ANNA UNIVERSITY COIMBATORE-
CURRICULAM 2007-FULL TIME MODE

M.E. PRODUCTION ENGINEERING

SEMESTER-I

Code no	Course Title	L	T	P	M
THEORY					
	Computational methods and probability	3	1	0	100
	Metrology and quality engineering	3	0	0	100
	Fluid power automation	3	0	0	100
	Design for manufacture and assembly	3	1	0	100
	Metal cutting theory and practice	3	0	0	100
	Computer numerical control and robotics	3	0	0	100
LAB	Production engineering laboratory	0	0	3	100

SEMESTER-II

Code no	Course Title	L	T	P	M
THEORY					
	Advanced materials and their processing	3	0	0	100
	Production and operations management	3	0	0	100
	Product data management	3	0	0	100
	Elective I	3	0	0	100
	Elective II	3	0	0	100
	Elective III	3	0	0	100
LAB	Data structures laboratory	2	0	3	100
SEMINAR		0	0	2	100

SEMESTER-III

Code no	Course Title	L	T	P	M
THEORY					
	Elective IV	3	0	0	100
	Elective V	3	0	0	100
	Elective VI	3	0	0	100
PRACTICAL					
	Project Work - Phase-I	0	0	12	*

SEMESTER-IV

Code no	Course Title	L	T	P	M
	Project Work – Phase-II	0	0	24	*

LIST OF ELECTIVES

M.E. PRODUCTION ENGINEERING

Course Code	Course Title	L	T	P	M
		3	0	0	100
	Metal Forming Theory and Practice	3	0	0	100
	Advances in Casting and Welding	3	0	0	100
	Total Quality Management	3	0	0	100
	Maintenance and Reliability Engineering	3	0	0	100
	Image Processing in Manufacturing	3	0	0	100
	Human Factors in Engineering	3	0	0	100
	Purchasing and Material Management	3	0	0	100
	Engineering Economics	3	0	0	100
	Rapid prototyping, tooling and manufacture	3	0	0	100
	IT in manufacturing	3	0	0	100
	Non traditional machining processes	3	0	0	100
	Product development strategies	3	0	0	100
	Six-sigma concepts	3	0	0	100
	Finite element analysis	3	0	0	100
	Integrated product and process development	3	0	0	100
	Optimization techniques	3	0	0	100
	Artificial intelligence in manufacturing	3	0	0	100
	Simulation of manufacturing systems	3	0	0	100
	Computer Integrated Manufacturing	3	0	0	100
	Micro systems technology	3	0	0	100

SEMESTER-I

COMPUTATIONAL METHODS AND PROBABILITY

3 1 0 100

INTRODUCTION TO COMPUTATIONAL METHODS: Examples, solving sets of equations, Gauss elimination method, Choleski method, Iterative methods, Relaxation method, System of non-linear equations- Newton Raphson method. (5)

NUMERICAL INTEGRATION: Newton-Cotes integration formulas, Trapezoidal rule, Simpson's rules, Gaussian quadrature, Adaptive integration, Cubic spline functions - Bezier curves and B-splines. (6)

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: Laplace's equations, representations as a difference equation, Iterative methods for Laplace's equations, Poisson equation, examples, Matrix patterns, Sparseness, ADI method. (6)

CURVE FITTING AND APPROXIMATION OF FUNCTIONS: Least square approximation, fitting of non-linear curves by least squares, regression analysis. (3)

PROBABILITY AND CONCEPT OF RANDOM VARIABLE: Axiomatic Approach to Probability – Random variables – Discrete random variables: Bernoulli, Binomial, Geometric and Poisson – Continuous random variables – Uniform, Exponential, Gamma and Normal – Expectation of random variables – Jointly distributed random variable Moment Generating functions. (4)

CONDITIONAL PROBABILITY AND CONDITIONAL EXPECTATION: Introduction – Discrete case – Continuous case – Computing expectation by conditioning – Computing probabilities by conditioning – Applications. (4)

THEORY OF ESTIMATION: Point estimation – characteristics of estimation – interval estimation – estimates of mean, standard deviation and properties. (4)

TESTING OF HYPOTHESIS: Probability density function and applications of t, F, Chi square distributions –Large sample tests for means, variances, and proportions – Small sample tests for means, variances, and attributes (5)

RELIABILITY: Hazard Rate and Mean Time To Failure, Mathematical models for reliability systems -exponential and Weibull failure laws – System reliability – series system, parallel system, [k,n] system - system failure rate, system MTTF. (5)

Total No of periods : 42

REFERENCES:

1. Curtis F Gerald and Patrick O Wheatley, "Applied Numerical Analysis", Pearson Education, 2002.
2. Rajasekaran S, “Numerical Methods in Science and Engineering – A Practical Approach”, Wheeler Publishing, 1999, Second Edition
3. Akai “Applied numerical methods for engineers” Wiley India Edition, 2007
4. Trivedi K.S., “Probability and Statistics with Reliability, Queueing and Computer Applications”, Prentice Hall, 2003.
5. Sheldon M.Ross, “Introduction to Probability Models”, Academic Press 2002.

METROLOGY AND QUALITY ENGINEERING

3 0 0 100

LASER METROLOGY: Introduction - types of lasers - laser in engineering metrology - metrological laser methods for applications in machine systems, methods of laser metrology - ray optical method - wave optical methods – interferometry - laser Doppler technique - laser Doppler anemometry - light in flight technique - contouring technique - interferometric arrangements - speckle metrology. (6)

PRECISION INSTRUMENTS BASED ON LASER: Laser telemetric systems - laser and lead based distance measuring instrument - detection of microscope imperfections on high quality surface - description of the proposed surfing flaw monitoring technique - uses of laser - computer aided laser metrology - laser interferometer - the pitter N.P.L gauge interferometer - mechanical properties of measurements - basic requirements - two beam interferometry - applications of laser in industries - classification of optical scanning systems - high inertia laser scan technique - rotating mirror technique - single inclined mirror fully illuminated - over illuminated pyramidal spinner - flat field scan system - low inertia laser scan technique - vibrational deflectors - magnetic vibrational deflector - Iteration and scan enhancement - reflective scanner - refractive scanner - diffractive scanner - measurement and inspection - laser welding - laser hardening - laser gauging - bar coding.

(6)

CO-ORDINATE MEASURING MACHINE: Types of CMM - constructional features of CMM – probe - touch trigger probe - non contact trigger probe - operation and programming - computer hardware - computer software - measuring systems - statistical process control - applications of CMM - advantages of CMM - role of CMM in inspection and measurement - measurement and timing of a typical manufactured part - role of CMM on reverse engineering - difficulties in reverse engineering - factors affecting CMM – present trends in CMM - achievements of CMM.

(5)

MACHINE VISION: Image analysis and computer vision - computer vision systems - image analysis technique - spatial feature extraction - image segmentation - digital image processing - basic classes of problems - vision system for measurement - comparison of laser scanning with vision system. (5)

QUALITY IN MANUFACTURING ENGINEERING: Importance of manufacturing planning for quality – initial planning for quality – concept of controllability: self controls – defining quality responsibilities on the factory flow – self inspection – automated manufacturing – overall review of manufacturing planning – process quality audits – quality and production floor culture.

(5)

QUALITY IN DESIGN ENGINEERING: Opportunities for improvement product design - early warning concepts and design assurance - designing for basic functional requirements – designing for time oriented performance (reliability) – availability – designing for safety – designing for manufacturability – cost and product performance – cost of quality – design review – concurrent engineering – improving the effectiveness of product development. (5)

QUALITY MANAGEMENT SYSTEM: Need for quality management system – design of quality management system - quality management system requirements – ISO 9001 and other management systems and models - improvements made to quality management systems. (5)

CONTINUOUS IMPROVEMENT: Basic quality engineering tools and techniques - statistical process control - control limits – control charts for variables - X, R charts – control charts for defective - p, np charts – control charts for defects - c charts. Techniques for process design and improvement - Taguchi methods for process improvement - six sigma - the 'DRIVE' framework for continuous improvement. (5)

Total No of periods: 42

REFERENCES:
1. Oakland J.S., “Total Quality Management - Text with Cases”, Butterworth – Heinemann – An Imprint of Elseiver, First Indian Print, New Delhi, 2005.
2. Elanchezhian C., Vijaya Ramnath B. and Sunder Selwyn T., “Engineering Metrology”, Eswar Press, Chennai, 2004.
3. John A.Bosch, Giddings and Lewis Dayton, “Coordinate Measuring Machines and Systems”, Marcel Dekker, Inc., 1999.
4. Juran J.M. and Gryna F.M., “Quality Planning and Analysis”, Tata McGraw Hill Edition , New Delhi, 1995.
5. ASTME, “Hand Book of Industrial Metrology”, Prentice Hall.

FLUID POWER AUTOMATION

3 0 0 100

INTRODUCTION
Need for Automation, comparison with other power system-ISO symbols for fluid power elements – Economic consideration of fluid power systems-Oil hydraulics, pneumatic-Introduction and selection criterion. (5)

HYDRAULIC POWER GENERATION, CONTROL AND REGULATING ELEMENTS
Basic elements in a fluid power system-Hydraulic pumps, Gear, Vane, piston-selection and specification, drive characteristics Hydraulic actuators-Linear and Rotary, Selection specification and characteristics, cushioning. (10)

PNEUMATICS AND ELECTRO PNEUMATICS
Generation and control of compressed air - Elements in pneumatic circuits, Fluidic devices and its application Flip- Flop, SRT Flip flop-Use of electrical switches, relays, timers in fluid power circuits - Electro pneumatics. (8)

CIRCUIT DESIGN
Design and methodology-Sequential circuits, cascade, Karnaugh-Veitch map, step counter methods-Compound and combination circuit design .Typical Industrial and hydraulic circuits-Synchronising and accumulator circuits-Circuits for machine tools-Aerospace application-Design and selection criteria. Electro pneumatic circuit design, Ladder diagram. (11)

COMPUTER CONTROL & MAINTENANCE OF FLUID POWER CIRCUITS:
Fuzzy logic in fluid power circuits- PLC in fluid powers- PLC ladder diagram. Installation-Fault diagnosis in fluid power circuits. (8)

Total No of periods: 42

REFERENCES:
1. Antony Esposito - " Fluid power system and control ", Prentice Hall,1998.
2. E.F. Fitch AND J.B. Suryaat Madyn - " Introduction to fluid power Logic ", McGraw Hill,1988
3. Peter Rohner - " Fluid Power Logic circuit design ", Macmillan Press,1994.
4. " Hydraulic systems Handbook ", Utility Publication, Secunderabad,1988.
5. Majumdar, “Oil Hydraulics Systems: Principles and Maintenance”, Tata Mc Graw Hil, 2003.
6. Majumdar, “Pneumatic Systems: Principles and Maintenance”, Tata Mc Graw Hil, 2003.

DESIGN FOR MANUFACTURE AND ASSEMBLY

3 1 0 100

PROCESS CAPABILITY AND TOLERANCES: Process capability, mean, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances-ISO standards-surface finish, review of relationship between attainable tolerance grades and different machining and sheet metal processes. Cumulative effect of tolerances- Worst Case Method, Root Sum Square Method, dimensions following truncated normal distributions, Monte Carlo Simulation. (6)

SELECTIVE ASSEMBLY: Interchangeable past manufacture and selective assembly, deciding the number of groups- Model-I: Group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal. Control of axial play - introducing secondary machining operations, laminated shims, examples. (6)

DATUM SYSTEMS AND FIXTURE DESIGN: Degrees of freedom, grouped datum systems - different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot and recess pair and tongue - slot pair - computation of translational and rotational accuracy, geometric analysis and applications. (4)

TRUE POSITION THEORY: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. (6)

F**ORM DESIGN OF CASTINGS, WELDMENTS AND SHEET METAL COMPONENTS :** Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, form design aspects of sheet metal components. (5)

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. (5)

REDESIGN FOR MANUFACTURE: Design features to facilitate machining : datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples. (5)

DFMA TOOLS: Computer Aided DFMA , Poke Yoka principles, Axiomatic design method, quality function deployment, design for six sigma, lean manufacturing, waste identification and elimination, value stream mapping, sensor interface for fool-proof system design. (5)

Total: 42

REFERENCES:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
2. Matousek, "Engineering Design - A Systematic Approach", Blackie and Son Ltd., London, 1974.
3. Micheal Wader “Lean Tools: A Pocket Guide to Implementing Lean Practices”, Productivity and Quality Publishing Pvt Ltd., 2002.
4. Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., 1983.
5. Oliver R Wade, "Tolerance Control in Design and Manufacturing" Industrial Press Inc., New York, 1967.
6. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.

7. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, Second Edition, 1987,
8. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992
9. Basem Said El—Haik, “Axiomatic Quality”, John Wiley and Sons, 2005

METAL CUTTING THEORY AND PRACTICE

3 0 0 100

INTRODUCTION

Basic mechanism of chip formation-Thin and Thick zone models-Types of chips-Chip breaker-Orthogonal Vs Oblique cutting- force and velocity relationship and expression for shear plane angle in orthogonal cutting-Energy Consideration in machining-Modern theories in Mechanics of cutting -Review of Merchant and Lee Shaffer Theories- critical comparison. (9)

TOOL NOMENCLATURE AND CUTTING FORCES

Nomenclature of single point tool-Systems of tool Nomenclature and Conversion of rake angles-Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces. (9)

THERMAL ASPECTS OF MACHINING

Thermodynamics of chip formation - Heat distributions in machining-Effects of various parameters on temperature - Method of temperature measurement in machining-Hot machining - cutting fluids. (9)

TOOL MATERIALS, TOOL LIFE AND TOOL WEAR

Essential requirements of tool materials-Developments in tool materials-ISO specifications for inserts and tool holders-Tool life-optimum tool life - Conventional and accelerated tool life tests-Concepts of machinability and machinability index- Economics of machining (9)

WEAR MECHANISMS AND CHATTER IN MACHINING:

Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs Speed graph, Mechanism of grinding-Various parameters affecting grinding process (6)

Total No of periods: 42

REFERENCES:

1. Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press,1984.
2. Bhattacharya. - " Metal Cutting Theory and Practice ", New central Book Agency(p) Ltd.,Calcutta1984.
3. Venkatesh .V.C. & Chandrasekharan.H. - " Experimental Techniques in Metal cutting ", Prentice Hall of India,1982
4. Juneja.B.L and Sekhon.G.S- " Fundamentals of metal cutting and machine tools ", New Age International(p) Ltd., 1995
5. Xing Sheng LI & Low I.M., Editors Advanced Ceramic Transtech publications,1994.
6. Kuppuswamy.G.- " Principles of metal cutting ", Universities Press(India)Ltd., 1996
7. Boothroy.D.G. and knight. W.A " Fundamentals of Machining and Machine tools "- Marcel Dekker,New York, 1989.

COMPUTER NUMERICAL CONTROL AND ROBOTICS

3 0 0 100

INTRODUCTION TO MACHINE TOOLS: Basic machine tool elements, types, applications, calculation of capacity, specifications, standards on NC machine tool, installation of NC machine, hard machining, high speed machining. (5)

CNC MACHINES: Machine structure, slides, guide ways, recirculating ball screws, spindle, bearing arrangements, tool magazines, turrets, ATC, APC, belts, pneumatic and hydraulic peripherals, design and selection of CNC machines, work holding, soft jaw, hard jaw, tooling for CNC. (8)

CONTROL SYSTEM AND INTERFACING: Open loop, closed loop, block diagram of CNC system, PLC, interpolation, standard and optional features of a control system, motors, drives, feedback devices, MCB, switches, interfacing of motor, controller, compensations, correction factors, trouble shooting. (5)

PART PROGRAMMING: Coding of preparatory functions, miscellaneous function, ISO, EIA standards, axis definition, datum, absolute and incremental programming, tool offset, positioning control, point-to-point, linear, circular, spline interpolation, coordinate systems, cutter diameter compensate, fixed cycles, drilling, boring, area clearance programming, part programming examples (5)

CNC PROGRAMMING USING CAM PACKAGES: Model creation, post processing, data exchange between softwares, NC code generation, input to CNC machine, case studies, typical features of CAM packages, tool path simulation, post processing, multi axis machining, programming examples. (5)

ROBOTICS: Classification of robots, major components of robot, specifications, mechanical elements used in robot, motion conversion, end effectors, electrical elements, control of robotic joints, robotic sensory devices, applications. (7)

ROBOT KINEMATICS: Homogeneous coordinates, homogeneous transformation and manipulator, forward solution, inverse solution, motion generation, Jacobian control. (7)

Total No of periods: 42

REFERENCES:

1. Steve Krar, “Computer Numerical Control”, Industrial Press Inc., New York, 2001.
2. Richaerd D. Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An Integral Approach”, Prentice-Hall India, New Delhi, 2001.
3. David Gibbs, Thomas M. Crandell, “An Introduction to CNC Machining and Programming” Industrial Press Inc., New York, 2000.
4. Yoram Koran, Joseph Ben-uri, “Numerical Control of Machine Tools”, Kanna Publishers, New Delhi, 1998.
5. Thyer G.E., “Computer Numerical Control of Machine Tools”, BHNEWNES, Second Edition, 1991.

PRODUCTION ENGINEERING LABORATORY

0 0 3 100

1. Solid modeling and assembly of machine components using modeling software
2. Manual part program generation for a CNC machine
3. CNC part programming using CAM software
4. Measurement of cutting forces and surface finish in CNC milling (DoE concepts for experimentation)
5. Measurement of material removal rate and surface finish in grinding / AJM / EDM / USM
6. Measurement of roundness using concentricity tester
7. Use of statistical quality control software for process control
8. Sequencing of cylinders using pneumatic trainer kit
9. Programming of PLC for automation systems
10. Development of ANN model of machining parameters using MATLAB software

Total No of periods: 42

SEMESTER-II

ADVANCED MATERIALS AND THEIR PROCESSING

3 0 0 100

CLASSIFICATION: Metals, ceramics, glasses, elastomers, polymers, composites, smart materials, members of each class, nano science materials, material properties viz mechanical, thermal, wear, corrosion / oxidation. (3)

MATERIAL SELECTION: Selection strategy, property limits and material indices, function objectives and constants, performance maximizing criteria. (3)

MATERIAL PROPERTY CHARTS: Modulus - density, strength – density, modulus – strength, specific stiffness and specific strength, fracture toughness, modulus fracture etc. (3)

SELECTION OF MATERIALS AND SHAPE: Shape factors, elastic extrusion, elastic body and twisting, failure, bending and twisting, axial loading and column buckling, efficiency of standard sections, material limits for shape factors, microscopic shape and shape factors. (4)

FERROUS ALLOYS: Types of cast irons, properties, structures, compositions and applications, plain carbon steels, 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. (5)

NON FERROUS ALLOYS: Alloys of copper, aluminium, nickel, magnesium, titanium, lead, tin, zinc - compositions, heat treatments, structures, properties, applications, castability, formability, machinability, hardenability and weldability of the materials. (4)

MATERIALS FOR AUTOMOBILES: Steels – HSLA, aluminium alloys, magnesium alloys, plastics and ceramics, ULSAB, ULSAS. (4)

HIGH TEMPERATURE MATERIALS: High temperature strength and stability – hot hardness requirements – high temperature steels and super alloys. (3)

LOW TEMPERATURE MATERIALS: Aluminium alloys, austenitic stainless steels, duplex stainless steels selection criteria for cryogenic applications. (3)

NON-METALLIC MATERIALS: Ceramics, refractories, abrasives, enamels, cement – glasses, polymers: thermosetting and thermoplastics, types of polymerisation, elastomers, electrical conducting polymers. (4)

ELECTRICAL AND MAGNETIC MATERIALS: P and N type semiconductors, single crystals, soft and hard magnets, superconductors, MEMS materials, nano science materials, smart materials, shape memory alloys. (3)

COMPOSITES: 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. (3)

Total No of periods: 42

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.

Guy A.G," Elements of Physical Metallurgy", Oxford & IBH Pub. Co., 1990

PRODUCTION AND OPERATIONS MANAGEMENT

3 0 0 100

FORECASTING: Introduction, measures of forecast, accuracy, forecasting methods - time series smoothing - regression models - exponential smoothing - seasonal forecasting – cyclic forecasting. (5)

FACILITY LOCATION AND LAYOUT: Location factors, location evaluation methods, different types of layouts for operations and production, arrangement of facilities within departments (5)

INVENTORY ANALYSIS AND CONTROL: Definitions - ABC inventory system - EOQ models for purchased parts - inventory order policies - EMQ models for manufactured parts - lot sizing techniques, inventory models under uncertainty. (5)

JUST IN TIME MANUFACTURING: Elements of JIT - uniform production rate - pull versus push method - Kanban system - small lot size - quick, inexpensive set-up - continuous improvement, optimised production technology. (5)

SCHEDULING AND CONTROLLING: Objectives in scheduling - major steps involved - information system linkages in production planning and control - production control in repetitive, batch and job-shop manufacturing environment. (5)

AGGREGATE PLANNING AND MASTER PRODUCTION SCHEDULING: 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. (6)

PROJECT PLANNING: Evolution of network planning techniques - critical path method (CPM) - project evaluation and Review Technique (PERT), network stochastic consideration, project monitoring, line of balance. (5)

SCHEDULING WITH RESOURCE CONSTRAINTS: 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. (6)

Total No of periods: 42

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.

PRODUCT DATA MANAGEMENT

3 0 0 100

INTRODUCTION: 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. (5)

COMPONENTS OF A PDM SYSTEM: 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. (7)

PROJECTS AND ROLES: 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. (8)

CHANGE MANAGEMENT: Engineering change order and its implementation in PDM system - affectivity - case studies. (9)

CONFIGURATION MANAGEMENT: Base lines - product structure, tools for configuration management. (7)

GENERIC PRODUCTS AND VARIANTS: 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. (6)

Total No of periods: 42

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 (E-Business)", 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.

ELECTIVES E1,E2& E3 –Refer ELECTIVES

DATA STRUCTURES LABORATORY

INTRODUCTION: Data structures, abstract data types, primitive data structures, analysis of algorithms, notation. (5)

ARRYS: Operations, implementation of one, two, three and multi dimensioned arrays, different types of array applications. (5)

STRINGS: Implementation, operations, applications.

SETS: Operation on sets, implementation of sets.

RECORDS: Implementation of variant records. (5)

STACKS: Primitive operations, sequential implementation, applications, Recursion, definition, process and implementation using stacks; Parentheses matching; Evaluation of expressions. (5)

QUEUES: Primitive operations, sequential implementation, priority queues, dequeues, applications. (4)

LISTS: 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. (5)

TREES: Terminologies, implementation, BINARY TREE: Properties, sequential and linked representation,
Binary tree, operations, traversals, expression trees, threaded trees. (4)

SORTING: Insertion sort, selection sort, shell sort, bubble sort, quick sort, heap sort, merge sort, radix sort, algorithms, analysis. (4)

TABLE: 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. (5)

Total No of periods: 42

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 Graw 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.

SEMESTER-III

ELECTIVES E4,E5& E6 –Refer ELECTIVES

ELECTIVES

METAL FORMING THEORY AND PRACTICE

3 0 0 100

THEORY OF PLASTICITY:
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. (13)

THEORY AND PRACTICE OF BULK FORMING PROCESSES:
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. (11)

SHEET METAL FORMING:
Conventional processes-H E R F techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming - Principles and process parameters- Advantages -Limitations and Applications. (6)

P/M FORMING
Overview of P/M technique-Advantages-applications-Powder preform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters. (6)

SPECIAL FORMING PROCESSES
Orbital forging-Isothermal forging- High speed extrusion-Rubber pad forming-Water hammer forming-Fine blanking -Superplastic forming techniques- electro forming. (6)

Total No of periods: (42)

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.
9. Altan T, Soo-Ik-Oh, GEGEL, HL - "Metal Forming, fundamentals and applications",American Society of Metals, Metals Park,Ohio,1983.

ADVANCES IN CASTING AND WELDING

3 0 0 100

CASTING METALLURGY AND DESIGN:

Heat transfer between metal and mould-Solidification of pure metal and alloys-Shrinkage in cast metals -progressive and directional solidification-Principles of grating and risering-Degasification of the melt-Design considerations in casting-Designing for directional solidification and minimum stresses-casting defects. (8)

SPECIAL CASTING PROCESSES:

Shell moulding, Precision investment casting, CO_2, moulding, centrifugal casting, Die casting and Continuous casting

(8)

WELDING METALLURGY AND DESIGN:

Heat affected Zone and its characteristics-Weldability of steels, cast iron, Stainless steel, aluminium and Titanium alloys-Hydrogen embrittlement-Lamellar tearing-Residual stress-Heat transfer and Solidification-Analysis of stresses in welded structures-pre and post welding heat treatments-Weld joint design-Welding defects-testing of weldment. (11)

UNCONVENTIONAL AND SPECIAL WELDING PROCESSES:

Friction welding- Explosive welding-Diffusion bonding-High frequency Induction welding-Ultrasonic welding- Electron beam welding-Laser beam welding. (6)

RECENT ADVANCES IN CASTING AND WELDING:

Layout of mechanised foundry-sand reclamation-Material handling in foundry - pollution control in Foundry- Recent trends in casting-Computer Aided design of Castings,Low pressure die casting, Squeeze casting,full mould casting process. Automation in welding-Welding robots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding. (9)

Total No of periods: (42)

REFERENCES:

1. Jain, “Principles of Foundry Technology ", Tata McGraw Hill,3rd Edition,2000.
2. " ASM Metals of Hand book on Casting " - Revised Edn,1995.
3. Lal.m. and Khanna.O.P-" A Text Books of foundry technology ", Dhanpat Rai & Sons,1996.
4. " Foundry Engineering Handbook ", Utility publishers Ltd.,1989.
5. Titoun.d. & stepanov .YU.A.-" Foundry Practice ", MIR Publishers,Moscow,1981.
6. Heine Loper & Rosenthal," Principles of Metal Casting ", Tata McGraw Hill,1980
7. P.C.Mukherjee," Fundamentals of Metal casting Oxford " - IBH,1979.
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 Allen & Unwin Publishers,1980.
12. Welding Handbook (Section I) American Welding Society, 1986.
13. Kazakov.N.F.-"Diffusion bonding of materials", MIR Publishers, Moscow, 1985.
14. Serope Kalpakjian-"Manufacturing Engineering and Technology (III Edition)".-Addison Wesley Publishing Co.1995
15. P.N.Rao - "Manufacturing Technology (Foundry, Forming and Wekding) II Edition", Tata McGraw Hill Pub. Co. Ltd, .New Delhi, 1998.

TOTAL QUALITY MANAGEMENT

3 0 0 100

EVOLUTION OF QUALITY:
Quality control-Quality Assurance-total quality management-Core concepts-Quality Gurus and their contribution- Quality costs-Quality measurement. (8)

TOOLS OF QUALITY:
Review of SQC -Quality control Vs Process control-Control charts-Applications-Problems-Old and New seven tools of quality-Applications. (7)

TECHNIQUES OF QUALITY:
Quality Function Deployment (QFD) -Failure mode effect Analysis (FMEA)- Just in time(JIT)-KANBAN-KAIZEN- 5S Principles-Zero defects-POKA-YOKE-Quality circles- Six Sigma. (13)

ISO 9001:2000:
Philosophy-Elements-Requirements-Benefits-Procedures-Doccumentation-Certification-Auditing-Implementation- Cost of Certification. (7)

CASE STUDIES:
Case studies in Quality Management (The students may be asked to select case studies and present). (7)

Total No of periods:(42)

REFERENCES:

1. Mohamed Zairi - " Total Quality Management for Engineers "-Woodhead Publications, 1991.
2. John Bank, "Essence of TQM ", Prentice Hall of India, 1990
3. Taguchi .G.L. Syed et al', "Quality Engineering production systems" - McGraw Hill, 1980.
4. Juran, - "Quality Control Handbook ", McGraw Hill, 1995.
5. Zaidi,-"Spc - Concepts, Methodologies & Tools ", Prentice Hall of India, 1990
6. Feigenbaum - "Total Quality Control ", McGraw Hill, 1995.
7. Vincent k. Omachonu and Joel E.Ross - "Principles of Total Quality ", Kogan press, 1994.
8. Perry l. Johnson - "ISO 9000 ", McGraw Hill, 1993.

MAINTENANCE AND RELIABILITY ENGINEERING

3 0 0 100

MAINTENANCE MANAGAMENT: 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. (9)

TYPES OF MAINTENANCE: Breakdown and Preventive maintenance-Advantages and Limitations-Maintenance prevention-Diagnostic maintenance-Design out maintenance-Opportunity maintenance. (8)

DIAGNOSTIC MAINTENANCE: Leak detection-wear monitoring-Temperature monitoring-Vibration monitoring-Signature analysis-Shock monitoring-Lubricant-Analysis-Methodology-Equipments-Applications (9)

CONCEPTS OF RELIABILITY: 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. (7)

DESIGN FOR RELIABILITY: 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. (9)

Total No of periods: (42)

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.

IMAGE PROCESSING IN MANUFACTURING

3 0 0 100

INTRODUCTION: Image representation and nomenclature-Relationship of image processing and computer vision-Digital image fundamentals-Geometric model for imaging and applications-Imaging requirements. (8)

IMAGE PROCESSING FUNDAMENTALS: Image transformers-Sampling-Enhancement-Restoration and conversions-Segmentation-Thresholding representation and description. (10)

IMAGE ANALYSIS: Processing binary images-Image measurements - Multilevel image analysis-Higher dimensional modeling-Image based knowledge manipulation. (9)

PRACTICAL IMAGE PROCESSING:2D/3D Image acquisition-3D image Visualisation- Imaging surfaces-Image processing system components. (10)

APPLICATION IN MANUFACTURING: Measurement of surface finish - Sorting and counting of objects -Tool Wear measurement, measurement technique - Robot application. (5)

Total No of periods: (42)

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, Gon Zalez & Richar E Woods - "Digital Image Processing ", Addison Wesley Publishing, 1993.
4. Ramesh C John - "Introduction to machine vision ", Tata Mc Graw Hill, 1995.

HUMAN FACTORS IN ENGINEERING

3 0 0 100

INTRODUCTION: Concepts of human factors engineering and ergonomics-Man-Machine system and Design Philosophy-Physical work- stress-manual lifting-work posture-repetitive motion-environmental factors. (9)

ANTHROPOMETRY: Physical dimensions of the human body as a working machine-Motion size relationships-Static and dynamic anthropometry- Design principles-Using anthropometric measures for industrial design- Procedure for anthropometric design. (8)

DESIGN OF SYTEMS: Displays-Controls-Work place-Seating-Work process-Duration of rest periods-Hand tool design-Design of visual displays-Design for shift work. (8)

ENVIRONMENTAL FACTORS IN DESIGN: Temperature-Humidity-Dust-Noise-Illumination and contrast-Use of Photometers-Recommended illumination levels-The ageing eye-Use of indirect (Reflected) lighting - Cost efficiency of illumination-Special purpose lighting for illumination and quality control-Measurement of sound-Noise exposure and hearing loss-Hearing protectors analysis and reduction of noise-Effects of noise performance-annoyance of noise and interface with communication-Sources of vibration discomfort it. (9)

WORK PHILOSOPHY: Provision of energy for muscular work-Role of oxygen physical exertion-Measurement of energy expenditure- Respiration-Pulse rate and blood pressure during physical work-Physical work capacity and its evaluation. (8)

Total No of periods: (42)

REFERENCES:

1. E.J.Mccormic, " Human factors in engineering design ", McGraw Hill 1976.
2. P.V.Karpovich,W.E.Sinning, " Physiology of muscular activity ", W.E.Saunders Co.1971.
3. " Applied Ergonomics HandBook ", I.P.C. Science and Technology Press.1978
4. Martin Helander, " A guide to the Ergonomics of manufacturing ", East West Press,1996.

PURCHASING AND MATERIAL MANAGEMENT

3 0 0 100

INTRODUCTION: Objectives of material management-material circle-Organization for material management-Integrated materials management approach-Organization and control-Materials research-Corporate policy-Value analysis. (6)

MATERIALS PLANNING AND INVENTOREY MANAGEMENT: 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. (10)

MATERIALS STORAGE AND WAREHOUSING: 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. (9)

PURCHASING: 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. (10)

MATERIALS ACCOUNTING, BUDGETING AND ADMINISTRATIVE CONTROL: 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. (7)

Total No of periods: (42)

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.

ENGINEERING ECONOMICS

3 0 0 100

INTRODUCTION: Present economic policy, liberalization, privatization, globalization, scope for industrial growth, **I**nterest 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. (5)

METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES: 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. (6)

REPLACEMENT ANALYSIS: 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. (4)

PROJECT FEASIBILITY ANALYSIS: 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. (6)

MARKETING FEASIBILITY: Types of market, identification of investment opportunities, market and demand analysis, forecasting demand (review), forecast control, secondary sources of information. (4)

TECHNICAL FEASIBILITY: Product design, concept of concurrent engineering, make Vs buy decisions, BPO, value analysis, FAST approach, product life cycle management. (7)

FINANCIAL FEASIBILITY: 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. (6)

RISK AND MULTI STAGE SEQUENTIAL DECISION ANALYSIS: Recognising risk, including risk in economic analysis, expected value, payoff table, decision tree, discounted decision tree. (4)

Total No of periods: (42)

REFERENCES:

1. James L Riggs, David D Bedworth 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

RAPID PROTOTYPING, TOOLING AND MANUFACTURE

3 0 0 100

INTRODUCTION: Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems. (4)

FUSED DEPOSITION MODELING: Principle, process parameters, path generation, applications. (5)

SELECTIVE LASER SINTERING: Types of machines, principles of operation, process parameters, data preparation for SLS, applications. (5)

STEREOLITHOGRAPHY SYSTEMS: Principle, process parameters, process details, data preparation, data files and machine details, applications. (4)

LAMINATED OBJECT MANUFACTURING: Principle of operation, LOM materials, process details, applications.

SOLID GROUND CURING: Principle of operation, machine details, applications.

LASER ENGINEERED NET SHAPING (LENS) (2)

CONCEPT MODELERS: Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system. (4)

RAPID TOOLING: 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. (7)

SOFTWARE FOR RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools. (4)

RAPID MANUFACTURING PROCESS OPTIMIZATION: Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation. (2)

ALLIED PROCESSES: Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models. (5)

Total No of periods: (42)

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.

IT IN MANUFACTURING

3 0 0 100

INTRODUCTION: Role of internet and information technology in manufacturing, present market constraints, extended enterprises, B2C and B2B, PLM and PDM. (6)

PRODUCT DEVELOPMENT AND ISSUES: Product lifecycle, sequential engineering Vs concurrent engineering, concurrent engineering and information technology, collaborative product development and its relevance. (9)

USE OF CAD AND CAM: 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. (9)

AUTOMATED PROCESS PLANNING: Process planning, structure of a process planning software, information requirements for process planning, operation of a typical computer aided process planning software, group technology. (5)

PLANNING OF RESOURCES FOR MANUFACTURING THROUGH IT: Background, role of MRP-II, MRP software, manufacturing applications, engineering applications, financial applications, marketing applications, dynamic enterprises, ERP, SCM, virtual manufacturing. (6)

COLLABORATIVE ENGINEERING: Faster design throughput, web based design, changing design approaches, extended enterprises, enterprise wide product visualization, enterprise application integration for PLM. (7)

Total No of periods: (42)

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.

NON- TRADITIONAL MACHINING PROCESSES

3 0 0 100

INTRODUCTION: Technological and commercial need, classification, performance constraints, selection of NTM, hybrid processes. (2)

MECHANICAL MACHINING PROCESS: Abrasive jet machining, water jet machining, abrasive water jet machining, abrasive flow machining, magnetic abrasive flow machining, magnetic abrasive finishing – process parameters. (9)

ULTRASONIC MACHINING: ultrasonic machining system, mechanics of cutting, process parameters, analysis, capability, grain growing model, grain hammering model, limitations and applications. (5)

THERMO ELECTRIC MACHINING PROCESS:
ELECTRO DISCHARGE MACHINING (EDM): 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. (7)

LASER BEAM MACHINING (LBM): 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. (3)

PLASMA ARC MACHINING (PAM): Working principle, process parameters, process capabilities, components of system and its functions, various plasma arc torches, process capabilities, comparison with oxy fuel cutting, application and limitations. (3)

ELECTRON BEAM MACHINING (EBM): working principle, process parameters, process capabilities, components of system and its functions, application and limitations. (2)

ELECTRO CHEMICAL AND CHEMICAL MACHINING PROCESSES: 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. (8)

HYBRID PROCESSES: introduction, working principle, equipment, process parameters, process capabilities, and applications of electro chemical grinding (ECG), electrical discharge grinding (EDG), electro chemical discharge machining (ECDG). (3)

Total No of periods: (42)

REFERENCES:

1. Hassan Abdel, Gaward El-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.

PRODUCT DEVELOPMENT STRATEGIES

3 0 0 100

JOURNEY IN PRODUCT DEVELOPMENT: 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. (7)

UNDERSTANDING CUSTOMER NEEDS: Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. (7)

PRODUCT TEARDOWN AND EXPERIMENTATION: Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios. (6)

GENERATING CONCEPTS: Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness (7)

DESIGN FOR THE ENVIRONMENT: 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. (5)

PHYSICAL PROTOTYPES: 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. (5)

DESIGN PROJECT (5)

Total No of periods: (42)

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.

SIX-SIGMA CONCEPTS

3 0 0 100

OVERVIEW OF SIX-SIGMA CONCEPTS: History of Six- sigma; Benefits; Tools and Themes of Six-Sigma programme. Ingredients of six-sigma; Cost of quality. (2)

KEY CONCEPTS OF THE SIX-SIGMA SYSTEM: 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). (7)

THE SIX-SIGMA ROAD MAP: 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. (5)

ADOPTING SIX-SIGMA: 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. (5)

TRAINING THE ORGANIZATION FOR SIX-SIGMA: Essentials of effective training; planning curriculum; selecting the right six-sigma projects-Essentials; process and Do's & Don'ts. (5)

IMPLEMENTING SIX-SIGMA: 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. (8)

DESIGN FOR SIX- SIGMA (DFSS): Introduction; Need for DFSS; DFSS Phases; Differences between six sigma and DFSS; Features of a sound DFSS strategy. (4)

DFSS DEPLOYMENT AND PROJECT ALGORITHM: Black belt-DFSS Team; Cultural change; DFSS Deployment strategy; DFSS strategy goals; DFSS sustainability factors; Introduction for six- sigma project algorithm. (6)

Total No of periods: (42)

REFERENCES:

1. Kai Yang and Basemel-Haik, "Design for Six-Sigma: A Roadmap for Product Development", McGraw Hill, 2003.
2. Crrevelng C.M., Slutsky 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.

FINITE ELEMENT ANALYSIS

3 0 0 100

OVERVIEW OF FEM: Basic concept, historical background, general description, comparison with other methods of analysis, finite element program packages, engineering applications. (4)

BASIC PROCEDURE: Discretization of the domain, basic element shapes, discretization process, node numbering scheme, assemblage of element equations, and incorporation of boundary conditions. (2)

INTERPOLATION MODELS: 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. (4)

STATIC ANALYSIS OF SOLID MECHANICS PROBLEMS: 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 (17)

DYNAMIC ANALYSIS OF SOLID MECHANICS PROBLEMS: Dynamic equations of motion, consistent and lumped mass matrices, free vibration analysis, dynamic response using finite element method. (7)

NON-LINEAR PROBLEMS & ERROR ESTIMATES: 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. (8)

Total No of periods: (42)

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.

INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

3 0 0 100

INTRODUCTION: Need for IPPD-Strategic importance of Product development – Integration of customer, designer, material supplier and process planner. Competitor and Customer-behaviour analysis Understanding customer-promoting customer understanding – Involve customer in development and managing requirements – Organization – Process management and Improvement – Plan and establish product specifications. (5)

CONCEPT GENERATION AND SELECTION: Task – Structured approaches – clarification-search-extemally and intemally-explore systematically- reflect on the solutions and processes – concept selection – methodology – benefits. (5)

PRODUCT ARCHITECTURE: Implications – Product change – Variety – Component standardization – Product performance – Manufacturability – 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 (10)

INDUSTRIAL DESIGN: Integrated 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.
(10)

DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT: 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. (12)
N.B.A.Consumer product design project is recommended.

Total No of periods: 42

REFERENCES

1. Product Design and Development,Kart T.Ulrich and Steven D.Eppinger, McGraw-Hill International Edns. 1999.
2. Concurrent Engg./Integrated Product Development, Kemnneth Crow, DRM Associates, 26/3, Via Offvera, Palos Verdes, CA 90274(310)377-569, Workshop Book.
3. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.
4. Tool Design – Integrated Methods for Successful Product Engineering, Stuart Pugh, Addison Wesley Publishing Neyourk, NY, 1991, ISBN 0-202-41639-5.
5. www./me.mit/2.7444

OPTIMIZATION TECHNIQUES

3 0 0 100

NONLINEAR OPTIMIZATION: 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. (9)

CONSTRAINED NONLINEAR OPTIMIZATION: Direct methods, the complex method, cutting plane method, indirect methods, transformation techniques, interior and exterior penalty function methods, Khun-Tucker conditions, Lagrangian method. (6)

INTEGER AND DYNAMIC PROGRAMMING: 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. (7)

NETWORK OPTIMIZATION MODELS: 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. (6)

NON-TRADITIONAL OPTIMIZATION – I: 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. (6)

NON-TRADITIONAL OPTIMIZATION – II: Introduction to genetic algorithms, ant colony algorithm, particle swap algorithm, hybrid algorithms, simple applications. (8)

Total No of periods: (42)

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.

ARTIFICIAL INTELLIGENCE IN MANUFACTURING

3 0 0 100

HUMAN AND MACHINE INTELLIGENCE: Concepts of fifth generation computing - Programming in AI environment, developing artificial intelligence system, natural language processing, neural networks. (8)

KNOWLEDGE REPRESENTATION FOR SMART SYSTEMS: Forward chaining, backward chaining, use of probability and fuzzy logic. Semantic nets-structure and objects, ruled systems for semantic nets; certainty factors, automated learning. (8)

LANGUAGES USED IN AI: Using PROLOG to design expert systems, converting rules to PROLOG, conceptual example, introduction to LISP, function evaluation, lists, predicates, rule creation. (7)

EXPERT SYSTEM DEVELOPMENT: Definition- choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing. (6)

EXPERT SYSTEM TOOLS: Expert systems – controlling reasoning – rule based system – canonical systems – rules and meta rules – associative nets and frame systems – graphs trees and networks – representing uncertainity – 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. (8)

INDUSTRIAL APPLICATION OF AI AND EXPERT SYSTEMS: Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition. (5)

Total No of periods: 42

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.

SIMULATION OF MANUFACTURING SYSTEMS

3 0 0 100

PRINCIPLE OF COMPUTER MODELING AND SIMULATION: Monte Carlo simulation. Nature of computer modeling and simulation. Limitations of simulation, areas of application. (5)

SYSTEM AND ENVIRONMENT: Components of a system - discrete and continuous systems. Models of a system - a variety of modeling approaches – steps in simulation study. (6)

DISCRETE EVENT SIMULATION: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory systems. (5)

RANDOM NUMBER GENERATION: Techniques for generating random numbers - midsquare method - midproduct method - constant multiplier technique - linear congruential method, mixed and multiplicative. (6)

TESTING OF RANDOM NUMBERS: Kolmogorov – Smirnov test – Chi-square test, frequency test, run test, test for autocorrelation, gap test and poker hand test. (4)

RANDOM VARIABLE GENERATION: 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. (6)

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Variance reduction techniques - antithetic variables - verification and validation of simulation models. (4)

INTRODUCTION TO GPSS: Concepts - programming for discrete event systems in GPSS, case studies. (6)

Total No of periods: (42)

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.

COMPUTER INTEGRATED MANUFACTURING

Vide M.E Manufacturing Engineering (Core subject)

MICRO SYSTEMS TECHNOLOGY

Vide M.E Manufacturing Engineering (Core subject)