AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI

REGULATIONS - 2009

IITO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

M.E. PRODUCTION ENGINEERING

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
PE9321	Advanced Materials and their Processing	3	0	0	3
PE9322	Production and Operations Management	3	0	0	3
PE9323	Product Data Management	3	0	0	3
E1**	Elective I	3	0	0	3
E2**	Elective II	3	0	0	3
E3**	Elective III	3	0	0	3
PRACTICALS					
PE9325	Data structures laboratory	0	0	2	2
	TOTAL	18	0	2	20

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	C
E4**	Elective IV	3	0	0	3
E5**	Elective V	3	0	0	3
E6**	Elective VI	3	0	0	3
PRACTICALS					
PE9331	Project Work (Phase I)	0	0	12	6
	TOTAL	9	0	12	15

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	C
PROJECT					
PE9341	Project Work (Phase II)	0	0	24	12
	TOTAL	0	0	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 69

LIST OF ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
CC 9257	Total Quality Management	3	0	0	3
IS 9016	Human Factors in Engineering	3	0	0	3
PD 9221	Integrated product and process Development	3	1	0	4
PE9001	Metal Forming Theory and Practice	3	0	0	3
MF9254	Advances in Casting and Welding Processes	3	0	0	3
PE9004	Maintenance and Reliability Engineering	3	0	0	3
PE9005	Image Processing in Manufacturing	3	0	0	3
PE9007	Purchasing and Material Management	3	0	0	3
PE9008	Engineering Economics	3	0	0	3
PE9009	Rapid prototyping, Tooling and manufacture	3	0	0	3
PE9010	IT in manufacturing	3	0	0	3
PE9011	Non traditional machining processes	3	0	0	3
PE9012	Product development strategies	3	0	0	3
PE9013	Six-sigma concepts	3	0	0	3
PE9014	Finite element analysis	3	0	0	3
PE9016	Optimization techniques	3	0	0	3
PE9017	Artificial intelligence in manufacturing	3	0	0	3
PE9018	Simulation of manufacturing systems	3	0	0	3
PE9019	Computer Integrated Manufacturing	3	0	0	3
PE9020	Micro systems technology	3	0	0	3

PE9321   ADVANCED MATERIALS AND THEIR PROCESSING   L T P C
                                                                    3 0 0 3

UNIT I   INTRODUCTION   9
Metals, ceramics, glasses, elastomers, polymers, composites, smart materials, members of each class, nano science materials, material properties. Selection strategy, property limits and material indices, function objectives and constants, performance maximizing criteria. Modulus - density, strength – density, modulus – strength, specific stiffness and specific strength, fracture toughness, modulus fracture etc.

UNIT II   FERROUS ALLOYS AND NON FERROUS ALLOYS   9
Low alloy steels and effects of alloying elements, high alloy steels, stainless steel types, tool steels, manganese steels, heat resistant steels, HSLA, maraging steels, castability, formability, machinability, hardenability and weldability of the material.   Alloys of copper, aluminium, nickel, magnesium, titanium, - compositions, heat treatments, structures, properties, applications, castability, formability, machinability, hardenability and weldability of the materials.

UNIT III   MATERIALS FOR INDUSTRIAL APPLICATIONS   9
Materials for Automobiles, Aerospace, Marine and Nuclear applications, Materials for Low for High Temperature applications.

UNIT IV   NON-METALLIC MATERIALS ELECTRICAL AND MAGNETIC MATERIALS   9
Ceramics, refractories, abrasives, enamels, cement – glasses, polymers: thermosetting and thermoplastics, types of polymerisation, elastomers, electrical conducting polymers. P and N type semiconductors, single crystals, soft and hard magnets, superconductors, MEMS materials, nano science materials, smart materials, shape memory alloys.

UNIT V   COMPOSITES   9
Types of composites, volume fraction - lamellar composites production and properties of whiskers of silicon carbide, graphite, fibres of zirconia, alumina and boron nitride - metal filaments - boron filaments - glass fibres applications.
                                                      TOTAL: 45 PERIODS

REFERENCES :
1. Michael F. Ashby, "Materials Selection in Mechanical Design", Butterworth Heinemann, 2005.
2. Daniel Yesudian C., "Materials Science and Metallurgy", Scitech Publications (India), 2004.
3. Polmear I.J., "Light Alloys", Arnold Publishers, 1995.
4. Swarup D. and Saxena M.N., "Elements of Metallurgy", Rastogi Publishers, Meerut, 1994.
5. Srinivasan N.K. and Ramakrishnan S.S., "The Science of Engineering Materials", Oxford and IBH Pub. Co., New Delhi, 1993.
6. Van Vlack L.H., "Elements of Materials Science and Engineering", Addison Wesley, New York, 1991.
7. Guy A.G," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990.

PE9322   **PRODUCTION AND OPERATIONS MANAGEMENT**   **L T P C**
                                                                      3 0 0 3

UNIT I   FORECASTING FACILITY LOCATION AND 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 JUST IN TIME (JIT)   **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. Elements of JIT - uniform production rate - pull versus push method - Kanban system - small lot size - quick, inexpensive set-up - continuous improvement, optimised 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 III   AGGREGATE PLANNING AND MASTER PRODUCTION
SCHEDULING   **9**
Approaches to aggregate planning - graphical, empirical, and optimisation, development of a master production schedule, materials requirement planning (MRP- I) and manufacturing resource planning (MRP - II), ERP.

UNIT IV   PROJECT PLANNING   **9**
Evolution of network planning techniques - critical path method (CPM) - project evaluation and Review Technique (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 PERIODS

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", John Wiley & 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.

PE9323   **PRODUCT DATA MANAGEMENT**   **L T P C**
                                                                            3 0 0 3

UNIT I   INTRODUCTION   9
New product introduction and issues – product life cycle and its relevance, introduction to PDM - present market constraints - need for collaboration - internet and developments in information technology and computing.

UNIT II   COMPONENTS OF A PDM SYSTEM   9
Introduction to objects, components of a typical PDM setup - hardware and software - document management - creation and viewing of documents - creating parts - versions and version control of parts and documents - case studies.

UNIT III   PROJECTS AND ROLES   9
Projects and roles - product development - life cycle management - automating information flow - work flows - creation of work flow templates - life cycle - work flow integration - case studies.

UNIT IV   CHANGE CONFIGURATION MANAGEMENT   9
Engineering change order and its implementation in PDM system - affectivity - case studies. Base lines - product structure, tools for configuration management.

UNIT V   GENERIC PRODUCTS AND VARIANTS   9
Product configurator - comparison between sales configuration and product configurator - generic product modeling configuration modeler- use of order generator for variant creation - registering of variants in product register-case studies.

                                                            TOTAL: 45 PERIODS

REFERENCES :
1. Kevin N Otto, Kristin L Wood, "Product Design", Pearson, 2001.
2. John Gosney, John W. Gosney, Christine Mears, "Business Intelligence with Cold Fusion (EBusiness)", Premier Press, 2000.
3. Wind chill R5.0 Reference Manuals, 2000.
4. Virgilio Almeida, Daniel Menasce, "Scaling for E-Business: Technologies, Models, Performance, and Capacity Planning", Prentice Hall, 2000.
5. Damer Amer, "The E-business Revolution", Prentice Hall, 2000.
6. Guus Schreiber, et. al., "Knowledge Engineering and Management: The Common KADS Methodology", The MIT Press, Bradfard, 1999.
7. Terry Quatrain, "Visual Modeling with Rational Rose and UML", Addison Wesley, 1998.

PE9325   **DATA STRUCTURES LABORATORY**   **L T P C**
                                                                 0 0 3 2

UNIT I   INTRODUCTION AND ARRAYS   9

Data structures, abstract data types, primitive data structures, analysis of algorithms, notation. Operations, implementation of one, two, three and multi dimensioned arrays, different types of array applications.

UNIT II   STRINGS AND SETS   9

Implementation, operations, applications. Operation on sets, implementation of sets.

UNIT III   RECORDS AND STACKS   9

Implementation of variant records. Primitive operations, sequential implementation, applications, Recursion, definition, process and implementation using stacks; Parentheses matching; Evaluation of expressions.

UNIT IV   QUEUES, LISTS AND TREES   9

Primitive operations, sequential implementation, priority queues, dequeues, applications. Insertion and deletion of nodes, singly linked lists, doubly linked lists, circular lists, multiply linked lists, applications, addition of polynomials; Sparse Matrix representation, linked stacks, linked queues, linked, priority queues. Terminologies, implementation, BINARY TREE: Properties, sequential and linked representation, Binary tree, operations, traversals, expression trees, threaded trees.

UNIT V   SORTING AND TABLE   **9**

Insertion sort, selection sort, shell sort, bubble sort, quick sort, heap sort, merge sort, radix sort, algorithms, analysis. Introduction, operations, implementation, Hash Table: Hash function Internal Hashing: Open addressing, coalesced hashing, separate chaining, External Hashing: Dynamic hashing, extendible hashing, linear hashing. Analysis: Probes for successful search, unsuccessful search.

TOTAL : 60 PERIODS

REFERENCES:
1. Aaron M Tanenbaum, Moshe J Augenstein and Yedidyah Langsam, "Data Structures using C and C++", Pearson Education, 2004.
2. Sahni Sartaj, "Data Structures, Algorithms and Applications in C++", WCB/Mc Graz Hill, 2000.
3. Kakde OK, Despande, "Data Structures and Algorithms", ISTE, 2001.
4. Nell Dale, "C++ Plus Data Structures", Narosa Publishing House, 1999.
5. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2003.
6. Robert L Kruse, Bruce P Leung and Clovin L Tondo, "Data Structures and Program Design in C", Pearson Education, 2004.
7. Angela B Shiflet, "Elementary Data Structures with Pascal", West Publishing Company, 1990.

CC9257 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 9
Need for TQM, evolution of quality, Definition of quality, TQM philosophy – CONTRIBUTIONS
OF Deming Juran, Crosby and Ishikawa, TQM models.

UNIT II PLANNING 9
Vision, Mission, Quality policy and objective Planning and Organization for quality, Quality policy
Deployment, Quality function deployment, introduction to BPR and analysis of Quality Costs.

UNIT III TQM PRINCIPLES 9
Customer focus, Leadership and Top management commitment, Employee involvement –
Empowerment and Team work, Supplier Quality Management, Continuous process
improvement, Training, performance Measurement and customer satisfaction.

UNIT IV TQM TOOLS AND TECHNIQUES 9
PDSA, The Seven Tools of Quality, New Seven management tools, Concept of six sigma,
FMEA, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles.

UNIT V QUALITY SYSTEMS 9
Need for ISO 9000 Systems, clauses Documentation, Implementation, Introduction to ISO14000
and OSHAS18000, Implementation of TQM, Case Studies.
TOTAL: 45 PERIODS

TEXT BOOK:
1. Dale H.Besterfiled, "Total Quality Management", Pearson Education Asia, (Indian reprint
   2002)

REFERENCES:
1. Oakland.J.S. "Total Quality Management", Butterworth–Hcinemann Ltd., Oxford, 1989.
2. Narayana V. and Sreenivasan, N.S., "Quality Management – Concepts and Tasks", New
   Age International 1996.
3. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.
4. Juran J.M and Frank M.Gryna Jr., "Quality Planning and Analysis", TMH, India, 1982.
5. Brain Rethery, ISO 9000, Productivity and Quality Publishing Pvt.Ltd., 1993.
6. D.Mills, Quality Auditing, Chapman and Hall, 1993.

IS9016   **HUMAN FACTORS IN ENGINEERING**   **L T P C**
                                                                                   3 0 0 3

UNIT I   ERGONOMICS AND ANATOMY   9

Introduction to ergonomics: The focus of ergonomics**,** ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the sprine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II   HUMAN BEHAVIOR   9

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness.Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration.Attitudes-Determination of attitudes, Changing attitudesLearning, Principles of Learning, Forgetting, Motivational requirements.

UNIT III   ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND
SEATED WORKS   9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness

Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work**,** effectiveness and cost effectiveness, research directions

UNIT IV   MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND
MANUAL HANDLING TASK   9

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine.

Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeltal disorders (WMSDs), reduction and controlling, training

Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

UNIT V   HUMAN SKILL AND PERFORMANCE AND DISPLAY,
CONTROLS AND VIRTUAL ENVIRONMENTS   9

A general information-processing model of the users, cognitive system, problem solving, effectiveness.

Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

TOTAL: 45 PERIODS

REFERENCES:
1. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis
2. Ergonomic design for organizational effectiveness, Michael O'Neill
3. Human factors in engineering and design, MARK S.SANDERS
4. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson

PD 9221	INTEGRATED PRODUCT DESIGN AND PROCESS DEVELOPMENT	L T P C 3 1 0 4

UNIT I   INTRODUCTION   12
Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement

UNIT II   CONCEPT GENERATION, SELECTION AND TESTING   12
Plan and establish product specifications. Task - Structured approaches - clarification - search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

UNIT III   PRODUCT ARCHITECTURE   12
Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV   INDUSTRIAL DESIGN   12
Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT   12
Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

A Term Project/Presentation must be given for Assessment – 3 (Compulsory)

TEXT BOOK:
1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999

REFERENCES:
1. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates,   6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992,ISBN, 1-55623-603-4
3. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing,Neyourk,NY,1991, ISBN 0-202-41639-5
4. www.me.mit/2.7444.

PE9001	METAL FORMING THEORY AND PRACTICE	L T P C
		3 0 0 3

UNIT I   THEORY OF PLASTICITY .   **13**
Theory of Plastic deformation - Yield criteria - Work of plastic deformation - Equilibrium in Cartesian, Cylindrical and Spherical coordinates - Energy-Slab method - Upper bound and Lower bound solution methods -Overview of FEM Applications in Metal Forming Analysis – Formability studies

UNIT II   THEORY AND PRACTICE OF BULK FORMING PROCESSES   11
Analysis of Plastic deformation in Forging, Rolling, Extrusion and rod/wire drawing processes-Effects of friction, Calculation of forces, Work done-process parameters, equipments used - Defects-Applications-Recent advances in forging, Rolling, Extrusion and drawing processes-Experimental techniques of evaluation of friction in metal forming, ring compression and double cup extrusion tests.

UNIT III   SHEET METAL FORMING   7
Conventional processes-H E R F techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming - Principles and process parameters- Advantages -Limitations and Applications.

UNIT IV   P/M FORMING   7
Overview of P/M technique-Advantages-applications-Powder preform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters.

UNIT V   SPECIAL FORMING PROCESSES   7

Orbital forging-Isothermal forging- High speed extrusion-Rubber pad forming-Water hammer forming-Fine blanking -Superplastic forming techniques- electro forming.

TOTAL: 45 PERIODS

REFERENCES :

1. Schuler - " Metal Forming Handbook "- Springer Verlag Publication, 1998
2. Hosford, WF and CADDELL, R.M. - " Metal Forming: Mechanics and Metallurgy ", PrenticeHall, Eaglewood Cliffs, 1993
3. Dieter, G.E. - " Mechanical Metallurgy (Revised EditionII) "- McGraw Hill Co, 1980
4. Nagpal, G.R.- " Metal Forming Processes ", Khanna Publishers1998
5. Chakrabarthy, J-" Theory of Plasticity ", McGraw Hill Co, 1987
6. Altan.T.-"Metal Forming-Fundamentals and applications-American Society of Metals", Metalspark, 1983.
7. Shiro Kobayashi, SOO-IK-oh-ALTAN,T - " Metal Forming and Finite Element Method ", Oxford University Press, 1989
8. Narayanasamy.R. -" Theory of Metal Forming Plasticity ", Ahuja Book Company,, 2001,2nd Ed. Altan T, Soo-Ik-Oh, GEGEL, HL - "Metal Forming, fundamentals and applications",American Society of Metals, Metals Park,Ohio,1983.

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

AIM:

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

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

UNIT I   CASTING DESIGN   8

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

UNIT II   CASTING METALLURGY   8

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

UNIT III   RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT   8

Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –– Computer aided design of casting.

UNIT IV   WELDING METALLURGY AND DESIGN   10

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels

Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V   RECENT TRENDS IN WELDING   11
Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

TOTAL: 45 PERIODS

REFERENCES:
1. ASM Handbook, Vol 15, Casting, 2004
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003
3. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
4. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002
5. HEINELOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Jain P.L., Principles of Foundry Technology,Tata McGrawHill Publishers, 2003
7. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
8. IOTROWSKI – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
9. SCHWARIZ, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
10. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
11. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980

PE9004   MAINTENANCE AND RELIABILITY ENGINEERING   L T P C
3 0 0 3

UNIT I   MAINTENANCE MANAGAMENT   9
Need for maintenance-Objective- Concepts-Types of maintenance-Organization-Trade force mix, type and location-Maintenance costs-Benefits- Computer Aided Maintenance management-Total productive maintenance.

UNIT II   TYPES OF MAINTENANCE   9
Breakdown and Preventive maintenance-Advantages and Limitations-Maintenance prevention-Diagnostic maintenance-Design out maintenance- Opportunity maintenance.

UNIT III   DIAGNOSTIC MAINTENANCE   9
Leak detection-wear monitoring-Temperature monitoring- Vibration monitoring-Signature analysis-Shock monitoring-Lubricant-Analysis-Methodology- Equipments-Applications

UNIT IV   CONCEPTS OF RELIABILITY   9

Elements of Probability-Reliability Definition-Measures of Reliability-Failures-Classification of failures-Failure data Analysis-Availability-Criticality matrix- Event tree analysis-Utilization factor-Factors affecting reliability.

UNIT V   DESIGN FOR RELIABILITY   9

Analysis of reliability data-Weibull analysis-Design and manufacture for Reliability-Reliability of parts and components-Design for system reliability- Economics of standby or redundancy in production system-reliability testing-Types.

TOTAL: 45 PERIODS

REFERENCES :

1. Higgins and Morrow,-" Maintenance Engineering Handbook ", Tata McGraw Hill, 1985.
2. Collact, "Mechanical Fault Diagnosis and Condition monitoring "- McGraw Hill-1985.
3. Miller & Blood. - " Modern maintenance Management" -Tarapooriwala & sons, 1976.
4. Jentry Ej and Kumamoto,H, " Reliability Engineering and Test assessment ", Prentice Hall,1992.
5. Carter, A.D.S. "Mechanical Reliability ",-Macmillan,1984.
6. Nakajima.s.. ," Introduction to TPM - Total Productive Maintenance", Productivity Press-1995.
7. O'connor, P.D.T', "Practical Reliability Engineering ", John Wiley-1994.
8. Kelley.a. & m.j.harris,-" Management of Industrial Maintenance", Newnes-Butter worth.

PE9005   IMAGE PROCESSING IN MANUFACTURING   L T P C
**   3 0 0 3**

UNIT I   INTRODUCTION   8

Image representation and nomenclature-Relationship of image processing and computer vision-Digital image fundamentals-Geometric model for imaging and applications- Imaging requirements.

UNIT II   IMAGE PROCESSING FUNDAMENTAL   10

Image transformers-Sampling-Enhancement- Restoration and conversions-Segmentation-Thresholding representation and description.

UNIT III   IMAGE ANALYSIS   9

Processing binary images-Image measurements - Multilevel image analysis- Higher dimensional modeling-Image based knowledge manipulation.

UNIT IV   PRACTICAL IMAGE PROCESSING   10

2D/3D Image acquisition-3D image Visualisation- Imaging surfaces-Image processing system components.

UNIT V   APPLICATION IN MANUFACTURING   8

Measurement of surface finish - Sorting and counting of objects -Tool Wear measurement, measurement technique - Robot application.

TOTAL: 45 PERIODS

REFERENCES:
1. John C Russ - "The Image Processing Hand Book, 3rd Edition", CRC Press/IEEE Press,2000.
2. Robert J Schalkoff -" Digital Image Processing and Computer Vision ", John Wiley & Sons Inc, 1998
3. Rafel C, Gin Zalez & Richar E Woods - "Digital Image Processing ", Addison Wesley Publishing, 1993.
4. Ramesh C John - "Introduction to machine vision ", Tata Mc Graw Hill, 1995.

PE9007   PURCHASING AND MATERIAL MANAGEMENT   L T P C
                                                            3 0 0 3

UNIT I   INTRODUCTION   7

Objectives of material management-material circle-Organization for material management-Integrated materials management approach-Organization and control-Materials research-Corporate policy-Value analysis.

UNIT II   MATERIALS PLANNING AND INVENTOREY MANAGEMENT   10

Materials forecasting-Selective inventory control-Fixed order size and fixed order interval systems-Deterministic models-Static inventory models-Probabilistic models-ABC Analysis-Spare parts management—Materials requirement planning and aggregate inventory management-Implementation of inventory systems.

UNIT III   MATERIALS STORAGE AND WAREHOUSING   9

Standard - Variety reduction-Codification- Storage designs-Store layout-Storage systems-Mechanisation of automation of warehouses- Materials handling-transportation and traffic management-Stores management- Procedure- Incoming materials control, Obsolete, Surplus and Scrap management.

UNIT IV   PURCHASING: 10

Purchasing policies and procedures-Legal aspects of purchasing-Selection of sources of supply-Make or buy decisions-Vendor development-Price-Cost analysis and negotiations-Forward buying-Speculation- Commodity markets-Capital equipment buying-Imports and customs clearance-Purchasing research-Creative purchasing.

UNIT V   MATERIALS ACCOUNTING, BUDGETING AND ADMINISTRATIVE
**   CONTROL   9**
Materials accounting-Stock verification-Budgeting, Evaluation of materials management performance- Information systems in material management-Buyer seller relationships in ethics. Application of operations research techniques in material managements.

**   TOTAL: 45 PERIODS**

REFERENCES:
1. P.Gopalakrishnan and m.sundaresan, "Materials Management Integrated approach ", PHI1996
2. Learner Lee Jr. and Donald.M.Dobbler, "Purchasing and Material management", Tata McGraw Hill, 1996
3. J.K.Westing, I.V.Fine and C.T.Zone, "Purchasing Management ", John Wiley and Sons 1976.
4. J.G.Monks, "Operation Management ", McGraw Hill, 1984.
5. M.K.Starr, "Operations Management ", Prentice Hall, 1982.

PE9008   ENGINEERING ECONOMICS   L T P C
**   3 0 0 3**

UNIT I   INTRODUCTION   9
Present economic policy, liberalization, privatization, globalization, scope for industrial growth, Interest and time value of money, cash-flow diagram, simple interest, compound interest, single payments, uniform series payments, interest factors and tables, nominal and effective interest rates, continuous compounding, uniform continuous payments.

UNIT II   METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES   9
Present worth comparison - equal, unequal lived assets, study period, assets with infinite life, capitalized cost, bond valuation. Equivalent uniform annual cost comparison, situations for EUAC, rate of return comparisons – IRR – MARR – IRR misconceptions.

UNIT III   REPLACEMENT ANALYSIS   9
Review of conventional approach, group replacement, analysis with time value accounting, replacement due to deterioration, obsolescence, inadequacy, economic life for cyclic replacements, current salvage value of the defender, defender and challenger with different lives, additional one year assessment.

UNIT IV   FEASIBILITY ANALYSIS FOR MARKETING, TECHNICALAND FINANCIAL 9
Case study, report preparation. Depreciation, reasons, depreciation accounts, causes of declining value, depreciation methods. Cost, volume, profit analysis: review of conventional approach, analysis with time value, linear, non-linear, multi product break even analysis. Review of project management, PERT – CPM, crashing, cost system. Product costing. Types of market, identification of investment opportunities, market and demand analysis, forecasting demand (review), forecast control, secondary sources of information. Product design, concept of concurrent engineering, make Vs buy decisions, BPO, value analysis, FAST approach,

15

product life cycle management. Means of financing, financial institutions, all India, state level, profitability, cash flows of a project, financial leverage of a business. Tax factors in investment analysis, effects of inflation in economic analysis.

UNIT V   RISK AND MULTI STAGE SEQUENTIAL DECISION ANALYSIS   9
Recognising risk, including risk in economic analysis, expected value, payoff table, decision tree, discounted decision tree.

TOTAL: 45 PERIODS

REFERENCES :
1. James L Riggs, David D Bed worth and Sabah U Randhawa, "Engineering Economics", McGraw Hill Book Company, New Delhi, 2004.
2. Prasanna Chandra, "Projects - Preparation, Appraisal and Implementation", Tata McGraw Hill, New Delhi, 2004.
3. William G Sullivan and others, " Engineering Economy" , Pearson Education Inc., Delhi, 2001
4. John A White et. al, "Principles of Engineering Economic Analysis", John Wiley and Sons, New York, 1998.
5. Leland T Blank and Anthony J Tarquin, "Engineering Economy", McGraw Hill Book Company, 1998.
6. Norman N Barish, "Economic Analysis for Engineering and Managerial Decision Making", McGraw Hill Book Company, 1983.

PE9009   RAPID PROTOTYPING, TOOLING AND MANUFACTURE   L T P C
3 0 0 3

UNIT I   INTRODUCTION, FUSED DEPOSITION MODELING(FDM) SELECTIVE
LASER SINTERING   9
Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems. Principle, process parameters, path generation, applications of FDM. Types of machines, principles of operation, process parameters, data preparation for SLS, applications.

UNIT II   STEREOLITHOGRAPHY SYSTEMS, LAMINATED OBJECT MANUFACTURING
(LOM), SOLID GROUND CURING   9
Principle, process parameters, process details, data preparation, data files and machine details, applications. Principle of operation, LOM materials, process details, applications of LOM. Principle of operation, of SGC machine details, applications of SGC.

UNIT III   CONCEPT MODELERSAND 3D PRINTING   9
Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system.

UNIT IV   RAPID TOOLING AND SOFTWARE FOR RP   9
Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite, 3D Keltool, etc., direct rapid tooling - direct AIM, quick cast process, copper polyamide, rapid tool, DMILS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling. STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools.

UNIT V   RAPID MANUFACTURING PROCESS OPTIMIZATION AND ALLIED
**   PROCESSES   9**
Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation. Allied process such as vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

TOTAL: 45 PERIODS

REFERENCES :

1. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2001.
2. Pham. D. T. and Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.
3. Paul. F. Jacobs, "Stereo lithography and other RP&M Technologies", SME, NY, 1996.
4. FDM Maxum User Guide.
5. FDM 1650 User Guide.
6. Sinterstation 2500 plus System User Guide.
7. MK-Technology Gmbh. System User Guide.

PE9010	IT IN MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION AND PRODUCT DEVELOPMENT   9
Role of internet and information technology in manufacturing, present market constraints, extended enterprises, B2C and B2B, PLM and PDM. Product lifecycle, sequential engineering Vs concurrent engineering, concurrent engineering and information technology, collaborative product development and its relevance.

UNIT II   USE OF CAD AND CAM   9
Modeling of geometry of parts, modeling of assemblies, different modeling packages and standards for data exchange between different softwares - cases, standard for graphics programming, features of GKS, Other graphics standards, PHIGS, PARASOLID, ACIS, exchange of CAD data, DXF, IGES, other data exchanges formats, product data technology support.

UNIT III   AUTOMATED PROCESS PLANNING   9
Process planning, structure of a process planning software, information requirements for process planning, operation of a typical computer aided process planning software, group technology.

UNIT IV   PLANNING OF RESOURCES FOR MANUFACTURING THROUGH IT   9
Background, role of MRP-II, MRP software, manufacturing applications, engineering applications, financial applications, marketing applications, dynamic enterprises, ERP, SCM, virtual manufacturing.

UNIT V   COLLABORATIVE ENGINEERING   9

Faster design throughput, web based design, changing design approaches, extended enterprises, enterprise wide product visualization, enterprise application integration for PLM.

TOTAL: 45 PERIODS

REFERENCES :
1. Radhakrishnan P., Subramanyan S. and Raju V., "CAD/CAM/CIM", New Age International Publishers, New Delhi, 2002.
2. Cornelius Leondes, "Computer Aided Design - Vol 2: Computer Integrated Manufacturing", CRC Press, 2001.
3. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall, 1998.
4. Puente E., Macconaill P., "Computer Integrated Manufacturing", Springer-Verlag, 1998.
5. Kant Vajpayee S., "Computer Integrated Manufacturing", Prentice Hall, Inc, 1995.
6. Bedworth O D., "Computer Integrated Design and Manufacturing", McGraw Hill, Inc, 1991.

PE9011   NON- TRADITIONAL MACHINING PROCESSES   L T P C
**   3 0 0 3**

UNIT I   INTRODUCTION AND MECHANICAL MACHINING PROCESS   9

Technological and commercial need, classification, performance constraints, selection of NTM, hybrid processes. Mechanical Machining Process such as abrasive jet machining, water jet machining, abrasive water jet machining, abrasive flow machining, magnetic abrasive flow machining, magnetic abrasive finishing – process parameters.

UNIT II   ULTRASONIC MACHINING AND ELECTRIC DISCHARGE MACHINING (EDM) 9

ultrasonic machining system, mechanics of cutting, process parameters, analysis, capability, grain growing model, grain hammering model, limitations and applications. Working principle, process parameters, process capabilities, components of system and its functions, analysis of RC circuit, power delivered to discharging circuit, current in discharge circuit, parametric relation for material removal rate and surface finish, gap cleaning, process characteristics, effect of various parameters on material removal rate, application and limitations.

UNIT III   LASER BEAM MACHINING (LBM)AND PLASMA ARC MACHINING (PAM)   9

Production of lasers, types of lasers, process characteristics, working principle, process parameters, process capabilities, components of system and its functions, limitations, application in drilling, cutting, marking and miscellaneous applications. Working principle, of PAM process parameters, process capabilities, components of system and its functions, various plasma arc torches, process capabilities, comparison with oxy fuel cutting, application and limitations of PAM.

UNIT IV   ELECTRON BEAM MACHINING (EBM) ELECTRO CHEMICAL AND
**   CHEMICAL MACHINING PROCESSES   9**

Working principle, process parameters, process capabilities, components of system and its functions, application and limitations. Working principle, components and functions, process parameters, limitations and applications – electro chemical machining, material removal rate and mechanism, inter electrode gap, zero feed rate, finite feed rate, maximum permissible feed rate, self regulation feature, effect of temperature, hydrogen bubbles, anode shape prediction, cos θ method, tool design – chemical machining, masks, etchants.

UNIT V   HYBRID PROCESSES   9

Introduction, working principle, equipment, process parameters, process capabilities, and applications of electro chemical grinding (ECG), electrical discharge grinding (EDG), electro chemical discharge machining (ECDG).

TOTAL: 45 PERIODS

REFERENCES :
1. Hassan Abdel, Gaward EI-Hofy, "Advanced machining processes", McGraw Hill Publications, 2005.
2. Vijay K. Jain, "Advanced machining processes" Allied Publications Pvt. Ltd. New Delhi, 2002.
3. Carl Sommer, "Non-traditional machining Handbook", Advance Publishing Inc., 2000.
4. James Brown, "Advanced Machining Technology Handbook", McGraw Hill Publications, 2005.
5. Pandey P.C.,"Modern Machining Process", Tata McGraw Hill Publications. New Delhi, 1996.
6. Gary.F.Benidict,"Non traditional manufacturing process", Marcel Dekker Inc, New York, 1987.
7. Amithaba Gosh and Ashok Kumar Malik, "Manufacturing Science", Affliated East West Press. Pvt. Ltd, 1985.

PE9012	PRODUCT DEVELOPMENT STRATEGIES	L	T	P	C
		3	0	0	3

UNIT I   INTRODUCTION   9

Product development versus design, types of design and redesign, modern production development process, reverse engineering and redesign product development process, examples of product development process, scoping product development – S-curve, new product development. Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality.

UNIT II   PRODUCT TEARDOWN AND EXPERIMENTATION   9

Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios.

UNIT III   GENERATING CONCEPTS   9

Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness

UNIT IV   DESIGN FOR THE ENVIRONMENT   9

DFE methods, life cycle assessment, weighted sum assessment method, techniques to reduce environmental impact – disassembly, recyclability, remanufacturing regulations and standards, analytical and numerical model solutions.

UNIT V   PHYSICAL PROTOTYPES   9

Types of prototypes, use of prototypes, rapid prototyping technique scale, dimensional analysis and similitude, physical model and experimentation – design of
experiments, statistical analysis of experiments.

TOTAL: 45 PERIODS

REFERENCES :

1. Kevin Otto, Kristin Wood, "Product Design – Techniques in Reverse Engineering and New Product Development", Pearson Education, New Delhi, 2004.
2. Karl. T. Ulrich and Stephen D. Eppinger, "Product Design and Development", McGraw Hill, New York, 1994.

PE9013   SIX-SIGMA CONCEPTS   L T P C
**   3 0 0 3**

UNIT I   INTRODUCTION   9

History of Six- sigma; Benefits; Tools and Themes of Six-Sigma programme. Ingredients of six-sigma; Cost of quality. A six-sigma vision of business leadership; An introduction to sigma measurement; Six-Sigma improvement and management strategies; The DMAIC Six-Sigma improvement model; Six-Sigma v/s TQM (comparison with TQM).

UNIT II   THE SIX-SIGMA ROAD MAP   9

Advantages of six-sigma roadmap; Steps in roadmap; over view and rationale behind each step. Application of six-sigma in service: Comparison of service and manufacturing; challenges making six-sigma work in services; using lean sigma in service.

UNIT III   ADOPTING SIX-SIGMA   9

Relevance of six sigma programme; Strategy phase of six-sigma program; preparing leaders to launch and guide effort. Preparing black belts and other key roles- Master Black belt; Champion and Green belts.

UNIT IV   TRAINING THE ORGANIZATION FOR SIX-SIGMA   9

Essentials of effective training; planning curriculum; selecting the right six-sigma projects-Essentials; process and Do's & Don'ts. Identifying core process; Defining customer requirements; measuring current performance. Six sigma process improvement; six sigma process design/ redesign; expanding and integrating the six sigma system.

UNIT V   DESIGN FOR SIX- SIGMA (DFSS)   5

Introduction; Need for DFSS; DFSS Phases; Differences between six sigma and DFSS; Features of a sound DFSS strategy. Black belt-DFSS Team; Cultural change; DFSS Deployment strategy; DFSS strategy goals; DFSS sustainability factors; Introduction for six-sigma project algorithm.

                                                                                  TOTAL: 45 PERIODS

REFERENCES :

1. Kai Yang and Basemel-Haik, "Design for Six-Sigma: A Roadmap for Product Development", McGraw Hill, 2003.
2. Crrevelng C.M., Slats J.L. and Antis D., "Design for Six Sigma", Pearson Education; 2003.
3. Michael.L.George, "Lean Six Sigma for Service", Tata McGraw Hill, 2003.
4. Peter S. Pande, Robert P.Neuman, Roland Cavanagh R., "The Six-Sigma way-How GE", Motorola and Other Top Companies are Honing their Performance, McGraw Hill, 2001.
5. Stamatis D.H., "Six-Sigma and Beyond-Foundations of Excellent Performance", St. Lucie press 2001.
6. Mikel Harry and Richard Schroeder.A., "Six-Sigma: The Break through Management Strategy", Currency Book Published by Doubleday, 2000.

PE9014   FINITE ELEMENT ANALYSIS   L T   P C
                                                                                  3 0 0 3

UNIT I   INTRODUCTION   9

Basic concept, historical background, general description, comparison with other methods of analysis, finite element program packages, engineering applications. Discretization of the domain, basic element shapes, discretization process, node numbering scheme, assemblage of element equations, and incorporation of boundary conditions.

UNIT II   INTERPOLATION MODELS   9

Polynomial form of interpolation functions, selection of the order of the interpolation polynomial, simplex, complex and multiplex elements, interpolation polynomial in terms of nodal degrees of freedom, convergence requirements, linear interpolation polynomials in terms of global coordinates and for vector quantities, coordinate transformation.

UNIT III   STATIC ANALYSIS OF SOLID MECHANICS PROBLEMS   9

Basic equations of solid mechanics, formulation of solid and structural mechanics problems, formulation of finite element equations, analysis of bar, space truss, beam and space frame, plates - triangular membrane, rectangular, triangular plate bending, tetrahedron and axisymmetric elements, case studies

UNIT IV   DYNAMIC ANALYSIS OF SOLID MECHANICS PROBLEMS   9

Dynamic equations of motion, consistent and lumped mass matrices, free vibration analysis, dynamic response using finite element method.

UNIT V   NON-LINEAR PROBLEMS & ERROR ESTIMATES   9

Introduction, material non-linearity, elasto plasticity, plasticity, visco plasticity, geometric non-linearity, large displacement, error norms and convergence rates, H-refinement with adaptivity, adaptive refinement.

TOTAL: 45 PERIODS

REFERENCES :

1. "Finite Element Analysis for Engineering Technology", Tirupathi R Chandrupatla Universities Press Published, 2004.
2. Daryl l Logan, "First Course in the Finite Element Method", Thomson Learning, 2002.
3. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis". Wiley, John & Sons, 1999.
4. S.S.Rao, "Finite Element Analysis" 2002 Edition.
5. Reddy J.N., "An introduction to Finite Element Method", McGraw Hill, International Edition, 1993.
6. Bathe K.J.,"Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990.

PE9016   **OPTIMIZATION TECHNIQUES**   **L T P C**
                                                              3 0 0 3

UNIT I   NONLINEAR OPTIMIZATION   9

Introduction, unconstrained optimization, one-dimensional optimization, elimination methods, Fibonacci method, golden section methods, interpolation methods, quadratic, cubic interpolations, direct root methods, multivariable optimization, direct search methods, pattern search methods, univariate method, Hooks and Jeeves method, Powel's method, simplex method, descent methods, steepest descent, conjugate gradient, Newton methods.

UNIT II   CONSTRAINED NONLINEAR OPTIMIZATION   9

Direct methods, the complex method, cutting plane method, indirect methods, transformation techniques, 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, and marketing problem.

UNIT IV   NETWORK OPTIMIZATION MODELS   9

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   9

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.

REFERENCES :

1. Kalyanmoy Deb, "Optimization for Engineering Design", Printice-Hall India (Pvt) Ltd., New Delhi, 2000.
2. Fred Glover, Manuel Laguna and Fred Laguna, "Tabu Search", Kluwer Academic Publishers, 1997.
3. Singiresu S Rao, "Engineering Optimization: Theory and Practice", Wiley-Interscience, 3rd Edition, 1996.
4. Stephen G Nash and Ariela Sofer, "Linear and Nonlinear Programming", McGraw Hill College Div., 1995.
5. Cihan H Dagli, "Artificial Neural Networks for Intelligent Manufacturing", Chapman and Hall, London, 1994, ISBN 0 412 48050.
6. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison-Wesley Pub Co., 1989.
7. Dimitri P Bertsekas, "Dynamic Programming: Deterministic and Stochastic Models", Prentice Hall, 1987.

PE9017   ARTIFICIAL INTELLIGENCE IN MANUFACTURING   L T P C
                                                                     3 0 0 3

UNIT I   INTRODUCTION   9
Concepts of fifth generation computing - Programming in AI environment, developing artificial intelligence system, natural language processing, neural networks. Forward chaining, backward chaining, use of probability and fuzzy logic. Semantic nets-structure and objects, ruled systems for semantic nets; certainty factors, automated learning.

UNIT II   LANGUAGES USED IN AI   9
Using PROLOG to design expert systems, converting rules to PROLOG, conceptual example, introduction to LISP, function evaluation, lists, predicates, rule creation.

UNIT III   EXPERT SYSTEM DEVELOPMENT   9
efinition- choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing.

UNIT IV   EXPERT SYSTEM TOOLS   9
Expert systems – controlling reasoning – rule based system – canonical systems – rules and meta rules – associative nets and frame systems – graphs trees and networks – representing uncertainty – probability in expert systems-learning- forms of learning – inductive learning – decision trees – knowledge in learning – Heuristic classification – Heuristic matching - case studies in expert systems – MYCIN – Meta-Dendral.- general structure of an expert system shell, examples of creation of an expert system using an expert system tool Fundamentals of object oriented programming, creating structure and object, object operations, invoking procedures, programming applications, object oriented expert system.

UNIT V INDUSTRIAL APPLICATION OF AI AND EXPERT SYSTEMS 9

Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition.

TOTAL: 45 PERIODS

REFERENCES :

1. Robert Levine et al, "A Comprehensive Guide to AI and Expert Systems", McGraw Hill Inc,1986.
2. Henry C Mishkoff, "Understanding AI", BPB Publication, New Delhi, 1986.
3. Peter Jackson, "Introduction to Expert Systems", First Indian Reprint, 2000, Addison-Wesley.
4. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 1995.
5. Elaine Rich et al., "Artificial Intelligence", McGraw Hill, 1995.
6. Winston P H, "Artificial Intelligence", Addison-Wesley, Reading, Massachusetts, Third Edition,1992.

PE9018 SIMULATION OF MANUFACTURING SYSTEMS
L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Monte Carlo simulation. Nature of computer modeling and simulation. Limitations of simulation, areas of application. Components of a system - discrete and continuous systems. Models of a system - a variety of modeling approaches – steps in simulation study.

UNIT II DISCRETE EVENT SIMULATION 9

Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory systems.

UNIT IV RANDOM NUMBER GENERATION AND TESTING 9

Techniques for generating random numbers – midsquare method - midproduct method - constant multiplier technique - linear congruential method, mixed and multiplicative. Kolmogorov – Smirnov test – Chi-square test, frequency test, run test, test for autocorrelation, gap test and poker hand test.

UNIT IV RANDOM VARIATE GENERATION 9

Inverse transform technique – exponential, uniform, Weibull, triangular distribution - empirical continuous distributions – empirical discrete, uniform and geometric distribution. Direct transform techniques for normal distribution, convolution method – Erlang distribution, acceptance – rejection techniques for Poisson and Gamma distribution.

UNIT V RESULT ANALYSIS & GPSS 9

Variance reduction techniques - antithetic variables - verification and validation of simulation models. Concepts of GPSS programming for discrete event systems in GPSS, case studies.

TOTAL: 45 PERIODS

REFERENCES :

1. Narsingh Deo, "System Simulation with Digital Computer", Prentice Hall, 2003.
2. Gordon G., "Systems Simulation", Prentice Hall Ltd., 2002.
3. Jerry Banks and John S. Carson II, "Discrete Event System Simulation", Prentice Hall Inc., 2001.
4. Francis Neelamkovil, "Computer Simulation and Modeling", John Wiley & Sons, 1987.

PE9019	COMPUTER INTEGRATED MANUFACTURING	L T P C
		3 0 0 3

UNIT I INTRODUCTION 9

Evolution of CAD/CAM and CIM, scope of CIM, segments of generic CIM, computers and workstations, an overview of CIM software. Geometric modeling techniques, automated drafting, graphic standards, engineering analysis, optimisation, principles of concurrent engineering.

UNIT II CNC TECHNOLOGY AND ROBOTIC SYSTEMS 9

Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC–flexible manufacturing systems. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly.

UNIT III GROUP TECHNOLOGY AND AUTOMATED PROCESS PLANNING AND MANUFACTURING SYSTEM SOFTWARE 9

Methods of developing part families, classification and coding systems, process planning, variant and generative process planning methods, AI in process planning. Production control–forecasting, master production schedule, MRP, capacity planning, shop floor control, inventory management, product routing, job costing, marketing applications.

UNIT IV FUNDAMENTALS OF NETWORKING AND RAPID PROTOTYPING 9

Networking concepts, networking devices – repeaters, bridges, routers, gateways, hubs and switches. MAP, TOP, LAN, WAN. Network topologies – star, bus, ring. Rapid prototyping techniques, software for rapid prototyping, process optimization.

UNIT V VIRTUAL ORGANISATION: 9

Paperless factory, introduction virtual reality and application, virtual prototyping and manufacturing instrumentation and measurement, virtual enterprises. Involving CAD/CAM/CAE activities for a selected product from industry.

REFERENCES:
1. Mikell P Groover, "Automation of Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi, 2001.
2. Lee Kunwoo, "CAD/CAM/CAE Systems", Addition, Wesley, USA, 1999.
3. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall, India, New Jersey, 2003.
4. Radhakrishnan P, Subramanyan S and Raju V, "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd, New Delhi, 2000.

PE9020   **MICRO SYSTEMS TECHNOLOGY**   **L T P C**
                                                                         3 0 0 3

UNIT I   INTRODUCTION   9
Definition, historical development, application. Refreshing basics of electronics, logic and memory chips, silicon water, epitaxy, lithography, diffusion, thin film deposition, assembly bulk micro machining.

UNIT II   MEMS AND MICRO SENSORS   9
Background and fundamentals – properties, micro fluidics, design and fabrication – modeling, fabrication techniques, application in various fields. Classification of sensors, signal conversion, ideal characteristics of sensor, scaling, mechanical sensors, displacement and accelerometers, pressure and flow sensors.

UNIT III   NANO MEASURING SYSTEMS   9
In process or in situ measurement of position of processing point, post process and on line measurement of dimensional features and surface, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.

UNIT IV   APPLICATION OF NANO ENGINEERING: 9
Nano-grating system, nano-lithography, photolithography, electron beam lithography, machining of soft metal mirrors with diamond turning, mirror grinding of ceramics, ultra-precision block gauges, balls for rolling bearings, fabrication of CCDs, VCR head assemblies, optical fibres.

UNIT V   FUTURE TRENDS IN NANO ENGINEERING: 9
Development of intelligent products, nano processing of materials for super high density ICs, nano mechanical parts, micro machines.

TOTAL: 45 PERIODS

REFERENCES :

1. May G.S. and Size S.M., "Fundamentals of Semiconductor Fabrication", John Wiley & Sons Inc, 2004.
2. Bharat Bhushan, "Handbook of Nano Technology", Springer, Germany, 2004.
3. Tai Ran Hsu, "Mems & Micro Systems Design and Manufacture", Tata McGraw Hill, 2003.
4. Norio Taniguchi, "Nanotechnology", Oxford University Press, New York, 2003.
5. Chang C.V. and Sze S.M., "VLSI Technology", Tata McGraw Hill, New Delhi, April 2003.
6. Mark J Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.
7. Julian.W.Gardner, "Micro sensors, Principles and Applications", CRC Press, 1997.