M.Law and W.David Kelton McGraw Hill.

CI 9157 PRECISION ENGINEERING L T P C
3 0 0 3

AIM

The aim is to understand the principles and applications of Precision Engineering.

OBJECTIVES

The student is motivated learn about the concept of part accuracy, Machining accuracy and to discuss on the types of errors, and their sources. The student will be able to understand the need for precision and application. In addition, the student will enhance his/her knowledge in Precision Engineering and its applications.

UNIT - I PRECISION ENGINEERING 08

Introduction – Accuracy and Precision– Need for high precision – concept of accuracy – tolerance an fits: system – Hole and shaft system – expects accuracy of a Manufacturing process – types of fits – Selective assembly.

UNIT - II MATERIALS FOR PRECISION ENGINEERING: 08

Diamond – types-single crystal- PCD – Natural-synthetic CBN - Ceramics – coated metals and non-metals–High– performance polymer – alloys – refractory metals: cutting tools – performance – components of instruments – Jewels – self Lubrication – smart materials – properties – testing – applications.

UNIT - III PRECISION MACHINING: 10

Precision grinding: IC chip manufacturing- ELID process – aspherical surface generation Grinding wheel- Designer and selection of grinding wheel-High-speed grinding-High-speed milling-Micro machining – Diamond turning-MEMS – micro finishing process – surface roughness measures – concept and non-concept method – comparison of features with machining process.

UNIT - 1V ERRORS: CAUSES AND REMEDICS: 10

Static stiffness - influence on machining accuracy. Introduction – over all stiffness in a machine/instrument – errors due to variation of cutting forces – clamping forces – errors due to compliance while machining. Inaccuracy due to thermal effects: Heat sources –war dissipation – Geometry of thermal deformation-influence of forced isstratics dimensional wear of elements – instruments; Machining tools their influence an accuracy- error due to clamping and setting location.

UNIT - V PRECISION MACHINE ELEMENTS: 09

Introduction- guide ways- Drive systems; rolling element bearings-Principles, construction, classification, application etc., -Lubricated sliding bearings- construction – Principles etc.,- Hydrostatics bearings-types – aerostatic bearings – linear drive motors – magnetic bearings- applications-limitations - advantages.

TOTAL: 45 PERIODS

TEXT BOOKS:-

1. R.L. Murthy, Precision Engineering in Manufacturing, New age Instruction Publishes 2005. New Delhi.
2. V.C. Venkatesh and Sudin, Izwan, Precision engineering:- Tata McGraw Hill Co., New Delhi, 2007.

REFERENCE:

1. JAMESD, MEADOWS, - “Geometric Dimensioning and tolerancing”, Marcel Dekker Inc.1995.

CI 9158 **DESIGN FOR MANUFACTURING** **L T P C**
3 0 0 3

AIM

The aim is to impart the students with knowledge of the general design principles of manufacturing and to provide complete informations for further study.

OBJECTIVE

At the end of this course the student should be able to understand the design principles of casting, welding, forming, machining and assembly, by considering various manufacturing constraints.

UNIT – I INTRODUCTION **06**

Economics of Process selection – General design principles of manufacturability – Proper material selection – Strength and Mechanical factors- Application of form design.

UNIT – II CASTING DESIGN AND WELDMENT DESIGN **10**

Factors affecting casting design- Strength aspects – Sand casting and die casting design-Factors affecting weldment design-Gas and arc welding design.

UNIT-III FORMED METAL COMPONENTS AND NON METALLIC PARTS DESIGN: **10**

Design considerations for the manufacture of extruded, cold headed metal parts – Tube and section bends – Powder metal parts-Thermo setting plastic parts-Reinforced – Plastic/Composite parts.

UNIT – IV MACHINED COMPONENTS DESIGN: **10**

Design considerations for the manufacture of Turned parts-drilled parts-milled parts, planned, shaped and slotted parts-Ground parts-parts produced by EDM.

UNIT – V DESIGN FOR ASSEMBLY **09**

Types of assembly – DFA –Index – evaluation of assembly – assembly cost reduction – case of assembly – impact on quality – related software usage – case studies.

TOTAL: 45 PERIODS

TEXTBOOK:

1. James G. Bralla – “Handbook of product design for manufacture”, McGraw Hill Book Co., 1986.

REFERENCES:

1. Henry Peck – “Designing for manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.
2. Matousek – “Engineering Design”, Blackie & sons, 1956.

CI 9159 RAPID PROTOTYPING 3 0 0 3

AIM: To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields.

OBJECTIVE:
Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

UNIT I INTRODUCTION: 8
Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Applications.

UNIT II REVERSE ENGINEERING AND CAD MODELING: 10
Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNITIII LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS:10
Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.
Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV POWDER BASED RAPID PROTOTYPING SYSTEMS: 10
Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping(LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V OTHER RAPID PROTOTYPING TECHNOLOGIES: 07
Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.

TOTAL:45

PERIODS
TEXT BOOK:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.

REFERENCE:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
2. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
3. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

CI 9160 ELECTRONICS MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

AIM: This course aims at providing knowledge in the field of electronic manufacturing and packaging.

OBJECTIVES: Upon completion of this course students will able to

1. Understand various steps in wafer preparation
2. Describe the method of manufacture and types of Printed circuit board(PCB)
3. Describe various components in THT and SMT
4. Explain Soldering and cleaning in Electronic packaging
5. Describe Surface Mount Technology (SMT)
6. Explain inspection, testing and rework of populated PCB.

UNIT – I INTRODUCTION TO ELECTRONICS MANUFACTURING: 08

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed Circuit Boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronic packaging – Through Hole Technology (THT) and Surface Mount Technology (SMT)

.

UNIT – II COMPONENTS AND PACKAGING: 09

Through-hole components – axial, radial, multi leaded, odd form. Surface mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, Flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT – III SOLDERING AND CLEANING: 09

Soldering theory, effect of elemental constituents on wetting, microstructure and soldering, solder paste technology – fluxing reactions, flux chemistry, solder powder, solder paste composition and manufacturing, solder paste rheology, Wave soldering. Adhesive and solder paste application. solder system variables. soldering temperature profile. Reflow soldering - profile generation and control, soldering quality and defects. Post solder cleaning and selection. Measurement of cleanliness levels.

UNIT – IV SURFACE MOUNT TECHNOLOGY: 11

SMT Equipment and Material Handling Systems, Handling of Components and Assemblies - Moisture Sensitivity and ESD, Safety and Precautions Needed, IPC

and Other Standards, Stencil Printing Process, solder paste storage and handling, stencils and squeegees, process parameters, quality control - Component Placement, Equipment Type, Chip shooter, IC placer, Flexibility, Accuracy of Placement, Throughput, reflow soldering, adhesive, underfill and encapsulation process, applications, storage and handling, process & parameters.

UNIT – V INSPECTION, TEST AND REWORK FOR PCB: 08

Inspection Techniques, Equipment and Principle – AOI, X-ray, stencil printing process- defects & corrective action, component placement process - defects & corrective action, Reflow Soldering Process- defects & corrective action, underfill and encapsulation Process- defects & corrective action, Testing of assemblies, In-circuit testing (ICT), functional testing, testing jigs and fixtures concept of yield, Rework and Repair, tools, rework criteria and process, Design for - Manufacturability, Assembly, Reworkability, Testing, Reliability and Environment.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Ning Cheng LEE, "Reflow Soldering Process and Trouble Shooting – SMT, BGA, CSP and Flip Chip Technologies", Newnes Elsevier, 2001
2. Gurnett, Keith W., "Surface Mount Handbook", Newnes Elsevier , 1999
3. Donald Seraphim, Ronald C. Lasky, Che-Yu Li, "Principles of Electronic Packaging" Mcgraw-Hill, 1989.

REFERENCES :

1. Rudolf Strauss, " SMT Soldering Handbook", Newnes Elsevier , 1998
2. Peter Van Zant, " Microchip Fabrication – a practical guide to semiconductor processing"McGraw Hill, 2000
3. Thomas L.Landers, "Electronics Manufacturing Processes", Prentice Hall, 1998
4. Prasad R.P., "Surface Mount Technology: Principles and Practice", New York : Chapman and Hall, 1997.
5. Clyde F.Coombs,Jr., " Printed Circuits Handbook " Mc Graw-Hill Hand books Sixth
   Edition, 2008

CI 9161 MICRO MACHINING METHODS

L T P C
3 0 0 3

AIM: The Purpose of this subject is to understand the principles of various micro fabrication processes**.**

OBJECTIVES:

Upon completion of this subject, student will be able to:

1. Understand principle of Microsystems and feed back systems
2. Know the different methods of micro fabrication.
3. Understand the properties and microstructure of materials
4. Appreciate integration processes in detail.
5. Enhance his/her knowledge in semiconductor manufacturing processes.

UNIT I INTRODUCTION: 08

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feed back systems.

UNIT II MICROMECHANICS: 09

Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials**.**

UNIT III MICRO-FABRICATION: 10

Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining-Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer-devices.

UNIT IV MECHANICAL MICROMACHINING: 10

Theory of micromachining-Chip formation-size effect in micromachining-microturning, micromilling, microdrilling- Micromachining tool design-Precision Grinding-Partial ductile mode grinding-Ultraprecision grinding- Binderless wheel – Free form optics.

UNIT V MICRO ELECTRO MECHANICAL SYSTEM FABRICATION: 08

Introduction – advance in Micro electronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Sámi Franssila, “Introduction to Micro Fabrication”, John Wiley and sons Ltd., UK, 2004, ISBN: 978-0-470-85106-7.

REFERENCE BOOKS:

1. Madore J, “fundamental of Micro fabrication”, CRC Press, 2002.
2. Mark J. Jackson, “Micro fabrication and Nanomanufacturing”, CRC Press, 2006.
3. Peter Van Zant, “Microchip fabrication”, McGraw Hill, 2004.
4. Mohamed Gad-el-Hak, “The MEMS Handbook”, CRC Press, 2006.

CI 9162 NANOTECHNOLOGY L T P C
3 0 0 3

AIM

The aim is to appreciate the students with the background, applications and current status of nanotechnology and nanomaterials, and to make them understand the relevant basic scientific principles underpinning nanotechnology.

OBJECTIVES:

At the end of this course the students are expected to understand the general issues relating to nanotechnology and nanofabrication.

- Methods for production of Nanoparticles
- Characteristic techniques of nanomaterials

UNIT – I INTRODUCTION TO NANOMATERIALS: **09**

Amorphous, crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials. Historical development of nanomaterials – Issues in fabrication and characterization of nanomaterials

UNIT – II SYNTHESIS OF NANOMATERIALS: **09**

Methods of production of Nanoparticles, Sol-gel synthesis, Inert gas condensation, High energy Ball milling, Plasma synthesis, Electro deposition and other techniques. Synthesis of Carbon Nanotubes – Solid carbon source based production techniques, Gaseous carbon source based production techniques - Growth mechanisms
Nano wires.

UNIT – III CHARACTERISATION OF NANOMATERIALS: **09**

Scanning Probe Microscopy (SPM) – Scanning tunneling microscope, Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning force microscopy, Electrostatic force microscopy , Dynamic force microscopy, Magnetic force microscopy, Scanning thermal microscopy, Peizo force microscopy, scanning capacitance microscopy, Nano indentation.

UNIT – IV APPLICATIONS OF NANOMATERIALS: **09**

Applications in Mechanical, Electronics engineering industries – Use of nanomaterials in automobiles, aerospace, defense and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.

UNIT – V NANO FABRICATION AND MACHINING: **09**

LIGA, Ion beam etching, Molecular manufacturing techniques – Nano machining techniques –, Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum materials.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A.K. Bandyopadhyay, " Nano Materials", New Age International Publishers, New Delhi, 2007
2. Bharat Bhushan, "Handbook of Nanotechnology", Springer, Germany, 2004.

REFERENCES:

1. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
2. Gregory Timp, "Nanotechnology", Springer, India, 2005
3. Ahmed Busnaina, "Nanomanufacturing Handbook", CRC Press, London, 2006

CI 9163 TECHNIQUES OF MATERIAL CHARACTERIZATION L T P C
3 0 0 3

AIM

This course aims at imparting knowledge on various techniques of material characterization.

OBJECTIVES

On completion of the course the students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, static and dynamic mechanical testing methods.

UNIT-I MICTRO STRUCTURAL EVALUATION: 09

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials.

UNIT – II CRYSTALSTRUCTURE ANALYSIS: 09

Elements of Crystallography – X- ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT – III ELECTRON MICROSCOPY: 09

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications .

UNIT – IV MECHANICAL TESTING – STATIC TESTS: 09

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Ductility Measurement – Impact Test – Charpy & Izod.

UNIT – V MECHANICAL TESTING – DYNAMIC TESTS: 09

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – Applications of Dynamic Tests.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.
2. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGraw Hill, 1995.
3. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn., 1982.

REFERENCES:

1. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., Scanning Electron Microscopy & X ray- Micro Analysis, (2nd Edition), ISBN – 0306441756, Plenum Publishing Corp., 2000.
2. Newby J., Metals Hand Book- Metallography & Micro Structures, (9th Edition), ASM International, 1989.
3. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.
4. Morita.S, Wiesendanger.R, and Meyer.E, "Noncontact Atomic Force Microscopy" Springer, 2002

CI 9164 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING L T PC
3 0 0 3

AIM

The aim is to appreciate the students with the background, applications and current status of productivity management and re-engineering, and to make them understand the relevant basic principles of these fields.

OBJECTIVES:

At the end of this course the students are expected to understand the general issues relating to Productivity management and re-engineering.

UNIT I INTRODUCTION : 05

Productivity concepts - Macro and Micro factors of productivity - Productivity benefit model, Productivity cycle.

UNIT II PRODUCTIVITY MODELS: 12

Productivity measurement at International, National and Organisational level - Total productivity models - Productivity management in manufacturing and service sectors - Productivity evaluation models - Productivity improvement models and techniques.

UNIT III ORGANISATIONAL TRANSFORMATION: 08

Principles of organisational transformation and re-engineering - fundamentals of process reengineering - preparing the workforce for transformation and reengineering – methodology – guidelines - DSMCQ and PMP model.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS: 10

PMI models - Edosomwan model - Moen and Nolan strategy for process improvement - LMICIP model - NPRDC model.

UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION: 10

Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order processing - user interfaces - maintainability and reusability.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sumanth, D.J., “Productivity engineering and management”, TMH, New Delhi, 1990.
2. Rastogi, P.N. “Re-Engineering and Re-inventing the enterprise”, Wheeler pub. New Delhi, 1995.

REFERENCES:

1. Edosomwan, J.A., “Organisational transformation and process re-engineering", British Library cataloging in pub. data, 1996.
2. Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A systems approach”,Narosa Pub. New Delhi, 1998.

M.E. COMPUTER INTEGRATED MANUFACTURING

IE9176 DESIGN OF CELLULAR MANUFACTURING SYSTEM L T P C
3 0 0 3

AIM: To impart knowledge on group technology, optimization algorithms, implementation of GT/CMS, Performance measurements and economical aspects of CMS.

OBJECTIVE:
At the end of this course the student should be able to understand

1. Concepts and applications of Cellular manufacturing systems
2. Traditional and non-traditional approaches of Problem solving
3. Performance measurement
4. Human and economical aspects of CMS.

UNIT I INTRODUCTION: 12
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

UNIT –II CMS PLANNING AND DESIGN: 10
Problems in GT/CMS - Design of CMS - Models, traditional approaches and non-traditional approaches -Genetic Algorithms, Simulated Annealing, Neural networks.

UNIT –III IMPLEMENTATION OF GT/CMS: 10
Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.

UNIT –IV PERFORMANCE MEASUREMENT AND CONTROL: 08
Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.

UNIT –V ECONOMICS OF GT/CMS: 05
Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Askin, R.G. and Vakharia, A.J., G.T "Planning and Operation, in The automated factory-Hand Book: Technology and Management", Cleland.D.I. and Bidananda, B (Eds), TAB Books , NY, 1991.
2. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), "Planning, design and analysis of cellular manufacturing systems", Elsevier, 1995.

REFERENCES:

1. Burbidge, J.L. Group "Technology in Engineering Industry", Mechanical Engineering pub.London, 1979.
2.. Irani, S.A. "Cellular Manufacturing Systems", Hand Book.

CI 9166 **PLASTICITY AND METAL FORMING** **L T P C**
3 0 0 3

AIM

To impart knowledge on the advanced metal forming techniques.

OBJECTIVES

At the end of the course the student should be able to understand the theory of plasticity and the advances in metal forming.

UNIT – I THEORY OF PLASTICITY: 09

Theory of plastic deformation – Engineering stress and strain relationship – Stress tensor – Strain tensor – Yield criteria – Plastic stress strain relationship – Plastic work – Equilibrium conditions – Incremental plastic strain.

UNIT – II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY: 07

Uniaxial tension test – Mechanical properties – Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress.

UNIT – III ANALYSIS OF METAL FORMING PROBLEMS: 12

Slab analysis – Slip line method, upper bound solutions, statistically admissible stress field, numerical methods, contact problems, effect of friction, thermo elastic Elasto plasticity, elasto visco plasticity – Thermo mechanical coupling – Analysis of forging, rolling, extrusion elasto visco plasticity – Thermo mechanical coupling – Analysis of forging, rolling, extrusion and wire drawing processes – Experimental techniques of the evaluation of metal forming.

UNIT – IV SHEET METAL FORMING: 08

Bending theory – Cold rolling theory – Hill's anisotropic theory, Hill's general yield theory – Sheet metal forming – Elements used – Mesh generation and formulation Equilibrium equations – Consistent full set algorithm – Numerical solutions procedures – examples of simulation of simple parts – Bench mark tests – Forming limit diagrams.

UNIT – V ADVANCES IN METAL FORMING: 09

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotropic pressing, high speed extrusion, rubber pad forming, micro blanking – Overview of Powder Metal techniques – Powder rolling – Tooling and process parameters

TOTAL: 45 PERIODS

TEXT BOOK:

1. Hosford, W.F. and Caddell, RM., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 1993.

REFERENCES:

1. Wagoner, R.H., and Chenot. J.J., Metal Forming Analysis, Cambridge University Press, 2002.
2. Slater, R.A.C., Engineering Plasticity – Theory & Applications to Metal Forming, John Wiley and Sons, 1987.
3. Shiro Kobayashi, Altan. T. Metal Forming and Finite Element Method, Oxford University Press, 1989.

4. Narayanaswamy, R, Theory of Metal Forming Plasticity, Narosa Publishers,1989.

CI 9167 INFORMATION SYSTEMS ANALYSIS AND DESIGN

L T P C
3 0 0 3

AIM

To impart knowledge in the key areas of information systems analysis and design.

OBJECTIVE

To provide knowledge in the concept of information system processing, decision making, analysis and design, quality assurance and knowledge based systems.

UNIT I COMPUTER BASED INFORMATION SYSTEM: 07

Concept of information and system – system classification – The challenge of information system – Computers and information processing – managing data resource – organizing data in a traditional file environment – a modern database environment – designing database.

UNIT II. MANAGEMENT INFORMATION SYSTEM : 10

Concepts – Design and implementation of MIS – Information system for decision making, types and levels of decision making – MIS as a technique for making programmed decisions – Decision – Assisting information systems – Conceptual system design – detailed system design.

UNIT III OVERVIEW OF SYSTEM DEVELOPMENT: 10

System analysis – System Design – Completing the system development process the traditional system life cycle – Stages and limitations of life cycle approach – case study.

UNIT IV QUALITY AND SERVICES: 10

Traditional tool and Methodologies for quality assurances – New approaches to quality – Information system failure causes – the concept of implementation – controlling risk factor.

UNIT V KNOWLEDGE – BASED SYSTEMS 08

Decision Support Systems – Group DSS – ESS – Artificial Intelligence – Expert System – Other intelligent technique – Neural network, Genetic Algorithm, Fuzzy Logic.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kenneth C.Laudon and Jane P.Laudon, “Management Information Systems”, Prentice Hall of India Pvt. Ltd., 10th Edn., 2007.
2. Robert G.Mudrick, Joel E.Ross and James R.Clagget, “Information System for Modern Management”, Prentice Hall of India Pvt. Ltd., 1995.
3. Chung.P.W.H and Lovegrove G., “Industrial and Engineering Application of Al and Expert systems”, Gardon Breach Science Publication, 1993.

REFERENCE:

1. Davis.G.B. MIS, “Conceptual Foundation, Structure and Development” McGraw-Hill Publishing Co., 1985.

WEB REFERENCE:

1. www.dis.uniromal.it

CI 9169 **LEAN MANUFACTURING** **L T PC**
3 0 0 3

AIM

The aim is to appreciate the students with the background, applications and current status of lean manufacturing and to make them understand the relevant basic principles in this field.

OBJECTIVES

At the end of this course the students are expected to understand the general issues relating to lean manufacturing.

UNIT-I. INTRODUCTION: 09

The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

UNIT- IISTABILITY OF LEAN SYSTEM: 09

Standards in the lean system – 5S system – Total Productive Maintenance – standardized work –Elements of standardized work – Charts to define standardized work – Man power reduction – Overall efficiency - standardized work and Kaizen – Common layouts.

UNIT- III. JUST IN TIME: 09

Principles of JIT – JIT system – Kanban – Kanban rules – Expanded role of conveyance – Production leveling – Pull systems – Value stream mapping**.**

UNIT- IV. JIDOKA (AUTOMATION WITH A HUMAN TOUCH: 09

Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka.

UNIT-V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY: 09

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture

TEXT BOOK:

1. Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, (Second edition), Productivity Press, New York, 2007.
2. Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, Lean Enterprise Institute, 1999.

REFERENCES:

1. Jeffrey Liker, The Toyota Way : Fourteen Management Principles from the World's Greatest Manufacturer,McGraw Hill, 2004.
2. Michael L. George, Lean Six SIGMA: Combining Six SIGMA Quality with Lean Production Speed,McGraw Hill, 2002.
3. Taiichi Ohno, Toyota Production System: Beyond Large-Scale Production,Taylor & Francis, Inc., 1988.

CI 9170 FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING

3 0 0 3

AIM

The aim is to provide the students with knowledge of the finite element method that will be of use in different manufacturing areas and to provide a foundation for further study.

OBJECTIVE

The objective is to equip students with fundamentals of finite element principles so as to enable them to understand the behaviour of various finite elements and to be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

UNIT – I INTRODUCTION: **06**

Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – review of Variational calculus – Integration by parts – Basics of variational formulation.

UNIT – II ONE DIMENSIONAL ANALYSIS: 10

Steps in FEA – Discretization, function – derivation of element characteristics 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

Global and Natural Co-ordinates – Shape functions for one and two dimensional elements – Three noded triangular and four noded quadrilateral element – Non linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional axi symmetric analysis.

UNIT – IV 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 – Solid and flow formulation – small incremental deformation formulation – FE Analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency.

UNIT – V COMPUTER IMPLEMENTATION: 09

Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages such as ANSYS and DEFORM – Development of code for one dimensional analysis and validation.

TOTAL: 45PERIODS

TEXT BOOK:

1. Reddy, J.N, “An Introduction to the Finite element Method”, McGraw – Hill, 1985.
2. Rao, “Finite Element Method in Engineering”, Pergammon Press, 1989.

REFERENCES:

1. Bathe, K.J., “Finite Element Procedures in Engineering Analysis, 1990.
2. Kobayashi, S, Soo-IK-Oh and Altan, T, “Metal forming and the Finite element Methods”, Oxford University Press, 1989.
3. Lewis, R.W., Morgan, K, Thomas, H.R., and Seetharaman, K.N., “The Finite Element Method in Heat Transfer Analysis”, John Wiley, 1994.

CI 9171 MANUFACTURING INFORMATION SYSTEM

3 0 0 3

AIM: To impart the knowledge in manufacturing information system.

OBJECTIVE: On completion of this course, the students are expected to be conversant with order policies, data base terminologies, designing, manufacturing considerations and information system for manufacturing.

UNIT-I INTRODUCTION: 05

The Evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

UNIT-II DATABASE: 07

Terminologies – Entities and attributes – Data models, schema and subschema - Data Independence – ER Diagram – Trends in database.

UNIT-III DESIGNING DATABASE: 13

Hierarchical model – Network approach- Relational Data model concepts, principles, keys, relational operations – functional dependence – Normalization types – Query

UNIT-IV MANUFACTURING CONSIDERATION: 10

The product and its structure, inventory and process flow – Shop floor control Data structure and procedure – various model – the order scheduling module, Input/output analysis module the stock status database – the complete IOM database.

UNIT-V INFORMATION SYSTEM FOR MANUFACTURING: 10

Parts oriented production information system – concepts and structure – Computerized production scheduling, online production control systems; Computer based production management system, computerized manufacturing information system – case study.

TOTAL: 45

PERIODS

TEXT BOOKS:

1. Luca G.Sartori, “Manufacturing Information Systems”, Addison-Wesley Publishing Company, 1988.
2. Date.C.J.,”An Introduction to Database Systems” Addison Wesley, 8th Edn,. 2003
3. Orlicky.G., “Material Requirements Planning”, McGraw-Hill, 1994.

REFERENCES:

1. Kerr.R, “Knowledge based Manufacturing Management”, Addison-Wesley, 1991.
2. RFID in Manufacturing, Gunther Oliver, Kletti Wolfhard, Kubach.vwe.,2008
3. Manufacturing Information & Data Systems Analysis, Design & Practice, CECELJA FRANJO, 2002.
4. Web reference: www.ist.psu.edu

CI 9171 MANUFACTURING INFORMATION SYSTEM L T P C
3 0 0 3

AIM

To impart the knowledge in manufacturing information system.

OBJECTIVE

On completion of this course, the students are expected to be conversant with order policies, data base terminologies, designing, manufacturing considerations and information system for manufacturing.

UNIT-I INTRODUCTION: 05

The Evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

UNIT-II DATABASE: 07

Terminologies – Entities and attributes – Data models, schema and subschema - Data Independence – ER Diagram – Trends in database.

UNIT-III DESIGNING DATABASE: 13

Hierarchical model – Network approach- Relational Data model concepts, principles, keys, relational operations – functional dependence – Normalization types – Query

UNIT-IV MANUFACTURING CONSIDERATION: 10

The product and its structure, inventory and process flow – Shop floor control Data structure and procedure – various model – the order scheduling module, Input/output analysis module the stock status database – the complete IOM database.

UNIT-V INFORMATION SYSTEM FOR MANUFACTURING: 10

Parts oriented production information system – concepts and structure – Computerized production scheduling, online production control systems; Computer based production management system, computerized manufacturing information system – case study.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Luca G.Sartori, “Manufacturing Information Systems”, Addison-Wesley Publishing Company, 1988.
2. Date.C.J.,”An Introduction to Database Systems” Addison Wesley, 8th Edn,. 2003
3. Orlicky.G., “Material Requirements Planning”, McGraw-Hill, 1994.

REFERENCES:

1. Kerr.R, “Knowledge based Manufacturing Management”, Addison-Wesley, 1991.
2. RFID in Manufacturing, Gunther Oliver, Kletti Wolfhard, Kubach.vwe.,2008
3. Manufacturing Information & Data Systems Analysis, Design & Practice, CECELJA FRANJO, 2002.
4. Web reference: www.ist.psu.edu

MS 9153 PROJECT MANAGEMENT L T P C
3 0 0 3

AIM

To Understand concepts and process involved in project management.

OBJECTIVE

To impart the knowledge that are essential in developing product, design, process improvement and the execution of a project.

UNIT I TOOLS FOR CONCEPT DEVELOPMENT 9

Products division, Quality function deployment, Concept engineering – Tools for Design Development design failure mode and design analysis. Reliability prediction – Tools for Design optimization. The Taguchi Loss Function. Optimization Reliability – Tools for Design Verification: Reliability Testing, Measurement system evaluation, Process Capability Evaluation.

UNIT-II TOOLS FOR PROCESS IMPROVEMENT: 9

Process improvement methodologies. The Deming Cycle-FADE-Basic tools for process improvement: flow charts; run charts and control charts, check sheets, histograms. Pareto diagrams. Cause and Effect Diagrams – Scatter Diagrams – Other tools for processes improvement. Kalzen Blitz. Poka-yoke (mistake proofing), process simulation-Engaging the work force in process improvement.

UNIT III STATISTICAL PROCESS CONTROL: 9

Quality control measurements - SPC methodology – Control charts for variables data- Special control charts for variables data-control charts for attributes – Summary of control charts construction chart, np-charts, c & u charts – Designing control charts: sampling, size, frequency-SPC, ISO 9000-2000, AND SIX SIGMA-Pre control.

UNIT IV BENCHMARKING AND ESTABLISHING ENGINEERING SPECIFICATIONS 9

A Benchmarking Approach – Support tools for the benchmarking process: indented assembly cost analysis, form diagram, trend analysis – Setting product specifications: Basic, Advanced method.

UNIT V PROJECT MANAGEMENT 9

Understanding and representing tasks: Tasks, charts – Baseline project planning – Accelerating projects-project execution – Postmortem execution.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Product Design & Development, Karl T.Ulrich, Steven D.Eppinger, TATA McGraw- HILL – 3rd Edition, 2003.

REFERENCES:

1. Kevin Otto & Kristin Wood, “Product Design Technique in Reverse Engineering and New Product Development”, Pearson Education (LPE), 2001.

2. James R.Evens, William M.Lindsay, "The Management and Control of Quality", 6th edition. Pub: son south-western (www.swlearning.com)

CI 9172 MANUFACTURING MANAGEMENT L T P C
3 0 0 3

AIM

To impart knowledge on Manufacturing strategies and compositeness, Designing of Products, facilities and jobs, Inventory systems, MRP and revising the systems.

OBJECTIVES:

1. Importance of manufacturing management
2. Designing of new products, facilities and jobs
3. Importance of inventory systems
4. Revising the system.

UNIT FIELD OF MANUFACTURING MANAGEMENT: 06

Introduction – Manufacturing Strategies and competitiveness-Meeting the competitive Project management-

UNIT IIDESIGNING OF PRODUCTS: 09

Process selection-Process flow Design – Operations Technology -Waiting line management-Computer simulation of waiting lines – Quality management.

UNIT - III DESIGN OF FACILITIES AND JOBS: 10

Capacity planning – Strategies – Planning service capacity- JIT –Facility location and layout-Job Design and Work measurement.

UNIT- IV INVENTORY SYSTEMS AND MRP: 10

Definition-Purposes of Inventory-Inventory models-Fixed order Quantity models and Fixed-time period models.MRP Systems-MRP system structures- Improvements in the MRP system-Advanced MRP-type systems.

UNIT-V REVISING THE SYSTEM: 10

Operations consulting – BPR- Synchronous Manufacturing and theory of Constraints
.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Production and Operations Management, Chase, Aquilano and Jacobs, eighth Edition, Tata McGraw Hill.

REFERENCES:

1. Manufacturing management: a quantitative approach, Robert A. Olsen,
2. International Textbook Co, 1968.
3. Production and Operations Management, S.N. Chary, Tata McGraw-Hill, 3rd Edition 2006.
4. Production and Operations Management: Strategic and Tactical Decisions, Jay Heizer, Barry Render - Business & Economics – 1996.
5. Operations Management, Jae K. Shim, Joel G. Siegel - Business & Economics – 1999.