VELS UNIVERSITY

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)

NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

M.E.
COMPUTER INTEGRATED MANUFACTURING

Curriculum and Syllabus
(Based on Choice Based Credit System)
Effective from the Academic year
2015-2016
(Modified Version)

Department of Mechanical Engineering
School of Engineering

PROGRAMME OUTCOMES:

Master of Engineering curriculum for the Computer Integrated Manufacturing is designed to impart Knowledge, Skill and Attitude on the graduates to

1. To impart concepts of computer aided design and computer aided manufacturing engineering through the use of analytical techniques, experiments, computer simulation methods, and other modern engineering tools.
2. Able to take up profession in R&D areas, management and teaching activity in the field of mechanical engineering.
3. Engage in industry institute interaction and lifelong learning by adhering to ethical and environmental conditions.
4. Apply the technical skills gained to model and analyze real time projects in the field of computer integrated manufacturing.

PROGRAMME SPECIFIC OUTCOMES

1. Advanced knowledge in manufacturing tools, solutions to industrial applications; Identify, formulate and solve mechanical engineering problems related to Computer integrated manufacturing environment.
2. To design a system, components, or process and meet specific objectives keeping in view the economical approaches, availability of materials and manufacturability with increased life.
3. To acquire knowledge of CAD-CAM engineering and be able to discriminate, evaluate, analyze and integrate existing and new knowledge.
4. To spreading the recent developments in CAD-CAM engineering field through educating the students using new technologies, software's and recent trends in CAD-CAM.
5. To develop habit of individual critical thinking in analyzing a complex problem in the computer aided designing, manufacturing and optimization.
6. To write CNC part programs using CADEM simulation package for simulation of machining operations such as Turning, Drilling & Milling.
7. To understand the operating principles of hydraulics, pneumatics and electro–pneumatic systems.
8. To understand & write programs for Flexible Manufacturing Systems & Robotics.

M.E. – COMPUTER INTEGRATED MANUFACTURING

CURRICULUM

Total number of credits: 80

Category	Code No.	Course	Hours / Week			Credits
			Lecture	**T**utorial	**P**ractical	
SEMESTER 1						
CORE	15MEI001	Optimization Techniques	3	1	0	4
CORE	15MEI002	Flexible Competitive Manufacturing System	3	1	0	4
CORE	15MEI003	Applied Materials Engineering	3	1	0	4
CORE	15MEI004	Metrology and Non Destructive Testing	3	1	0	4
DSE	15MEI___	Discipline Specific Elective I	3	0	0	3
CORE	15MEI005	Seminar I	0	0	6	2
		Total	15	4	6	21
SEMESTER 2						
CORE	15MEI006	Computer Aided Design and Manufacturing	3	1	0	4
CORE	15MEI007	Manufacturing Information Systems	3	1	0	4
CORE	15MEI008	Supply Chain Management	3	1	0	4
DSE	15MEI___	Discipline Specific Elective II	3	0	0	3
GE	15MEI___	Generic Elective I	3	0	0	3
CORE	15MEI009	Computer Integrated Manufacturing LAB	0	0	6	3
CORE	15MEI010	In-Plant Training	0	0	0	2
		Total	15	3	6	23
SEMESTER 3						
DSE	15MEI___	Discipline Specific Elective III	3	0	0	3
DSE	15MEI___	Discipline Specific Elective IV	3	0	0	3
GE	15MEI___	Generic Elective II	3	0	0	3
CORE	15RMCI31	Project Work – Phase I	0	0	18	9
		Total	9	0	18	18
SEMESTER 4						
CORE	15RMCI41	Project Work – Phase II	0	0	36	18
		Total	0	0	36	18

M.E. - COMPUTER INTEGRATED MANUFACTURING

CURRICULUM

List of Discipline Specific Elective Courses

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
15MEI101	Computer Aided Process Planning	3	0	0	3
15MEI102	Production and Operations Management	3	0	0	3
15MEI103	Manufacturing System Simulation	3	0	0	3
15MEI104	Productivity Management and Re-Engineering	3	0	0	3
15MEI105	Machine Vision and its Applications	3	0	0	3
15MEI106	Rapid Prototyping and Tooling	3	0	0	3
15MEI107	Metal Forming Technology	3	0	0	3
15MEI108	Newer Welding and Casting Processes	3	0	0	3
15MEI109	Finite Element Analysis in Manufacturing Engineering	3	0	0	3
15MEI110	Mechatronics in Manufacturing Systems	3	0	0	3
15MEI151	Total Quality System and Engineering	3	0	0	3
15MEI152	Design of Cellular Manufacturing System	3	0	0	3
15MEI153	Instrumentation and Experimental Techniques	3	0	0	3

List of Generic Elective Courses

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
15CMCI11	Information Systems Analysis and Design	3	0	0	3
15CMCI12	Tool Engineering	3	0	0	3
15CMCI21	Reliability and Total Productive Maintenance	3	0	0	3
15CMCI22	Special Optimization	3	0	0	3
15CMCI31	Robotics and Sensors	3	0	0	3
15CMCI32	Computer Applications in Manufacturing	3	0	0	3
15CMCI33	Design of Hydraulic and Pneumatic Systems	3	0	0	3

.

SYLLABUS
CORE COURSES

15MEI001	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1. To understand the optimization techniques used in compiler design.
2. To be aware of the various computer architectures that support parallelism.
3. To become familiar with the theoretical background needed for code optimization.
4. To understand the techniques used for identifying parallelism in a sequential program.
5. To learn the various optimization.

UNIT I LINEAR PROGRAMMING 9

Formulation- Assumption of liner programming-linear programming model, terminology for solution of the model- Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

UNIT II UNCONSTRAINED ONE DIMENSIONAL OPTIMIZATION TECHNIQUES 9

Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

UNIT III UNCONSTRAINED N DIMENSIONAL OPTIMIZATION TECHNIQUES 9

Direct search methods –Random search –pattern search and Rosen brooch's hill claiming method-Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

UNIT IV CONSTRAINED OPTIMIZATION TECHNIQUES 9

Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.

UNIT V DYNAMIC PROGRAMMING 9

Principle of optimality- recursive equation approach-application to shortest route, Backward-Moving Solution Procedure, Forward-Moving Solution Procedure cargo-loading, allocation and production schedule problems.

TOTAL 45 Hours

COURSE OUTCOMES:

After successful completion of Optimization Techniques course, the student will be able to

CO 1. Understand the basic theoretical principles in optimization and formulation of optimization models

CO 2. Apply basic concepts of mathematics to formulate an optimization problem.

CO 3. Acquire an idea about the various direct and indirect search methods.

CO 4. Understand evolutionary algorithms.

CO 5. Visualize advanced optimization applications in Mechanical engineering.

CO 6. Analyse and appreciate variety of performance measures for various optimization problems.

CO 7. Apply basic concepts of mathematics to formulate an optimization problem

CO 8. Understand the methods of sensitivity analysis and post processing of results and wide range of engineering problems.

CO 9. Understand the techniques used for identifying parallelism in a sequential program.

CO 10. Understand importance of optimization of industrial process management.

REFERENCES:

1. Rao, S.S.,'Optimization :Theory and Application' Wiley Eastern Press, 1978.
2. Taha, H.A., Operations Research –An Introduction, Prentice Hall of India.
3. Fox, R.L., 'Optimization methods for Engineering Design', Addition Welsey, 1971.

15MEI002 FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM

L	T	P	C
3	1	0	4

COURSE OBJECTIVE:

The course serves as an introduction to the modern methods of manufacturing. Its objectives are:

1. To expose the student to the different types of manufacturing available today such as the Special
2. Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS),
3. To learn the fundamentals of computer assisted numerical control programming and programming languages
4. Automated flow lines,
5. The common CAD/CAM data base organized to serve both design and manufacturing, and
6. To practice the PLC control devices and CNC operation skills

UNIT I MANUFACTURING SYSTEMS & CONTROL 9

Automated Manufacturing Systems - Modelling - Role of performance modelling -simulation models- Analytical models. Product cycle - Manufacturing automation -Economics of scale and scope - input/output model - plant configurations. Performance measures - Manufacturing lead-time - Work in process -Machine utilization - Throughput – Capacity - Flexibility - performability - Quality. Control Systems - Control system architecture - Factory communications - Local area networks - Factory net works - Open systems interconnection model - Net work to network interconnections - Manufacturing automation protocol - Database management system.

UNIT II MANUFACTURING PROCESSES 9

Examples of stochastic processes - Poisson process Discrete time Markov chain models - Definition and notation - Sojourn times in states - Examples of DTMCs in manufacturing - Chapman - Kolmogorov equation - Steady-state analysis. Continuous Time Markov Chain Models - Definitions and notation - Sojourn times instates - examples of CTMCs in manufacturing - Equations for CTMC evolution -Markov model of a transfer line .Birth and Death Processes in Manufacturing - Steady state analysis of BD Processes- Typical BD processes in manufacturing.

UNIT III QUEUING MODELS 9

Notation for queues - Examples of queues in manufacturing systems – Performance measures - Little's result - Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns Analysis of a flexible machine center.

UNIT IV QUEUING NETWORKS 9

Examples of QN models in manufacturing - Little's law in queuing networks – Tandem queue - An open queuing network with feedback - An open central server model for FMS - Closed transfer line - Closed server model - Garden Newell networks.

UNIT V PETRI NETS 9

Classical Petri Nets - Definitions - Transition firing and reachability – Representational power - properties -Manufacturing models. Stochastic Petri Nets - Exponential timed Petri Nets - Generalized Stochastic Petri Nets - modelling of KANBAN systems - Manufacturing models.

TOTAL 45 Hours

COURSE OUTCOMES:

After successful completion of Flexible Competitive Manufacturing System course, the student will be able to

CO 1. Understand the modern methods of manufacturing.

CO 2. Apply the concepts of PPC and GT to the development of FMS.

CO 3. Discuss the planning and scheduling methods used in manufacturing systems.

CO 4. Identify various workstations, system support equipments and hardware components of FMS.

CO 5. Identify different types of manufacturing available today; such as the Special Manufacturing. System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS), etc.

CO 6. Apply innovative skills and analyze computer aided design and manufacturing problems critically.

CO 7. Know the fundamentals of computer assisted numerical control programming and programming languages.

CO 8. Understand the automated flow lines.

CO 9. Use the common CAD/CAM data base organized to serve both design and manufacturing, and practice the PLC control devices and CNC operation skills.

REFERENCES:

1. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1994.

2. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice Hall, New Jersey, 1982.

3. Gupta S.C., & Kapoor V.K., "Fundamentals of Mathematical Statistics", 3rd Edition, Sultan Chand and Sons, New Delhi, 1988.

15MEI003	APPLIED MATERIALS ENGINEERING	L T P C 3 1 0 4

COURSE OBJECTIVE:

- This course provides knowledge in the areas of Industrial metallurgy, advanced materials and selection of materials for industrial 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 fracturetoughness-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 – Selectionfor 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 IVMATERIAL 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 Hours

COURSE OUTCOMES:

After successful completion of Applied Materials Engineering course, the student will be able to

CO 1. Select different materials and emphasis the need of modern materials other than conventional metals and alloys for specific engineering applications.

CO 2. Apply core concepts in Materials Science to solve engineering problems.

CO 3. Understand the heat treatment of steels using TTT and CCT diagrams and analyze the various metallurgical factors influencing the performance of materials from different structural engineering applications.

CO 4. Be knowledgeable of contemporary issues relevant to Materials Science and Engineering.

CO 5. Understand the professional and ethical responsibilities of a materials scientist and engineer.

CO 6. Classify different mechanical properties and how they can influence the materials behavior with respect to applied load.

CO 7. Possess the skills and techniques necessary for modern materials engineering practice.

CO 8. Know the principles of metallurgical microscope, X-ray Diffractrometer (XRD), scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Thermal analysis and dilatometer.

CO 9. Perform various sample/specimen preparation techniques for XRD, SEM and TEM

CO 10. Can determine the crystal structure, lattice parameter, surface topography using different methods.

REFERENCES:

1. The Hand book of Advance Materials, James k.Wessel, Wiley, Intersam, john, Wilson Publishers., 2004.
2. Surface Engineering of Materials- Principles of EquipmeTechniques ,Tadensz.
3. Burakonsa &T.Wierzchan. Thoas h.Courtney , "Mechanical Behaviour of Materials",(second edition), McGraw Hill, 2000.
4. Flinn,R.A.and Trojan ,P.K.., "Engg Meterials and their Application (fourthEdition), Jaico, 1999.
5. Metals hand book , vol. 10, "Failure Analysis and Prevention" ,(tenth edition) 1994.
6. George E.Dieter, "Mechanical Metallurgy", McGraw Hill, 1988.
7. Charles, J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", (third Edition), Butterworth – Heiremann, 1977.

15MEI004 METROLOGY AND NON DESTRUCTIVE TESTING L T P C
3 1 0 4

COURSE OBJECTIVE:

- To educate students with the NDT methods include ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI).

UNIT I MEASURING MACHINES 9

Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Image shearing microscope - Use of computers - Machine vision technology - Microprocessors in metrology.

UNIT II STATISTICAL QUALITY CONTROL 9

Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits -Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

UNIT III LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 9

Characteristics of liquid penetrants - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.

UNIT IV RADIO GRAPHY 9

Sources of ray-x-ray production - properties of d and x rays - Film Radiography- film characteristics - use of film, characteristic curves (H & D curve) - latent image formation on film - radiographic exposure, reciprocity law, photographic density exposure charts - contrasts - operational characteristics of x ray equipment - Radiographic Image Quality and Radiographic Techniques- applications.

UNIT V ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES 9

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Metrology and Non Destructive Testing course, the student will be able to

CO 1. To have a basic knowledge of surface NDE techniques; which enables to carry out various inspections in accordance with the established procedures.

CO 2. To calibrate the instrument and inspect for in-service damage in the components.

CO 3. Differentiate various defect types and select the appropriate NDT methods for better evaluation.

CO 4. Differentiate various defect types and select the appropriate NDT methods for the specimen.

CO 5. Ability to communicate their conclusions clearly to specialist and non-specialist audiences.

CO 6. Documentation of the testing and evaluation of the results for further analysis.

CO 7. To have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples.

CO 8. Understand the eddy current instrument and perform inspection of weldments with unknown defects.

CO 9. Inspect and evaluate the surface imperfections using penetrant testing method and Inspect subsurface defects by magnetic particle and eddy current testing method

CO 10. Provide knowledge and enrich ideas about the conventional NDT techniques and develop to inspecting and evaluating components in accordance with industry specifications.

REFERENCES:

1. JAIN, R.K. " Engineering Metrology ", Khanna Publishers, 1997.

2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.

3. American Society for Metals, " Metals Hand Book ", Vol.II, 1976.

4. Progress in Acoustic Emission, " Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.

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15MEI005	SEMINAR I	L T P C 0 0 6 2

COURSE OBJECTIVE:

- To identify a specific topic/ area/ problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To train the students in preparing reports and to face reviews and examination for the first semester.

SYLLABUS:

The student individually select a specific topic approved by the head of the division under the guidance of a faculty member of the particular subject or who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners of the same department.

COURSE OUTCOMES:

After successful completion of Seminar I, the student will be able to

CO 1. The Seminar engages students in the integrated activities of reading, research, discussion, and composition around a modern manufacturing environment.

CO 2. The Students with opportunities for both sustained, rigorous investigation of a topic and close faculty-student interaction.

CO 3. Students will gain a deeper appreciation of the role of writing in scholarly investigation, as they refine, adapt, and expand their abilities to absorb, synthesize and construct arguments in close-knit community.

CO 4. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.

CO 5. To set the stage for future recruitment by potential engineer. Students will demonstrate the ability to speak and debate with an appreciation for complex social and cultural sensibilities

CO 6. Convey a clear idea of the interdisciplinary nature of environmental and health risk assessment.

CO 7. Understand how each discipline of the subjects was mapped into the society and the world market in the realm of environmental issues.

Students will practice capabilities related to entry-level thinking, research, and writing in a particular field. Specifically, they will develop the "rhetorical flexibility" necessary to recognize that different academic domains require their own approaches appropriate to the context.

CO 8. Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.

15MEI006	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- 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 8

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, induction, 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 Hours

COURSE OUTCOMES:

After successful completion of Computer Aided Design and Manufacturing course, the student will be able to

CO 1. Understand 2 dimensional and 3 dimensional transformations, modeling and analysis and CAD/CAM integration.

CO 2. CNC machine tool building, CNC programming using manual method and generation of CNC codes using CAM software.

CO 3. Use basic and advanced features of current CAD software.

CO 4. Understand how CAD technology can be leveraged in the design process

CO 5. Design a part or assembly of parts using Computer-Aided Design software.

CO 6. Use parametric modeling techniques to reflect engineering requirements.

CO 7. Apply top-down design principles to model a design.

CO 8. Use motion and interference checking to ensure that parts will not interfere throughout their complete range of motion.

CO 9. Use CAD software collaboratively when designing on a team.

CO 10. Make appropriate selection of CAD functionality to use as tools in the design process and to communicate effectively the geometry and intent of design features.

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, fourth Edition, 2002
6. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw –Hill Ed., 2007
7. HMT, "Mechatronics", Tata McGraw –Hill Ed., 1998
8. P Radhakrishnan, S Subramanyan, "CAD/CAM/CIM", New Age Publishers, 1994.

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15MEI007	MANUFACTURING INFORMATION SYSTEMS	L T P C 3 1 0 4

COURSE OBJECTIVE:

- The purpose of the course is to provide an importance of databases and its application in manufacturing systems that prepare students for their engineering practice by organization by conversant with order policies, data base terminologies, designing, manufacturing considerations.

UNIT I INTRODUCTION **5**

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

UNIT II DATABASE **7**

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 Hours

COURSE OUTCOMES:

After successful completion of Manufacturing Information Systems course, the student will be able to

CO 1. Provide an importance of databases and its application in manufacturing systems that prepare students for their engineering practice by organization by conversant with order policies, data base terminologies, designing, manufacturing considerations.

CO 2. Understand/implement computer models of common engineering information types.

CO 3. Understand the importance and be able to critically discuss the role of management information systems for design, engineering and manufacturing.

CO 4. Understand the role of non-IT managers in information systems planning, systems development, and hardware and software selection.

CO 5. Discuss and evaluate engineering data management issues across the extended enterprise.

CO 6. Demonstrate an appreciation of the complex relationship between information systems and organisation.

CO 7. Define and explain basic terms in the area of manufacturing, as well as structure, design,

configuration and practical use of IT systems for manufacturing.

Understand knowledge in the area of manufacturing information systems, as an upgrade of the basic knowledge about information systems provided in the core courses.

CO 8. Define problems and the current environment for existing business systems in the areas of accounting, finance, marketing, and manufacturing.

CO 9. Recognize different manufacturing setups, and have basic knowledge about configuring a manufacturing – supporting ERP system.

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, CECELJAFRANJO, 2002.
4. Luca G.Sartori, "Manufacturing Information Systems", Addison-Wesley Publishing Company, 1988.
5. Date.C.J.,"An Introduction to Database Systems" Addison Wesley, 8th Edn,.2003
6. Orlicky.G., "Material Requirements Planning", McGraw-Hill, 1994.

15MEI008 **SUPPLY CHAIN MANAGEMENT** **L T P C**
3 1 0 4

COURSE 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 6

Definition of Logistics and SCM: Evaluation, Scope Importance & Decision phases – Drivers of SC performance and Obstacles-Development trends- Centralized vs Decentralized Planning and Scheduling- Green Paradigms

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 – A facility location model featuring supply chain aspects, Multi-period supply chain planning, A heuristic for the multi-period SCND problem- Framework for network Decisions – Managing cycle inventory and safety.

UNIT IV SOURCING AND PRICING IN SUPPLY 9

Supplier Selection and contracts – design collaboration – Procurement process, the progression from a procurement focus to strategic sourcing focus Supplier Management- Supplier Relationship Management- Supply Base Management. Revenue management in supply chain- Realize the benefits- Impact the Bottom-line/

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 Hours

COURSE OUTCOMES:

After successful completion of Supply Chain Management course, the student will be able to

CO 1. Develop a systematic framework for analyzing the behavior of large and complex supply chain networks.

CO 2. Recognize the relationship and motivations of suppliers and distributors to ensure supplies of raw materials and markets for finished goods.

CO 3. Utilize information technology and various quantitative and qualitative approaches that reduce production, inventory and transportation costs, and improve service levels and profitability.

CO 4. Develop applied research skills which can help you in the analysis of emerging supply chain management issues.

CO 5. Acquire familiarity and a working knowledge of the principles and practice of operations management as applied to the service industries.

CO 6. Understand terminology, applications, and tools which are essential for managing operations in service industries.

CO 7. Design factors of supply chain, implement the logistics management, managing the supply chain and Sourcing and revenue management

CO 8. Utilize quantitative and qualitative methods and software applications in managing service operations.

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.

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

15MEI009 **COMPUTER INTEGRATED MANUFACTURING LAB**

L	T	P	C
0	0	6	3

COURSE OBJECTIVE:

- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's and to impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

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. Nonlinear analysis (Exercise must include plastic deformation of simple objects or crash analysis simple structures.
4. 3 Axis CNC code generations for CNC machining.
5. CNC Machining of complex features like machining of hemispherical cavity, tapered hole, hole of parabolic shape etc.

LIST OF EQUIPMENTS REQUIRED:

1. Computers 18
2. CAD Workstation
3. FEA Software
4. CAM Software for 3 axis machining or more
5. CNC Production type lathe or Milling Machine

COURSE OUTCOMES:

After successful completion of Computer Integrated Manufacturing lab, the student will be able to

CO 1. Impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's.

CO 2. To impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

CO 3. Identify the main elements in computer integrated manufacturing systems; Apply knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes.

CO 4. Apply the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion;

CO 5. Process product models with CAM tools and CNC machines.

15RMCI31	Project Work – Phase I	L	T	P	C
		0	0	18	9

COURSE OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 Hours

COURSE OUTCOMES:

After successful completion of Project Work – Phase I, the student will be able to

CO 1. Identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.

CO 2. Develop the methodology to solve the identified problem.

CO 3. Train the students in preparing project reports and to face reviews and viva-voce examination.

CO 4. Get clear idea about the project work and they are in a position to carry out the remaining phase II work in a systematic way.

CO 5. Should be able to apply the relevant knowledge and skills, which are acquired within the technical area, to a given problem

CO 6. Should within given constraints, independently analyze and discuss inquiries/problems and handle larger problems on the basic level within the technical area

CO 7. Should reflect on, evaluate, and critically assess one's own and others' results

CO 8. Able to document and present one's own work, for a given target group, with requirements on structure, format, and language usage.

CO 9. Able to identify one's need for further knowledge and continuously develop one's own competencies.

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15RMCI41	Project Work – Phase II	L	T	P	C
		0	0	36	18

COURSE OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

TOTAL: 360 Hours

COURSE OUTCOMES:

After successful completion of Project Work – Phase II, the student will be able to

CO 1. Continue the phase I work on the selected topic as per the formulated methodology under the same supervisor.

CO 2. Solve the identified problem based on the formulated methodology.

CO 3. Develop skills to analyze and discuss the test results, and make conclusions.

CO 4. On completion of the project work student will be in a position to take up any challenging practical problems in the field of construction engineering and management and find better solutions to it.

SYLLABUS
DISCIPLINE SPECIFIC ELECTIVE COURSES

15MEI101	COMPUTER AIDED PROCESS PLANNING	L T P C 3 0 0 3

COURSE 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 **9**

The Place 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 **9**

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure - Geometric modelling for process planning - GT coding - The optiz system - The MICLASS system.

UNIT III PROCESS ENGINEERING AND PROCESS PLANNING **9**

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al.

UNIT IV COMPUTER AIDED PROCESS PLANNING SYSTEMS **9**

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

UNIT V AN INTERGRADED PROCESS PLANNING SYSTEMS **9**

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Computer Aided Process Planning course, the student will be able to

CO 1. Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation.

CO 2. Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence.

CO 3. Predict the effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances.

CO 4. Explain the generation of tool path and solve optimization models of machining processes.

CO 5. Create awareness about the implementation techniques for CAPP

CO 6. Familiarize the students with process planning in the manufacturing cycle, design, drafting, geometric modeling, systems in CAPP and report generation.

CO 7. Manage the computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.

CO 8. Understand about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP), Computer aided quality control and Flexible manufacturing systems, Artificial intelligence and Expert systems.

REFERENCES:

1. Gideon Halevi and Roland D. Weill, " Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.
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.
4. Nanua Singh, " Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996.
5. Rao, “Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.

15MEI102 PRODUCTION AND OPERATIONS MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

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

UNIT I FORECASTING AND FACTORY LAYOUT 9

Introduction, measures of forecast, accuracy, forecasting methods - time series smoothing - regression models - exponential smoothing - seasonal forecasting – cyclic forecasting. Location factors, location evaluation methods, different types of layouts for operations and production, arrangement of facilities within departments.

UNIT II INVENTORY ANALYSIS AND CONTROL 9

Definitions - ABC inventory system - EOQ models for purchased parts - inventory order policies - EMQ models for manufactured parts - lot sizing techniques, inventory models under uncertainty.

UNIT III JUST IN TIME AND SCHEDULING 9

Elements of JIT - uniform production rate - pull versus push method - Kanban system - small lot size - quick, inexpensive set-up - continuous improvement, optimized production technology. Objectives in scheduling - major steps involved -information system linkages in production planning and control - production control in repetitive, batch and job-shop manufacturing environment.

UNIT IV AGGREGATE PLANNING AND PROJECT PLANNING 9

Approaches to aggregate planning - graphical, empirical, and optimization, development of a master production schedule, materials requirement planning (MRP- I) and manufacturing resource planning (MRP -II), ERP. Evolution of network planning techniques - CPM – PERT- Network stochastic consideration, project monitoring, line of balance.

UNIT V SCHEDULING WITH RESOURCE CONSTRAINTS 9

Allocation of units for a single resource - allocation of multiple resources - resource balancing, line balancing - helgeson brine approach - region approach, stochastic mixed - product line balancing, flexible manufacturing system - concepts - advantages and limitation - computer integration and AI in manufacturing and operations, electronic data interchange.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Production and Operations Management course, the student will be able to

CO 1. Understand the role of operations management in the overall business strategy of the firm.

CO 2. Explain the major concepts in the functional areas of accounting, marketing, finance, and management.

CO 3. Evaluate the legal, social, and economic environments of business.

CO 4. Describe the global environment of business.

CO 5. Describe and explain the ethical obligations and responsibilities of business.

CO 6. Apply decision-support tools to business decision making.

CO 7. Construct and present effective oral and written forms of professional communication.

CO 8. Apply knowledge of business concepts and functions in an integrated manner.

CO 9. Use specialized knowledge in Operations Management to solve business processes and apply knowledge of fundamental concepts of operations management.

CO 10. Use specialized knowledge in Operations Management to solve business processes and apply knowledge of approaches to operational performance improvement.

REFERENCES:

1. Thomas E Vollmann, William I Berry, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 2003.
2. Panneerselvam R., “Production and Operations Management”, Prentice-Hall of India Pvt.Ltd., New Delhi, 2002.
3. Elwood S Buffa, Rakesh K Sarin, “Modern Production and Operations Management”, JohnWiley & Sons Inc, 2002.
4. Everette E Adam, Ronald J Ebert, “Production and Operations Management: Concepts Models and Behavior”, Prentice Hall, Inc., 2002.
5. James D Dilworth, "Production and Operations Management ", Tata McGraw Hill, Inc, New Delhi, 1993.
6. Bedworth D.D., "Integrated Production Control Systems Management, Analysis, Design", John Wiley & Sons, New York, 1982.

15MEI103	MANUFACTURING SYSTEM SIMULATION	L T P C 3 0 0 3

COURSE OBJECTIVE:

- To provide knowledge in the concept of manufacturing system simulation environment through the simulation languages and case studies.

UNIT I INTRODUCTION **8**

Basic concepts of system – elements of manufacturing system - concept of simulate on – 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 **9**

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 **9**

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

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Manufacturing System Simulation course, the student will be able to

CO 1. Characterise a system in terms of its essential elements, that is, its purpose, stakeholders, constraints, performance requirements, sub-systems, interconnections and environmental context.

CO 2. Conceptualise real world situations related to systems development decisions, originating from source requirements and goals.

CO 3. Apply the processes, procedures and techniques which are required for the successful execution of systems engineering methodology to resolve different types of complex problems faced by senior manager, at an earlier stage of system design.

CO 4. These problems may relate to system specification, requirements allocation, maintenance concepts, and critical issue resolution.

CO 5. Use common simulation software packages to construct and execute goal-driven system models

CO 6. Develop structured walkthroughs of a typical product and process engineering problem.

CO 7. Create system reports and system specification documents.

CO 8. Interpret the model and apply the results to resolve critical issues in a real world environment.

CO 9. Design and analyse control mechanism and management function to ensure that the system achieves its purpose.

CO 10. Describe and apply the principles and techniques of simulation and Construct models of discrete event simulation for manufacturing systems.

CO 11. Use simulation software to design and analysis manufacturing systems using statistical technique. It constructs and deduces result for simulation based experiments.

REFERENCES:

1. Jerry Banks and John S.Carson, “Discrete event system simulation”, Prentice Hall 1991
2. 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. hannon R.E., “System simulation”, Prentice Hall 1993.

15MEI104 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To educate students in productivity management and re-engineering environment.

UNIT I PRODUCTIVITY **5**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT **12**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

UNIT III ORGANISATIONAL TRANSFORMATION **8**

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & 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 Hours

COURSE OUTCOMES:

After successful completion of Productivity Management and Re-Engineering course, the student will be able to

CO 1. Understanding of the interaction of organisational goals and objectives and how engineering companies should be structured to efficiently achieve these goals in the prevailing industrial environment.

CO 2. Understanding of the importance of product and service development and their effects on the management, operations, and personnel of engineering organizations.

CO 3. Understanding of basics of managing a technological organization, and the importance of business strategy and operation strategy, and as well the link between business strategy and operation management.

CO 4. Develop analytical and problem solving skills in dealing with legacy systems and software integration challenges.

CO 5. Develop on hands experience in reverse engineering and reengineering existing software systems.

CO 6. Apply the methods learned to assess the situation of a small-scale legacy system and decide a suitable reengineering strategy for it, in the light of the objectives of the reengineering/renovation effort.

CO 7. Understand the reverse engineer and reengineer moderate size legacy software systems using some of the available commercial and research tools.

CO 8. Make students aware of various productivity measurement models, their assumptions and silent features.

CO 9. Understand the characteristics, strengths and weaknesses of manufacturing and service sectors in The context of measurement of productivity.

CO 10. Understanding the concepts of Business Process Reengineering to the students.

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

15MEI105	MACHINE VISION AND ITS APPLICATIONS	L T P C 3 0 0 3

COURSE OBJECTIVE:

- To familiarize the students with machine vision system through the various image processing utility and knowing the application of machine vision system.

UNIT I BASIC PRINCIPLE OF MACHINE VISION CONCEPT 8

Introduction to Machine Vision - Advantages of Machine vision - Applications of machine vision. Image Processing- Binary Algorithms- Morphological Operators- Optical Character Recognition.

UNIT II FUNDAMENTALS OF IMAGE PROCESSING 8

Image acquisition Principles and Devices -Binary image processing - Digital Imaging - Grey Scale Modification -Sharpening and Smoothing the images - Regions and Edges - Region representation - image storage - Image enhancement - Image Filtering.

UNIT III DYNAMIC VISION AND OBJECT RECOGNITION 10

Histogram modifications, linear systems and filters. Image Detection -Edge detection- Contours, geometry of curves, Digital curves, Curve fitting, Circular arcs, Conics and Spline curves - Surfaces, representations, interpolation, Approximation, Segmentation, Registration.

UNIT IV IMAGE PROCESSING DEVICES 9

Introduction to Texture, Statistical and Model based analysis of Texture, Structural analysis of ordered texture - Model-Based Methods for Texture Analysis - Shape from Texture, Photometric stereo. Dynamic Vision - Segmentation using Motion and Moving camera Motion.

UNIT V APPLICATION AND INTERFACING 10

Object recognition - Object Representation, Feature Detection, Recognition Strategies, Verification and their applications with examples, two and three dimensional measurements, Inter facing a robot with a Vision system.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Machine Vision and its Applications course, the student will be able to

CO 1. Understand the role of computers in metrology.

CO 2. Apply the concepts of calibration, traceability and uncertainty for accurate and reliable measurements.

CO 3. Identify and estimate measurement errors and suggest suitable techniques to minimize them.

CO 4. Understand the methods and devices for dimensional measurements.

CO 5. Assess surface roughness and form errors.

CO 6. Enhance digital image using various algorithms with the help of computer programming.

CO 7. Understand the role of image processing in different fields such as medical, engineering, space, biotechnology, ocean, agriculture, food industry, etc.

CO 8. Realize the significance of digital image processing in automation.

CO 9. Know the mathematical calculations of basic filters used in digital image enhancement.

CO 10. understand the machine vision system through the various images processing utility and knowing the application of machine vision system.

REFERENCES:

1. Pham. D.T., Dimov. S. S., 'Rapid manufacturing: the technologies and applications of RPT and rapid tooling', Springer, London, 2001.
2. Hilton.P.D., 'Rapid Tooling', Marcel Dekker, 2000.
3. Chua.C.K., 'Rapid Protyping', Wiley, 1997.
4. Beaman.J.J. et all, 'Solid freeform fabrication', Kluwer, 1997.
5. Jacohs.P.F., 'Stereolithography and other rapid prototyping and manufacturing technologies', ASME, 1996.
6. Burns.M, 'Automated Fabrication', PHI, 1993.

15MEI106	RAPID PROTOTYPING AND TOOLING	L T P C 3 0 0 3

COURSE OBJECTIVE:

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

UNIT I INTRODUCTION **7**

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **10**

Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS: **10**

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

UNIT IV REVERSE ENGINEERING ANDCAD 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.

UNIT V RAPID TOOLING **8**

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Rapid Prototyping and Tooling course, the student will be able to

CO 1. Describe tool design methods and punch and die manufacturing techniques.

CO 2. Select material for cutting tools and gages; classify various cutting tools and gages and identify their nomenclature

CO 3. Describe the principles of clamping, drill jigs and computer aided jig design

CO 4. Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools

CO 5. Explain the principles of dies and moulds design and use rapid prototyping techniques for reverse engineering.

CO 6. Understand and use techniques for processing of CAD models for rapid prototyping.

CO 7. Understand and apply fundamentals of rapid prototyping techniques.

CO 8. Use appropriate tooling for rapid prototyping process.

CO 9. Describe the current available rapid prototyping systems, their fundamental operating principles, and their characteristics

CO 10. Describe complementary, secondary fabrication processes commonly used with the above rapid prototyping systems and select the appropriate fabrication.

REFERENCES:

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006
4. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
5. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

15MEI107 **METAL FORMING TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- At the end of the course the student should be able to understand the advances in 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 9

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 9

Formability studies – Conventional processes – H E R F techniques – Super plastic 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 Hours

COURSE OUTCOMES:

After successful completion of Metal Forming Technology course, the student will be able to

CO 1. Understand the theoretical foundations and methodology necessary for solving metal-forming technologies on the principles of plastic deformation and theory of plasticity.

CO 2. Explain in simplified mathematical representation of metal forming processes while applying the various principles of materials.

CO 3. Know the necessary for a creative and complex engineering solution of the technologies of metal-forming processes.

CO 4. Understand the fundamentals of metal working and plasticity of the materials.

CO 5. Understand the fundamental principles such as the physical, chemical, mechanical and thermodynamic principles of metallic bodies changing from the elastic into the plastic state, and when these bodies are plastically deformed into the required shape.

CO 6. Explain the basic metal forming techniques, forging, extrusion, drawing and rolling.

CO 7. Explain the elements of the theory of plasticity, fundamentals of metal working, forging process, rolling process, extrusion process, drawing of rods, wires and tubes, sheet metal forming process, high energy rate forming.

CO 8. Understand the loading of the forming tool or machine, and how to determine the critical values of deformation.

CO 9. Understand the fundamentals of metal forming process and its applications with forming mechanics.

CO 10. Understand the workability of testing techniques of metal forming process and understand the tribology in metal forming and other phenomena.

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

15MEI108	NEWER WELDING AND CASTING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- At the end of the course the student should be able to understand the welding and various casting processes in production environment.

UNIT I CASTING DESIGN 8

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

UNIT II CASTING METALLURGY 8

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

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8

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

UNIT IV WELDING METALLURGY AND DESIGN 10

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

UNIT V RECENT TRENDS IN WELDING 11

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

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Newer Welding and Casting Processes course, the student will be able to

CO 1. Understand basic definitions the Welding and casting process

CO 2. Make Sand Moulding Cores Gates, Risers, cleaning of castings & Moulding Machines

CO 3. Understand Melting Furnaces & Special moulding Process

CO 4. Understand Welding Processes

CO 5. Understand Metallurgical aspects in welding & Inspection Methods

CO 6. Classify various manufacturing process and list the types of patterns and binders

CO 7. List types of moulds and cores and classify types of sand used for preparing the same. Sketch the types of mould machine, casting defects

CO 8. Understand Sketch and Identify the various welding defects also describe the various non destructive inspection methods.

CO 9. Student can Classify types of special moulding process and sketch the types of special mould process.

CO 10. Define and classify various welding process and sketch the special t ype of welding process

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

15MEI109 FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- The objective is to equip students with fundamentals of finite element principles so as to enable them to understand the behavior of various finite elements and to be able 36 to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

UNIT I INTRODUCTION 6

Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – review of Variation 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 9

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: 45 Hours

COURSE OUTCOMES:

After successful completion of Finite Element Analysis in Manufacturing Engineering course, the student will be able to

CO 1. Understand the Finite Element Formulation procedure for structural Problems.

CO 2. Understand the representation and assembly considerations for Beam and Frame elements.

CO 3. Analyze Plane stress, Plane strain, axis-symmetric Problems.

CO 4. Formulate and solve simple heat transfer and fluid mechanics problems

CO 5. Identify significant applications of FEM in Manufacturing.

CO 6. Explain the basic theoretical principles of the Finite Element method.

CO 7. Employ industry-standard software for interactive FE model generation, analysis and the post-processing of results.

CO 8. Formulate the boundary conditions of a problem in a suitable form for correct analysis

CO 9. Assess alternative strategies (of element type, mesh design, boundary condition definition etc.) for economical and accurate FE modeling of specific 2D, 3D and axi-symmetric structural problems.

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

15MEI110 **MECHATRONICS IN MANUFACTURING SYSTEMS** **L T P C**
3 0 0 3

COURSE 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 Hours

COURSE OUTCOMES:

After successful completion of Mechatronics in Manufacturing Systems course, the student will be able to

CO 1. Generate conceptual design for Mechatronics products based on potential customer requirements

CO 2. Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes

CO 3. Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers

CO 4. Determine the performance of a Mechatronics system

CO 5. Understand MEMS fabrication techniques

CO 6. Classify robots based on joints and arm configurations.

CO 7. Design application specific End Effectors for robots.

CO 8. Compute forward and inverse kinematics of robots and determine trajectory plan.

CO 9. Program robot to perform typical tasks including Pick and Place, Stacking and Welding.

CO 10. Design and select robots for Industrial and Non-Industrial applications.

REFERENCES:

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.
3. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007.
4. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.
5. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and applications” Tata McGraw-Hill Publishing Company Limited, 2003

15MEI151 TOTAL QUALITY SYSTEM AND ENGINEERING

L	T	P	C
3	0	0	3

COURSE 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 - Organizational 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 **8**

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

UNIT V PRODUCTS LIABILITY **7**

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

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Total Quality System and Engineering course, the student will be able to

CO 1. Understand the philosophy and core values of Total Quality System and Engineering.

CO 2. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality.

CO 3. Imparting total quality system in education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.

CO 4. Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.

CO 5. Select and apply appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQS system.

CO 6. Develop and understanding on Total Quality System (TQS) and Engineering philosophies and frameworks.

CO 7. Develop in-depth knowledge on various tools and techniques of Total Quality System and Engineering.

CO 8. Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

CO 9. Develop a strategy for implementing TQM in an organization. Identify the key aspects of the quality improvement cycle.

CO 10. Select and use the appropriate tools and techniques for controlling, improving and measuring the quality. It measure's the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement.

REFERENCES:

1. Harvid Noori and Russel, " Production and Operations mangement - TotalQuality 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.
5. Besterfield D.H., Besterfield C.M, Besterfield G.H and Besterfield M.S., "Total Quality Management ", Pearson Education, 2002.
6. R. Pugazhenthi, A. Baradeswaran, K. Balachandran, and P. Balamurali, "Total Quality Management", sams publications, 2015.

15MEI152	DESIGN OF CELLULAR MANUFACTURING SYSTEM	L T P C 3 0 0 3

COURSE OBJECTIVE:

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

- Concepts and applications of Cellular manufacturing systems
- Traditional and non-traditional approaches of Problem solving
- Performance measurement
- 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 8

Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.

UNIT V ECONOMICS OF GT/CMS: 5

Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Design of Cellular Manufacturing System course, the student will be able to

CO 1. Understand the effect of manufacturing automation strategies and derive production metrics.

CO 2. Analyze automated flow lines and assembly systems, and balance the line.

CO 3. Design automated material handling and storage systems for a typical production system.

CO 4. Design a manufacturing cell and cellular manufacturing system.

CO 5. Develop CAPP systems for rotational and prismatic parts.

CO 6. Understand the importance of data communications in CIM environment and analyze the role of OSI model in the design of communication protocols.

CO 7. Understand the concepts in multiplexing and identify the errors in communications and apply correction strategies.

CO 8. Develop manual and APT part programs for 2D complex profiles and test the programs through simulation.

CO 9. Classify and distinguish NC, CNC and DNC systems, Understand CNC machine structures and system drives and develop interpolation algorithms for control loops.

CO 10. Develop manual part programs for 2D-complex profiles for Fanuc and Siemens controller using CNC Simulator.

REFERENCES:

1. Burbidge, J.L. Group " Technology in Engineering Industry ", Mechanical Engineering pub. London, 1979.
2. Irani, S.A. " Cellular Manufacturing Systems ", Hand Book
3. 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.
4. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems ", Elsevier, 1995.

15MEI153 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To enhance the knowledge of the students about various measuring instruments, operation of different measurement technology, instruments transducers and their application in automotive industry.
- To understand the various steps involved in error analysis and uncertainty analysis of the automotive industry

UNIT I MEASUREMENT SYSTEMS 6

Static and Dynamic Measurement systems- Requirements and characteristics – Analysis of experimental detail, Error analysis.

UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays –Signal Analyzing.

UNIT III MECHANICAL MEASUREMENT 10

Instrumentation For Measuring Weight , Force, torque , pressure power, temperature, fluid flow, vibration, rotational speed , velocity, acceleration and angular motion.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 12

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9

Introduction to various vehicle experimental techniques, Laboratory tests- vehicle tracks test - Vehicle endurance Tests- Vehicle crash tests- Vehicle wind tunnel tests- Vehicle Brake tests.

TOTAL : 45 Hours

COURSE OUTCOMES:

After successful completion of Instrumentation and Experimental Techniques course, the student will be able to

CO 1. Develop among the students, the competence to analyze systems, develop models, design controllers and configure automation systems.

CO 2. Give an overview of principles of operation and comparative study of sensors, transducers and analyzers.

CO 3. Impart practical knowledge in process control and design of instrumentation systems.

CO 4. Prepare students' to work in interdisciplinary areas.

CO 5. Prepare students' to have successful career in industry / R&D organization and academic institutions.

CO 6. Enhance the knowledge of the students about various measuring instruments, operation of different measurement technology, instruments transducers and their application in automotive industry.

CO 7. Understand the various steps involved in error analysis and uncertainty analysis of the automotive industry.

CO 8. Make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.

CO 9. Explore the various types of analyzers used in industrial applications.

CO 10. Make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.

TEXT BOOKS:

1. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, New Delhi, 1995

REFERENCES:

1. A.W. Judge, 'Engineering Precision Measurement', Chapman and Hall Ltd, Essex Street W.C.,1951,
2. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi, 1990.
3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990
4. Anthony Martyr, Michael Alexander Plint, 'Engine Testing', Elsevier, 2012.

SYLLABUS
GENERIC ELECTIVE COURSES

15CMCI11 INFORMATION SYSTEMS ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

COURSE 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 7

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 8

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

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Information Systems Analysis and Design course, the student will be able to

CO 1. Provide knowledge in the concept of information system processing, decision making, analysis and design, analysis the information systems.

CO 2. Define and describe the five phases of the system development life cycle.

CO 3. State at least five expected benefits from systems projects.

CO 4. Explain at least three ways in which information systems support business requirements.

CO 5. Describe how systems analysts interact with users, management, and other information systems professionals.

CO 6. Develop data flow diagrams, decision tables and Perform a feasibility study.

CO 7. Evaluate systems development alternatives.

CO 8. Solve realistic systems analysis problems and work as an effective team member on assigned projects.

CO 9. Determine methods for evaluating the effectiveness and efficiency of a system.

REFERENCES:

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

15CMCI12	TOOL ENGINEERING	L T P C 3 0 0 3

COURSE 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 7

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 9

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 Hours

COURSE OUTCOMES:

After successful completion of Tool Engineering course, the student will be able to

CO 1. Explain role of tool engineering in industries for establish importance of process planning in tool engineering.

CO 2. Explain role of tool engineering in industries to Identify and select elements of universal acts in manufacturing operations.

CO 3. Re-sharpen given cutting tool and select proper tool for given manufacturing operation

CO 4. Interpret designation system of cutting tool and tool holder and select locating and clamping devices for given component.

CO 5. Select and design jig and fixture for given simple component.

CO 6. Classify and explain various press tools and press tools operations.

CO 7. Determine dimensions of punch and die for given press tool component and determine shear angle.

CO 8. Select suitable press tool operation for given simple press tool component and calculate press tonnage.

CO 9. Center of pressure for given press tool component Prepare scrap strip layout for given press tool component.

CO 10. Design of single point and multi point cutting tools, dies, jigs, fixtures and limit gauges and toll design for CNC machines.

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 PressLtd. 1968
4. Cyril Donaldson et al, “Tool Design”, Tata Mc-Graw Hill, 2006
5. Pollack H.W., “Tool Design” Reston Publishing Company, Inc. 1976.

15CMCI21	RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE	L T P C 3 0 0 3

COURSE OBJECTIVE:

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

UNIT I RELIABILITY AVAILABILITY AND MAINTAINABILITY ENGINEERING 9

Reliability engineering fundamentals and applications -Reliability function - MTBF - MTTF - mortality curve - availability -Maintainability Definition and application of Maintainability Engineering- Factors affecting Maintainability- Maintainability design criteria, operating and down time categories,

UNIT II FAILURE DATA ANALYSIS 9

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

UNIT III RELIABILITY PREDICTION 9

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

UNIT IV RELIABILITY MANAGEMENT 9

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

UNIT V TOTAL PRODUCTIVE MAINTENANCE: 9

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 Hours

COURSE OUTCOMES:

After successful completion of Reliability and Total Productive Maintenance course, the student will be able to

CO 1. Problem solving and decision making (analysis and synthesis, analytical and system thinking, intuition, judgment, result interpretation).

CO 2. Advanced technical competence (engineering science, modeling, simulation, testing, correlation, validation, result interpretation).

CO 3. Professional, legal and ethical standards (safety, environmental, quality).

CO 4. develop your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system.

CO 5. empower you with the skills to manage a manufacturing system to achieve continuous system availability for production.

CO 6. equip with essential system diagnosis techniques so that you can identify and take appropriate actions on error symptoms and causes of failures.

CO 7. Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment.

CO 8. Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.

CO 9. Manage the manufacturing organisation with highest possible availability.

REFERENCES*:*

1. Paul Kales, " Reliability for technology Engineering and Management ", PrenticeHall, New Jersey, 1998.
2. Gopalakrishnan.P, and Banerji A.K., "Maintenance and Spare PartsManagement ", Prentice Hall of India, New Delhi, 1996.
3. Modarres, "Reliability and Risk Analysi ", Meral Dekker Inc., 1993.
4. Nakajima, Seiich, "Introduction to TPM", Productivity Press, 1988.

15CMCI22	SPECIAL OPTIMIZATION	L T P C 3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge on group technology, optimization algorithms and non-traditional optimization techniques.

UNIT I NONLINEAR OPTIMIZATION 9

Introduction – unconstrained optimization - one-dimensional optimization – elimination methods – Fibonacci method, golden section methods – interpolation methods – quadratic, direct route method – multivariable optimization **-** direct search methods – pattern search methods – univariate method, hooks and jeeves method, simplex method – descent methods – steepest descent, Newton methods.

UNIT II CONSTRAINED NONLINEAR OPTIMIZATION 9

Direct methods – the complex method, cutting plane method – indirect methods – interior and exterior penalty function methods, Khun-Tucker conditions, Lagrangian method.

UNIT III INTEGER AND DYNAMIC PROGRAMMING: 9

Introduction to integer programming – solution techniques - graphical method, the branch and bound technique, gomary's cutting plane method, examples on the application in manufacturing / design systems – introduction to dynamic programming – bellman's principle of optimality, examples on the application on routing problem, inventory problem.

UNIT IV NETWORK OPTIMIZATION MODELS: 8

Terminology of networks – the shortest route problem – the minimum spanning tree problem – the maximum flow problem – the minimum cost flow problem – the network simplex method.

UNIT V NON-TRADITIONAL OPTIMIZATION 10

Introduction to non-traditional optimization, computational complexity – NP-hard, NP-complete, no free lunch theorem – working principles of simulated annealing, Tabu search, and neural networks, simple applications. Introduction to Genetic Algorithms, Ant Colony Algorithm, Particle Swap Algorithm, Hybrid Algorithms, Simple Applications.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Special Optimization course, the student will be able to

CO 1. To impart knowledge on group technology, optimization algorithms and non-traditional optimization techniques.

CO 2. Differentiate and classify traditional and non-traditional optimization methods

CO 3. Differentiate and classify traditional and non-traditional optimization methods.

CO 4. Formulate an optimization problem to solve complex manufacturing engineering problems.

CO 5. Understand the Branch and Bound search techniques for problem solving.

CO 6. Apply GA, PSO and ACO algorithms for problems in scheduling, process planning and layout design.

CO 7. Identify different types of optimization problems.

CO 8. Understanding of different optimization technique.

CO 9. Ability to solve various multivariable optimization problems.

CO 10. Ability to solve optimization using software tools and ability to solve problems by using least square analysis.

CO 11. Identify different types of test of Hypotheses and Understand Correlation and Regression.

REFERENCES:

1. Singiresu S Rao, “Engineering Optimization: Theory and Practice”, Wiley-Interscience, Third Edition, 1996.
2. Kalyanmoy Deb, “Optimization for engineering design”, Prentice Hall India Pvt. Ltd., New Delhi, 2000.
3. David E Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley Pub Co., 1989.
4. Marco Dorigo and Thomas Stutzle, “Ant Colony Optimization”, Prentice Hall of India, 2005.
5. Maurice Clerc, “Particle Swarm Optimization”, ISTE, 2007
6. Dimitri P Bertsekas, “Dynamic Programming: Deterministic and Stochastic Models”, Prentice Hall, 1987.
7. Harvey M Salkin, “Integer Programming”, Addison-Wesley Pub. Co., 1975.
8. Stephen G Nash and Ariela Sofer, “Linear and Nonlinear Programming”, McGraw Hill College Div., 1995.
9. Fred Glover, Manuel Laguna and Fred Laguna, “Tabu Search”, Kluwer Academic Publishers, 1997.
10. Cihan H Dagli**,** “Artificial Neural Networks for Intelligent Manufacturing”, Chapman and Hall, London, 1994, ISBN 0 412 48050.

15CMCI31	ROBOTICS AND SENSORS	L T P C 3 0 0 3

COURSE OBJECTIVE:

- On completion of the course the students are expect to the knowledgeable in Robot anatomy, end effectors, sensors, vision systems, and kinematics.

UNIT I INTRODUCTION 5

An Introduction to sensors and Transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics.

UNIT II SENSORS IN ROBOTICS 9

Position sensors - optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors - Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors

UNIT III MISCELLANEOUS SENSORS IN ROBOTICS 11

Different sensing variables - smell, Heat or Temperature, Humidity, Light, Speech or Voice recognition Systems, Tele-presence and related technologies.

UNIT IV VISION SENSORS IN ROBTICS 10

Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effectors camera Sensor.

UNIT V MULTISENSOR CONTROLLED ROBOT ASSEMBLY 10

Control Computer, Vision Sensor modules, Software Structure, Vision Sensor software, Robot programming, Handling, Gripper and Gripping methods, accuracy - A Case study.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Robotics and Sensors course, the student will be able to

CO 1. Classify robots based on joints and arm configurations.

CO 2. Design application specific End Effectors for robots.

CO 3. Compute forward and inverse kinematics of robots and determine trajectory plan.

CO 4. Program robot to perform typical tasks including Pick and Place, Stacking and Welding.

CO 5. Design and select robots for Industrial and Non-Industrial applications.
Understand many modern devices and technologies used in sensors.

CO 6. Appreciate various material properties which are used in engineering applications and devices.

CO 7. Understand the application of various sensors for direct contact and non-contact measurements.

CO 8. Explain expect to the knowledgeable in Robot anatomy, end effectors, sensors, vision systems, and kinematics.

CO 9. Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes.

REFERENCES:

1. Paul W Chapman, "Smart Sensors", an Independent Learning Module Series, 1996
2. Richard D. Klafer, Thomas a. Chmielewski; Michael Negin, "Robotic Engineering - An integrated approach", Prentice Hall of India Private Limited, 1989
3. John Iovice, "Robots, Androids and Animalrons", Mc Graw Hill, 1998
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics - Control Sensing, Vision and Intelligence", Mc Graw Hill Internation Editions, 1987
5. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G. Odrey, "Industrial Robotics - Technology, Programming and Applications", Mc Graw Hill, International Editions, 1986
6. Sabric Soloman, "Sensors and Control Systems in Manufacturing", Mc Graw Hill, International Editions, 1994

15CMCI32	COMPUTER APPLICATIONS IN MANUFACTURING	L T P C 3 0 0 3

COURSE OBJECTIVE:

- On completion of the course the students are expected to be knowledgeable in Engineering product specification, CAD/CAM integration, CNC machine tool building, CNC programming using manual method, generation of CNC codes using CAM software, Tooling and work holding devices.

UNIT I Introduction to Cam, Geometric Dimensioning and Tolerance 9

CNC machine tools, Principle of operation of CNC,Construction features including structure, drives and CNC controllers, 2D and 3Dmachining on CNC Geometrical dimensioning andtolerancing, Tolerance stacking – types and remedies

UNIT II CNC Part Programming 9

Detailed Manual part programming on Lathe & Millingmachines using G & M codes, FAPT programming (FANUC). Generation of tool path, generation of G & M codes, Optimization of tool path (to reduce machining time)

UNIT III CNC Tooling 9

Different types of tools and tool holders used onCNC Machines, parameters for selection of configuration of cutting tools, work holding devices used on CNC machines

UNIT IV Advanced CNC Processes 9

Introduction to advanced CNC processes, EDM, Wire EDM, Abrasive water jet, LASERcutting, RPT, (Working principles, construction or set up of process, applications)

UNIT V APT Programming 9

APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to-point motion commands, continuous path motion commands. Post processor commands, complication control commands. Macro subroutines. Part programming preparation for typical examples

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Computer Applications in Manufacturing course, the student will be able to

CO 1. Design and develop Computer Integrated Manufacturing systems using the knowledge of mathematics, science, engineering and IT tools.

CO 2. Apply modern computational, analytical, simulation tools and techniques to face the challenges in manufacturing.

CO 3. Communicate ideas effectively with diversified groups to become lead professionals in academia and industry in advanced areas of manufacturing.

CO 4. Engage in continuous and life-long learning by exhibiting professionalism, ethical attitude and team work.

CO 5. Apply knowledge of manufacturing engineering and management principles to design and evaluate automated manufacturing systems.

CO 6. Analyze problems of manufacturing and industrial systems to formulate the design requirements for CIM systems.

CO 7. Develop sustainable and eco-friendly manufacturing systems using the knowledge of contemporary issues.

CO 8. Formulate competitive priorities and manufacturing strategy for a given production system to derive strategic advantage.

CO 9. Explain the CAD/CAM with CNC operation environment; they can understand and manage the Product lifecycle management (PLM) environment.

REFERENCES:

1. Jon Stenerson and Kelly Curran “Computer Numerical Control”, Prentice-Hall of India Pvt. Ltd. New Delhi, 2008
2. Ibrahim Zeid “CAD/CAM - Theory and Practice” Mc Hill, International edition, 1998
3. P. N. Rao “CAD/Cam principles and operations”, Tata McGraw Hill
4. Reference Manuals of FANUC, Siemens, Mazak, etc.
5. Thomas M. Crandell “ CNC Machining and Programming, Industrial Press ISBn- 0-8311-3118-7
6. Bedworth, Wolfe and Henderson - “Computer aided design and manufacturing” - McGraw Hill
7. “Manufacturing Science” - A. Ghosh and Malik - Affiliated East West Press Pvt. Ltd.
8. Tilak Raj - “CNC Technology and Programming”, Dhanpat Rai Publication Company.

15CMCI33	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
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COURSE OBJECTIVE:

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

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 6

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT II CONTROL AND REGULATION ELEMENTS 12

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT III HYDRAULIC CIRCUITS 6

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits- industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 15

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7

Pneumatic equipments- selection of components - design calculations – application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of Design of Hydraulic and Pneumatic Systems course, the student will be able to

CO 1. Understand the principles, practices and techniques of Design of Hydraulic and Pneumatic Systems.

CO 2. Integrate hydraulic, pneumatic and electric components into a unique system in an industrial environment.

CO 3. Draw symbols used in hydraulic systems and classify the valves used in hydraulic systems.

CO 4. Explain and design the physical and technological basis of hydraulic and pneumatic devices.

CO 5. Describe development and application of hydraulic and pneumatic systems,

CO 6. Integrate hydraulic, pneumatic and electric components into a unique system,

CO 7. Carry out experiments and measurements in laboratory and on hydraulic, pneumatic and electric components, devices and systems,

CO 8. Interpret the acquired data and results,devise independently simple hydraulic and pneumatic systems,

CO 9. Create solutions in analysis, design and development of components, devices and equipment of hydraulic and pneumatic systems.

REFERENCES:

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall,
3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
5. K.Shanmuga Sundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S. Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).