ANNA UNIVERSITY COIMBATORE
CURRICULUM 2007 – FULL TIME MODE
M.E. PRODUCT DESIGN AND DEVOLOPMENT
SEMESTER-I

Code no.	Course title	L	T	P	M
THEORY					
	GEOMETRIC MODELLING	3	0	0	100
	PRODUCT DATA MANAGEMENT	3	0	0	100
	FINITE ELEMENT ANALYSIS	3	0	0	100
	PRODUCT DEVELOPMENT STRATEGIES	3	0	0	100
	RAPID PROTOTYPING AND TOOLING	3	0	0	100
	ELECTIVE-I	3	0	0	100
PRACTICAL					
	CAD LABORATORY	0	0	3	100

SEMESTER-II

Code no.	Course title	L	T	P	M
THEORY					
	DESIGN FOR MANUFACTURE AND ASSEMBLY	3	0	0	100
	CNC MACHINES, PROGRAMMING AND ROBOTICS	3	0	0	100
	FAILURE ANALYSIS IN DESIGN	3	0	0	100
	HUMAN FACTORS ENGINEERING	3	0	0	100
	ELECTIVE-II	3	0	0	100
	ELECTIVE-III	3	0	0	100
PRACTICAL					
	PRODUCT DESIGN AND DEVELOPMENT LABORATORY	0	0	3	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	100

SEMESTER-IV

Code no.	Course title	L	T	P	M
PRACTICAL					
	PROJECT WORK PHASE-II	0	0	24	*

LIST OF ELECTIVES
M.E. PRODUCT DESIGN AND DEVOLOPMENT

Course code	Course title	L	T	P	M
	OPTIMIZATION TECHNIQUES IN DESIGN	3	0	0	100
	DATABASE MANAGEMENT SYSTEMS	3	0	0	100
	PRODUCTION AND OPERATION MANAGEMENT	3	0	0	100
	MECHATRONIC SYSTEM DESIGN	3	0	0	100
	COMPUTER AIDED PROCESS PLANNING	3	0	0	100
	ENTERPRISE COMPUTING	3	0	0	100
	ADVANCED STRENGTH OF MATERIALS	3	0	0	100
	RELIABILITY ENGINEERING	3	0	0	100
	TOTAL QUALITY MANAGEMENT	3	0	0	100
	ADVANCED TOOL DESIGN	3	0	0	100
	SIMULATION OF MANUFACTURING SYSTEMS	3	0	0	100
	MECHANICS OF COMPOSITE MATERIALS	3	0	0	100
	COMPUTATIONAL FLUID DYNAMICS	3	0	0	100
	COLLABORATIVE PRODUCT DESIGN AND PRODUCT LIFE CYCLE MANAGEMENT	3	0	0	100
	VIBRATION AND CONDITION MONITORING	3	0	0	100
	CLEANER PRODUCTION AND CDM	3	0	0	100
	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	100

07PD101 GEOMETRIC MODELING 3 0 0 100

TYPES AND MATHEMATICAL REPRESENTATION OF CURVES: Introduction, Wire frame models, parametric representation of curves (analytic & synthetic), curve manipulation, design examples. (6)

MATHEMATICAL REPRESENTATION OF SURFACES: Surface models, parametric representation, surface manipulation, design applications. (6)

MATHEMATICAL REPRESENTATION OF SOLIDS: Fundamentals of solid modeling, Boundary representation, constructive solid geometry, sweep representation, analytic solid modelers, design applications. (8)

VISUAL REALISATION: Model cleanup, hidden line removal, hidden surface removal, shading, colouring. (5)

COMPUTER ANIMATION: Computer animation, animation systems, types and technique, design applications, Computer Graphics Standard. (5)

LABORATORY PRACTICE: **(**15)

Total: 45

REFERENCES:

1. David Solomon, " Computer Graphics and Geometric Modeling", Springer Verlag, 1999
2. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw Hill Inc., New York, 1991.
3. Radhakrishnan P & Kothandaraman C P, "Computer Graphics and Design", Dhanpat Rai and Sons, 1997.
4. Radhakrishnan P & Subramanyan S, “CAD/CAM/CIM”, New Age International (P) Ltd., 1997.
5. Michael E Mortenson, "Geometric Modeling", John Wiley & Sons Inc., Second Edition, 1997

07PC103 PRODUCT DATA MANAGEMENT 3 0 0 100

INTRODUCTION: Introduction to PDM-present market constraints-need for collaboration-internet and developments in server-client computing. (3)

COMPONENTS OF PDM: 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. (9)

CONFIGURATION MANAGEMENT: Base lines- product structure-configuration management- case studies. (5)

PROJECTS AND ROLES: Creation of projects and roles- life cycle of a product- life cycle management- automating information flow- work flows- creation of work flow templates-life cycle-work flow integration- case studies. (12)

CHANGE MANAGEMENT: Change issue-change request-change investigation-change proposal-change activity-case studies. (6)

GENERIC PRODUCTS AND VARIANTS: Product configurator-comparison between sales configuration and product configurator-generic product modeling in configuration modeler-use of order generator for variant creation- registering of variants in product register-case studies. (10)

Total: 45

REFERENCES:

1. David Bedworth, Mark Henderson & Phillip Wolfe, “Computer Integrated Design and Manufacturing”, McGraw Hill Inc.,1991.
2. Terry Quatrain, “Visual Modeling with Rational Rose and UML”, Addison Wesley, 1998.
3. Wind-chill R5.0 Reference manuals, 2000.

07ED103 FINITE ELEMENT AND MECHANISM ANALYSIS 3 0 0 100

INTRODUCTION TO FEM: Engineering design analysis - meaning and purpose-steady state, propagation and transient problems-basic concepts of FEM - applicability of FEM to structural analysis heat transfer and fluid flow problems-advantages and limitations of FEM - commercial finite element packages-organisation-advantages & limitations. (6)

STATIC ANALYSIS: General procedure of FEM - skeletal and continuum structures - Discretization of domain-basic types of elements-shape function - Reyleigh - Ritz method-formulation of element stiffness matrices - truss, beam, triangular, quadrilateral and brick elements - Isoparametric elements. (10)

DYNAMIC ANALYSIS : Equations of motion for dynamic problems - consistent and lumped mass matrices - formulation of element mass matrices - free vibration and forced vibration problem formulation. (7)

SOLUTION METHODS FOR FINITE ELEMENT EQUATIONS : Handling of simultaneous equations - Gaussian elimination method - Choleski method-solving of eigen value problems - Jacobi & subspace iteration methods - direct integration and mode superposition methods - Interpolation techniques. (6)

HEAT TRANSFER AND FLUID FLOW ANALYSIS : Basic equations of heat transfer & fluid flow problems - Galerkin method- finite element formulation - one dimensional heat and fluid flow problems. (6)

MECHANISM ANALYSIS : Introduction to Analysis of mechanisms - Creation of kinematic models - imposement of constraints and forces - inertial data - static and dynamic analysis of kinematic systems - analysis of output data - animation - displacement, velocity and acceleration functions. (10)

Total: 45

REFERENCES:

1. Segerlind L J, "Applied Finite Element Analysis", John Wiley & Sons, 2 nd Edition, 1984.
2. Bathe K J, "Finite Element Procedures in Ind., Engineering Analysis", Prentice Hall, New Jersey, 1982
3. Shames I H & Dym C L , “Energy and Finite Element Methods in Structural Mechanics,” Wiley Eastern Ltd., 1995.
4. Shigley .J. E. & Vicker .J. J., "Theory of Machines and Mechanisms", McGraw Hill, 1998.
5. MDI, "ADAMS Reference Manual".
6. Rao SS, "The Finite Element Method in Engineering", Pergomon Press, Oxford, 2nd Edition., 1989
7. Cook R.D., Malkus D.S.,. & Plesha M.E., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, 1989.

07PC103 PRODUCT DEVELOPMENT STRATEGIES 3 0 0 100

Phases in the life cycle of a product, configuration management. (6)

Concurrent Engineering, Cost of design changes, schemes for concurrent engineering, axiomatic design, design for manufacturing and assembly, robust design, failure mode and effect analysis, Value engineering. (8)

CAD/CAM hardware - windows NT and unix based systems. (5)

Geometric modeling, current concepts, part design, sketching, use of datums construction features, free form manipulation, patterning, copying, modifying features. (7)

Assembly modeling, tolerancing, mass property calculations, rapid prototyping and tooling. Finite element modeling and analysis, general procedure, analysis techniques, finite element modeling, static, dynamic and thermal analysis. (9)

Mechanism analysis (5)

Design Project. (5)

Total: 45

REFERENCES:

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw Hill Inc., 1991.
2. David Bedworth, Mark Henderson & Philip Wolfe, "Computer Integrated Design and Manufacturing", McGraw Hill Inc., 1991.
3. "Pro/Engineer, Part Modeling Users Guide", 1998.

07PC104 RAPID PROTOTYPING AND TOOLING 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)

STEREOLITHOGRAPHY SYSTEMS: Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications. (4)

SELECTIVE LASER SINTERING: Types of machines, Principle of operation, Process parameters, Data preparation for SLS, Applications. (4)

FUSION DEPOSITION MODELING: Principle, Process parameters, Path generation, Applications. (3)

SOLID GROUND CURING: Principle of operation, Machine details, Applications. (3)

LAMINATED OBJECT MANUFACTURING: Principle of operation, LOM materials, Process details, Applications. (3)

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

LASER ENGINEERED NET SHAPING (LENS)

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. (5)

ALLIED PROCESSES: Vacuum Casting, Surface Digitizing, Surface Generation from point cloud, Surface modification, data transfer to solid models. (4)

Total : 45

REFERENCE:

1. Terry Wohlers, "Wohlers Report 2000", Wohlers Associates, 2000.
1. Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, NY, 1996.
2. Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.

07ED1L1 CAD LABORATORY 0 0 3 100

Developing a Specified Product Using Modeling, Analysis and Simulation Software and Making a Model Using RP.

07ED204 DESIGN FOR MANUFACTURE AND ASSEMBLY 3 0 0 100

EFFECT OF MATERIALS AND MANUFACTURING PROCESSES ON DESIGN: Major phases of design. Effect of material properties on design. Effect of manufacturing processes on design. The material selection process - cost per unit property, weighted properties, and limits on properties, methods. (5)

TOLERANCE ANALYSIS: Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances- sure fit law, normal law and truncated normal law. (5)

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: 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. (5)

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, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. (6)

F**ORM DESIGN OF CASTINGS AND WELDMENTS:** Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols. (6)

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. Design features to facilitate machining : datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples. (6)

CASE STUDIES: Redesign to suit manufacture of typical assemblies, tolerance design of a typical drive - system, example, design of experiments. Value analysis and design rules to minimise cost of a product. Computer Aided DFMA , Poke Yoka principles. (6)

Total: 45

REFERENCES:

1. Spotts. M. F., "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., 1983.
2. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 1967.
3. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
4. Trucks. H. E., "Design for Economic Production", Society of Manufacturing Engineers, Michigan, 2nd Edition, 1987,
5. Poka Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992
6. Farag. M., "Materials Selection for Engineering Design", Prentice Hall, 1997.
7. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.

8. Matousek, "Engineering Design A Systematic Approach", Blackie & Son Ltd., London, 1974.

07PD201 CNC MACHINES, PROGRAMMING AND ROBOTICS 3 0 0 100

BASIC CONCEPTS OF CNC MACHINES:
Introduction-Classification-Construction details of CNC machines-machine structure, guideways, feed drives- Spindle, measuring systems-Drivers and controls-Spindle drives, feed drives, D.C. drives-A.C.drives. (5)

CNC SYSTEM:
Introduction -Configuration of CNC system-Interfacing-Monitoring-Diagnostics-Machine data-Compensations for machine accuracies-PLC programming-DNC-Adaptive control CNC systems. (8)

PROGRAMMING OF CNC MACHINES
Various programming techniques-APT- programming for various machines in ISO and FANUC - CAM packages for CNC machines such as Unigraphics, IDEAS, Pro-Engineer CATIA, ESPIRIT, MASTERCAM,etc. (8)

FUNDAMENTAL CONCEPTS OF ROBOTICS: History, present status and future trends, Robotics and Automation, Laws of Robotics, Robot Definition, Robotics Systems and Robot Anatomy, Specification of Robots. Resolution, Repeatability and Accuracy of a Manipulator. (8)

ROBOT DRIVES: Power transmission systems and control Robot drive mechanisms, hydraulic-electric-pneumatic drives, Mechanical transmission method - Rotary-to-Rotary motion conversion, Rotary-to-linear motion conversion End effectors - types - grip ping problem - Remote-Centered compliance Devices - Control of Actuators in Robotic Mechanisms. (10)

SENSORS AND INTELLIGENT ROBOTS: Sensory devices - Non-optical-Position Sensors - Optical position Sensors - Velocity Sensors - Proximity sensors: - Contact and non-contact type - Touch and slip sensors - Force and Torque Sensors - AI and Robotics. (6)

Total:(45)

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REFERENCES:
1.Shuman Y.Nof, "Handbook of Industrial Robotics", John Wiley & Sons, New York, 1985.
2.Deb S.R "Robotics Technology and Flexible Automation", McGraw Hill Book Co., 1994.
3. " Mechatronics ", HMT Limited,TATA McGraw Hill,Publishing Company Ltd.,1998.
4. THYER,G.E. - " Computer Numerical Control of Machine Tools ", B.H.Newberg,1991.
4. KRAR.S. - " CNC Technology and Programming ", McGraw Hill,1990.
5. PETER SMID, “CNC Programming Hand Book”, Industrial Press Inc, 2000.
6. Richard D Klafter, Thomas A Chmielewski, Michael Negin "Robotic Engineering - An integrated approach", Eastern Economy Edition Prentice Hall India Pvt. Ltd., 1989.
2.Fu K S, Gomaler R C, Lee C S G, "Robotics: Control Sensing, Vision, intelligence", McGraw Hill Book Co., 1987.
3. RADHAKRISHNAN,P., - " Computer Numerical Control Machines ", New Central Book Agency,1996
4. SEHRAWAT,M.S.and Narang,J.S.., - " CNC Machines ", Dhanpat Rai and Co,,1999

07PD202 FAILURE ANALYSIS AND DESIGN 3 0 0 100

FUNDAMENTAL SOURCES OF FAILURES: Deficiencies in design, material, processing, service and maintenance, Stages, of failure analysis. Classification and identification of various types of fracture. (5)

OVERVIEW OF FRACTURE MECHANICS CONCEPT: Ductile and brittle fracture - Fracture origin, initiators, characteristics of ductile and brittle fracture. (5)

FATIGUE FAILURE: General concepts, Fracture characteristics revealed by microscopy. Factors affecting fatigue life. Some case studies of fatigue failures. (5)

WEAR FAILURES : Type of wear, role of friction in wear, lubricated and nonlubricated wear. Analysing wear failures. (5)

CORROSION FAILURES: Factors influencing corrosion failures, analysis of corrosion failures. Overview of various types of corrosion. Stress corrosion cracking - Sources, characteristics of stress corrosion cracking. Procedure of analysing stress corrosion cracking. Various types of hydrogen damage failures. (6)

ELEVATED TEMPERATURE FAILURES: Creep, stress rupture, Elevated temperature fatigue, Metallurgical instabilities, Environmental induced failure. Elevated temperature effects on certain Gas turbine components and Petroleum refinery components. (6)

RELIABILITY: Reliability concept and hazard function, Life prediction, Condition monitoring, application of Poisson, exponential and Weibull distribution for reliability - bath tub curve - Parallel and series system - mean time between failures and life testing. (6)

FMEA: Definition - Analysis causes of Failure - Modes - Ranks of Failure Modes - Fault Tree Analysis - case studies. (7)

Total : 45

REFERENCE:

1. Shigley & Mische, "Mechanical Engineering Design", McGraw Hill, 1992**.**
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, Ohio, USA, Vol. 10, 10th edition, 1995.

07PD203 HUMAN FACTOR ENGINEERING 3 0 0 100

INTRODUCTION: An approach to industrial design - elements of design - structure for industrial design in engineering application in modern manufacturing systems. (5)

ERGONOMICS AND INDUSTRIAL DESIGN: Introduction - general approach to the man - machine relationship - work station design - working position. (5)

CONTROL AND DISPLAYS: Shapes and sizes of various controls and displays - multiple display and control situations - design of major controls in automobiles, machine tools etc., - design of office furniture - redesign of instruments. (6)

ERGONOMICS AND PRODUCTION: Ergonomics and product design - ergonomics in automated systems - expert systems for ergonomic design. Anthropomorphic data and its applications in ergonomic design - limitations of anthropomorphic data - use of computerised data base. (6)

VISUAL EFFECTS OF LINE AND FORM: The mechanics of seeing - psychology of seeing - general influences of line and form. (5)

COLOUR: Colour and light - colour and objects - colour and the eye - colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipments. (6)

AESTHETIC CONCEPTS: Concept of unity - concept of order with variety - concept of purpose - style and environment - Aesthetic expressions. Style - components of style - housestyle, observing style in capital goods. (6)

INDUSTRIAL DESIGN IN PRACTICE: General design situation - specifying design requirements - rating the importance of industrial design - industrial design in the design process. (6)

Total: 45

REFERENCES:

1. Mayall W. H., "Industrial design for Engineers", London Iliffee Books Ltd, 1988.
2. Brian Shackel (Edited), “Applied Ergonomics Hand Book", Butterworth Scientific, London, 1989.
3. Dale Huchinson R., "New Horizons for Human Factors in Design", Mc Graw Hill book company, 1990.
4. Robert W. Bailey, "Human Performance Engineering", Prentice Hall Inc., New Jercey, 1991.

07PC2L1 PRODUCT DESIGN AND DEVELOPMENT LABORATORY 0 0 3 100

1. Identify a suitable product (mobile phone hand sets, hair dryers, electronic goods used in domestic applications, helmets, hand tools, machine components, automotive components, any product that is used in day today life and subjected to customization, mosquito repellant device, battery chargers for handled communication devices,.)
2. Explore the possibility of modifying its form and function or that of component.
3. Modify the features as identified in (2) in CAD.
4. Study the new concept for feasibility.
5. Carryout functional analysis in a suitable environment (stress, dynamic, thermal, flow).
6. Optimize the design in CAE.
7. Develop digital tooling using CAM.
8. Trend forecasting, bench marking and parametric analysis.
9. Estimate costs.
10. Prepare reports.

07ED001 OPTIMIZATION TECHNIQUES IN DESIGN 3 0 0 100

INTRODUCTION: Engineering applications, statement of an optimization problem, classification. (6)

CLASSICAL OPTIMIZATION TECHNIQUES: Single, variable optimization algorithms with and without constraints, Fibonaces search, Newton, Raphson of Prualty function methods, Multivariable optimization algorithms with and without constraints, Simplex search, Cauchy's steepest descent & prualty function methods. (9)

INTEGER PROGRAMMING: Algorithms, applications, stochastic programming, linear, non linear and dynamic programming applications introduction to linear programming. (7)

NON-LINEAR PROGRAMMING TECHNIQUES: One dimensional minimization, elimination and interpolation methods, unconstrained optimization, direct search and descent methods, constrained optimization, direct and indirect methods, application to mechanical design problems. (9)

STOCHASTIC PROGRAMMING: Basic concepts of Probability theory, Stochastic linear and non - linear programming. (6)

NON TRADITIONAL OPTIMIZATION ALGORITHM: Genetic algorithms, working principle, Differences & Similarities between GAs & traditional methods, GAs for constrained optimization. Simulated Annealing approach - Introduction (only). (8)

Total: 45

REFERENCES:

1. Rao S S, "Optimization", Wiley Eastern, New Delhi, 1995.
2. Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall of India, 2000.
3. Ray C Johnson, "Mechanical Design Synthesis with Optimization Applications", Van Nostrand, Reinhold Company, 1971.
4. Wild D J, "Globally Optimum Design", John Wiley & Sons, New York, 1978.

07PC001 DATABASE MANAGEMENT SYSTEMS 3 0 0 100

FILE ORGANISATION: Storage Device Characteristics. The constituents of a file, formal specification of storage of a file, operations on files. Serial files, Index - sequential files, direct file, secondary key retrieval. (6)

DATA MODELLING FOR A DATABASE: Three level architecture proposal for a DBMS. Components of a DBMS - advantages and disadvantages of a DBMS. (6)

DATA ASSOCIATIONS: Entity - relationship model - relational data model, network data model and hierarchical data model. (5)

RELATIONAL MODEL: Relational database - Relational algebra, Relational calculus, Relational database manipulation - SQL, views. (5)

RELATIONAL DATABASE DESIGN: Anomalies in a database, universal relation, functional dependency, normalization - INF , 2NF, 3NF and BCNF - Normalization through synthesis approach - Multivalued dependency. (6)

CONCURRENCY MANAGEMENT: Serializability - Congruency Control - Locking scheme - Time stamp - based order - Optimistic Scheduling - Deadlock and its resolution - Atomicity congruency and recovery. (6)

DATABASE SECURITY: Integrity and control - Security and Integrity threats - Defence Mechanisms - Integrity. (5)

DATABASE DESIGN: The organization and its information system - Definition of the problem - Analysis of Existing system and procedures - Preliminary design - computing system Division - Final design – Implementation and testing - operation - operation and tuning. (6)

Total: 45

REFERENCES:

1. Henry F Korth & Sudarshan S, Abrahm Silber Schatz, “Database System Concepts”, McGraw Hill Inc., 1997.
2. Elmasri R. & Navathe S B, “Fundamentals of Database Systems”, The Benjamin / Cumming Publishing Company, Inc. 1994.
3. Raghu Ramakrishnan, “Database Management Systems”, McGraw Hill Inc., 1997.
4. Bipin C. Desai, “An Introduction to Database Systems”, West Publishing Company, 1996.

07PC002 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)

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). (6)

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)

SCHEDULING AND CONTROLLING: Objectives in Scheduling - Major steps involved - information system linkages in Production Planning and Control - Production control in repetitive, batch and jobshop manufacturing environment. (6)

JUST IN TIME MANUFACTURING: INTRODUCTION: Elements of JIT - uniform production rate - Pull versus Push method- Kanban system - small lot size - Quick, inexpensive set-up - Continuous improvement. Optimised Production Technology. (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. (6)

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: 45

REFERENCES:

1. Bedworth. D.D. " Integrated Production Control systems Management, Analysis, Design", John Wiley & Sons, New York, 1982.
2. Vollman. T.E., "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 1998.
3. Dilworth B. James, "Operations Management, Design, Planning and Control for Manufacturing and Services", Mc-Graw Hill, Inc, New Delhi, 1992.

07PC003 MECHATRONICS SYSTEM DESIGN 3 0 0 100

INTRODUCTION

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design. (3)

SENSORS AND TRANSDUCERS

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems. (12)

MICROPROCESSORS IN MECHATRONICS

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller. (15)

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC. (8)

DESIGN AND MECHATRONICS

Designing - Possible design solutions - Case studies of Mechatronics systems. (7)

Total : 45

REFERENCES:

1. Michael B.Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., " Mechatronics ", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, " Microprocessor Architecture, Programming and Applications "Wiley Eastern, 1998.
4. Lawrence J.Kamm, " Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 2000.
5. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, " Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1995.

07PC004 COMPUTER AIDED PROCESS PLANING 3 0 0 100

INTRODUCTION: Evolution of CAD/CAM, scope of CIM, segments of generic CIM, computers and workstations, an overview of CIM softwares. (5)

PRODUCT DEVELOPMENT THROUGH CAD AND CAE: Geometric modeling techniques, automated drafting, graphic standards, engineering analysis, optimization (6)

AUTOMATED PROCESS PLANNING: Process planning, general methodology of group technology, code structures variant and generative process planning methods, Al in process planning, process planning software. (6)

CNC TECHNOLOGY : 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, NURBS and High Speed Machining. (7)

MANUFACTURING SYSTEM SOFTWARE: MRP II software production control software, forecasting, master production schedule, materials requirements planning, capacity requirements planning, shop floor control, shop floor data collection techniques, inventory management, purchase orders and receiving financial control, bill of materials, standard product routing, job costing, marketing applications. (7)

ROBOTICS AND AUTOMATED ASSEMBLY: Types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, selecting assembly machines, feeding and transfer of arts, applications of robots in manufacture and assembly, sensors. (7)

DATA COMMUNICATIONS AND TECHNOLOGY MANAGEMENT: Technology issues, configuration management, database systems, management of technology, networking concepts, LAN, MAN, SQL fundamentals, MAP/TOP fundamentals, CIM models, IBM, Siemens, DEC, ESPRIT - CIM OSA model, economics of CIM, implementation of CIM. (7)

Total: 45

REFERENCES:

1. Radhakrishnan P., “CAD/CAM/CIM”, New Age International (P) Ltd., 1992.
2. Eric Teicholz & Joel Orr, "Computer Integrated Manufacturing Hand Book", Mc Graw Hill Book Co., 1989.
3. Paul G. Ranky, "Computer Integrated Manufacturing", 1985.

07PC005 ENTERPRISE COMPUTING 3 0 0 100

ENTERPRISE RESOURCE PLANNING

Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models (10)

TECHNOLOGY AND ARCHITECTURE

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – luation framework. (10)

ERP SYSTEM PACKAGES

SAP - People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organizational and social issues. (10)

ORACLE

Overview – Architecture – AIM – applications – Oracle SCM. SAP: Overview – Architecture – applications -Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET . (7)

ERP PROCUREMENT ISSUES

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies. (8)

Total:45

REFERENCES:

1. Sadagopan. S , ERP-A Managerial Perspective, Tata McGraw Hill, 1999.
2. Jose Antonio Fernandez, The SAP R/3 Handbook, Tata McGraw Hill, 1998.
3. Vinod Kumar Crag and N.K.Venkitakrishnan, Enterprise Resource Planning – Concepts and Practice, Prentice Hall of India, 1998.
4. ERPWARE, ERP Implementation Framework, Garg & Venkitakrishnan, Prentice Hall, 1999.
5. Thomas E Vollmann and Bery Whybark, Manufacturing and Control Systems, Galgothia Publications, 1998.

07ED003 ADVANCED STRENGTH OF MATERIALS 3 0 0 100

ELASTICITY

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle-plane stress-Airy's stress function. (7)

SHEAR CENTER AND UNSYMMETRICAL BENDING

Location of shear center for various sections -shear flows.

Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section**.** (10)

CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES

Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.Stresses in circular and rectangular plates due to various types of loading and end conditions buckling of plates. (12)

TORSION OF NON-CIRCULAR SECTIONS

Torsion of rectangular cross section - S.Venants theory - elastic membrane analogy Prandtl's stress function torsional stress in hollow thin walled tubes. (7)

STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds.

Methods of computing contact stress-deflection of bodies in point and line contact applications. (7)

Total 45

REFERENCES:

1. Seely and Smith, "Advanced Mechanics of Materials", John Wiley International Edn, 1952.
2. Rimoahwnko, "Strength of Materials", Van Nostrand.
3. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
4. Wang, "Applied Elasticity", McGraw Hill.
5. Cas, "Strength of Materials", Edward Arnold, London 1957.
6. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985.

07PC006 RELIABILITY ENGINEERING 3 0 0 100

RELIABILITY CONCEPT:
Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness. (7)

FAILURE DATA ANALYSIS:
Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting. (10)

RELIABILITY PREDICTION MODELS:
Series and parallel systems – RBD approach – Standby systems – m/n configuration – Application of Bayes' theorem – cut and tie set method – Markov analysis – Fault Tree Analysis – limitations. (12)

RELIABILITY MANAGEMENT:
Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model**.** (10)

RISK ASSESSMENT:
Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment. (6)

Total : 45

REFERENCES:

1. Srinath L.S, "Reliability Engineering", Affiliated East-West Press Pvt Ltd, New Delhi, 1998.
2. Modarres, Reliability and Risk analysis, Maral Dekker Inc.1993.
3. John Davidson, "The Reliability of Mechanical system" published by the Institution of Mechanical Engineers, London, 1988.
4. Smith C.O. "Introduction to Reliability in Design", McGraw Hill, London, 1976.

07PC007 TOTAL QUALITY MANAGEMENT 3 0 0 100

INTRODUCTION: Definitions of the terms - quality, quality planning, quality control, quality assurance, quality management, Total Quality Management (TQM) as per ISO 8402 - overview on TQM - The TQM axioms - Commitment - Scientific knowledge - Involvement - Consequences of total quality. (5)

THE DEMING APPROACH TO TQM: Deming's fourteen points on quality management - five DDs - implementing the Deming philosophy - action plan - the Deming cycle - questions and opinions of Deming. (5)

JURAN ON QUALITY: Developing a habit of quality - Juran quality trilogy - the universal break through sequence - comparison Juran and Deming approaches. (5)

CROSBY AND THE QUALITY TREATMENT: Crosby's diagnosis of a troubled company - Crosby's quality vaccine - Crosby's absolutes for quality management - Crosby's fourteen steps for quality improvement. (5)

KAIZEN: Meaning - Kaizen and innovation - the Kaizen management practices - total quality control (TQC) - approaches of Faigenbaum, Ishikawa - Kaizen and TQC - Kanban systems - small group activities - quality control circles - suggestion systems - comparison of Kaizen and Deming's approach. (7)

SUPPORTING TOOLS, ACTIVITIES AND TECHNIQUES IN TQM PROJECTS: Affinity diagram - bar chart - block diagram - brainstorming - cause and effect analysis - customer-supplier relationship checklist - decision analysis - flow charts - force field analysis - line graph/run charts - Pareto analysis - quality costing - Quality Function Deployment (QFD) - quality project approach and the problem solving process. (8)

ISO 9000 SERIES QUALITY SYSTEM STANDARDS: The structure of ISO 9000 series quality system standards - certification process - action plan development for cases. (5)

STRATEGIC QUALITY MANAGEMENT: Integrating quality into strategic management - Quality and the management cycle - Resources for Quality activities - Training for Quality - Self Managing Teams - Role of the Quality Director - Obstacles to achieving successful Strategic Quality Management. (5)

Total: 45

REFERENCES:

1. Logothetics N., "Managing for Total Quality - From Deming to Taguchi and SPC", Prentice Hall of India Private Ltd., 1997.
2. Juran J.M & Gryna F.M., "Quality Planning and Analysis From Product Development Through Use", Tata McGrawHill Publishing Limited, New Delhi, 3rd Edition, 1995.
3. Deming W.E., "Out of the Crisis", MIT Press, Cambridge, MA, 1982.
4. Juran .J.M., "Juran on Leadership for Quality An Executive Handbook", The Free Press, New York, 1989.
5. Salor .J.H.,"TQM-FIeld Manual", McGraw Hill, New York, 1992.

07PC008 ADVANCED TOOL DESIGN 3 0 0 100

TOOL-DESIGN METHODS

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis – Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig-boring practice – Installation of Drill Bushings – Punch and Die Manufacture – Electro-discharge machining – Electro-discharge machining for cavity. (5)

TOOLING MATERIALS AND HEAT TREATMENT

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification – Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools (9)

DESIGN OF DRILL JIGS

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing . (9)

DESIGN OF FIXTURES AND DIES

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations. (14)

TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines (8)

Total : 45

REFERENCES:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000

07PC009 SIMULATION OF MANUFACTURING SYSTEMS 3 0 0 100

PRINCIPLE OF COMPUTER MODELLING AND SIMULATION: Monte Carlo simulation. Nature of computer modelling 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 modelling approaches. (5)

RANDOM NUMBER GENERATION: Techniques for generating random numbers - Midsquare method - The midproduct method - Constant multiplier technique - Additive congruential method - Linear congruential method - Tests for random numbers - The Kolmogorov-Smirnov test - the Chi-square test. (6)

RANDOM VARIABLE GENERATION: Inverse transform technique - exponential distribution - uniform distribution - Weibull distribution. Emprical continuous distribution - generating approximate normal variates - Erlang distribution. (6)

EMPRICAL DISCRETE DISTRIBUTION: Discrete uniform distribution - Poisson distribution - geometric distribution - acceptance - rejection technique for Possion distribution - gamma distribution. (6)

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Variance reduction techniques - antithetic variables - verification and validation of simulation models. (6)

DISCRETE EVENT SIMULATION: Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. (6)

INTRODUCTION TO GPSS: Programming for discrete event systems in GPSS. Case studies (5)

Total : 45

REFERENCES:

1. Narsingh Deo, “System Simulation with Digital Computer”, Prentice Hall of India, 1979
2. Francis Neelamkovil, “Computer Simulation and Modeling”, John Wiley & Sons, 1987
3. Ruth M. Davis & Robert M.O'Keefe, “Simulation Modeling with Pascal”, Prentice Hall Inc., 1989.
4. Jerry Banks & John S. Carson II., “Discrete Event System Simulation”, Prentice Hall Inc., 1984
5. Gordon G, “Systems Simulation”, Prentice Hall of India Ltd., 1991

07ED005 MECHANICS OF COMPOSITE MATERIALS 3 0 0 100

INTRODUCTION: Classification and characteristics of composite materials - mechanical behaviour of isotropic and orthotropic materials - terminology of laminated fibre reinforced composite materials - advantages of strength and stiffnesses of composites - current and potential usage of composites. (6)

MECHANICAL BEHAVIOUR OF A LAMINA: Engineering constants for orthotropic materials- stress, strains relations for plane stress in an orthotropic materials and in a lamina of arbitrary orientation - strength of an orthotropic lamina - Basic strength theories - Determinations of engineering constants - mechanics of materials approach . (6)

MECHANICAL BEHAVIOUR OF A LAMINATE: Classical lamination theory - lamina stress - strain behaviour - Resultant forces and moments in a laminate - Types of laminates - Strength and Stiffness of laminates - Interlaminar stresses in laminates. (6)

LAMINATED PLATES AND BEAMS: Types of laminated plates and beams - elementary mechanical behaviour- Bending and Buckling of laminated plates - forces and moments- Stresses and Deflections under different boundary conditions. (6)

PRODUCTION OF COMPOSITE MATERIALS & PRODUCTS: Matrix and their role - Principal types of fibre and matrix materials - Basic principles of production of composite materials & products- Advantages & limitations of different processes. (6)

MOULDING AND FORMING OF COMPOSITES: Lay up and curing - open and closed mould processes - hand lay up techniques - bag moulding - Filament winding - Pultrusion - Pulforming- Thermoforming - Injections moulding - blow moulding. (5)

MACHINING AND JOINING OF COMPOSITES: Cutting, Machining of composites - drilling - mechanical fastening - adhesive bonding - joining methods - Advantages and limitations. (5)

APPLICATIONS OF COMPOSITES: Aircraft - missiles - space hardware - Automobile - electrical and electronics recreational and sports equipments - Future potential of composites. (5)

Total: 45

REFERENCES:

1. Agarwal B D & Broutman L J, “Analysis and Performance of Fibre Composites", John Wiley & Sons Inc, 1990.
2. Terry Richardson, "Composites - A Design Guide", Industrial Press Inc, NY, 1987.
3. Robert M Jones,” Mechanics of Composite Materials", McGraw Hill Book Co, 1970.
4. Meier Sehwartyz, "Composite Materials Hand Book", McGraw Hill Book Co, 1984.

07ED017 COMPUTATIONAL FLUID DYNAMICS 3 0 0 100

INTRODUCTION: Governing equations - conservation of mass momentum and energy - laminar and turbulent flow - orthogonal and general co-ordinate systems - Initial and boundary conditions. (6)

FINITE DIFFERENCE METHOD: Forward, backward and central difference schemes - explicit and implicit methods. Errors, consistency, stability analysis, upwind schemes. (6)

Solution methods for elliptic, hyperbolic, and first order wave equations. Grid generation methods. (5)

INCOMPRESSIBLE FLOW: Finite difference, MAC and SIMPLE algorithms, stream function and vorticity formulation. (5)

INVISCID FLOW: Panel method, calculation of lift and drag. Compressible flow: Basic governing equation, different solution algorithms. (5)

CONDUCTION HEAT TRANSFER: Steady and unsteady state, boundary conditions, Runge - Kutta method, finite difference method, iterative and direct methods. (6)

CONVECTIVE HEAT TRANSFER: Governing equations, approximate methods for forced convection: Similarity solution for natural convection, modeling of convection problems. (6)

RADIATIVE HEAT TRANSFER: Basic concepts, radiosity method, Monte - Carlo method, phase change problems. (6)

Total: 45

REFERENCES:

1. Yogesh Jaluria & Kenneth E.Torrance, “Computational Heat Transfer”, Hemisphere Publishing Corporation, 1986.
2. Muralidhar K & Sundararajan T, “Computational Fluid Flow and Heat Transfer”, Narosa Publication, 1995
3. Patankar S.V., “Numerical Heat Transfer and Fluid Flow”, Hemisphere Publishing Company New York, 1980.

07PC010 COLLABORATIVE PRODUCT DESIGN AND LIFE CYCLE MANAGEMENT **3 0 0 100**

INTRODUCTION: Product lifecycle management-concepts, benefits, value addition to customer. Lifecycle models- creation of projects and roles, users and project management, system administration, access control and its use in life cycle. Product development process and functions. (8)

DATA MANAGEMENT: Components of typical PDM setup-hardware, software. Document management-creation and viewing of documents. Creating parts-part master, version and version control of parts and documents, case studies. CAD and ERP integration in PDM-use of product view and info engine. (9)

AUTOMATING BUSINESS PROCESS: Workflows-life cycle and work flow integration. Product configuration management-product structure, configuration item, practical example of a complex product. Change management. Industrial case studies. (8)

COLLABORATIVE PRODUCT DESIGN: Data transfer. Variants of e-commerce. Multisystem information sharing. Workgroup collaboration. Development of standard classification for components and suppliers. Model assembly process-link product and operational information. Customisation factors-creation of business objects, user interfaces, search facilities as designed by the enterprise. Software-PDM/CPC/PLM and their comparison. (9)

PRODUCT DEVELOPMENT: Quality function deployment-quality project approach and the problem solving process. Design creativity-innovations in design alternatives. Concurrent engineering. Rapid prototyping. Industrial design principles. (8)

Total : 42

REFERENCES:

1. John W Gosnay and Christine M Mears, “Business Intelligence with Cold Fusion”, Prentice Hall India, New Delhi, 2000.
2. David S Linthicum, “B2B Application Integration”, Addision Wesley, Boston, 2001.
3. Alexis Leon, “Enterprise Resource Planning”, Tata McGraw Hill, New Delhi, 2002.
4. David Ferry and Larry Whipple, “Building and Intelligent e-business”, Prima Publishing, EEE Edition, California, 2000.
5. David Bedworth, Mark Hederson and Phillip Wolfe, “Computer Integrated Design and Manufacturing” McGRaw-Hill Inc., New York, 1991.
6. Wind-Chill R5.0 Reference manuals 2000.

07PC011 VIBRATION CONTROL AND CONDITION MONITORING 3 0 0 100

INTRODUCTION

Review of Fundamentals of Single Degree Freedom Systems – Two Degree Freedom Systems, Multi Degree Freedom System, Continuous system, Determination of Natural frequencies and mode shapes, Numerical methods in Vibration Analysis. (11)

VIBRATION CONTROL

Introduction – Reduction of Vibration at the Source - Control of Vibration – by Structural design – Material Selection – Localized additions – Artificial damping – Resilient isolation, Vibration isolation, Vibration absorbers. (12)

ACTIVE VIBRATION CONTROL

Introduction – Concepts and applications, Review of smart materials – Types and Characteristics, Review of smart structures – Characteristics Active vibration control in smart structures. (6)

CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS

Introduction - Condition Monitoring Methods - The Design of Information system, selecting methods of monitoring, Machine condition monitoring and diagnosis – Vibration severity criteria – Machine maintenance techniques – Machine condition monitoring techniques – Vibration monitoring techniques – Instrumentation systems – Choice of monitoring parameter. (10)

DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY

Introduction, Dynamic Balancing of Rotors, Field Balancing in one Plane, two Planes, and in several Planes, Machinery Alignment, “Rough” Alignment Methods, The Face- Peripheral Dial Indicator Method, Reverse Indicator Method, Shaft-to-coupling spool method. (6)

Total : 45

REFERENCES:

1. K.J. Bathe and F.I., Wilson – “Numerical Methods in Finite Element Analysis” – Prentice Hall of India Pvt. Ltd., New Delhi, 1978.
2. J.O. Den Hartog – “Mechanical Vibrations” – McGraw Hill, Newyork, 1985.
3. Rao, J.S.” Vibratory Condition Monitoring of Machines “. CRC Press, 2000.
4. Science Elsevier,” Hand Book of Condition Monitoring”, Elsevier Science, 1996.
5. Singiresu S. Rao, “Mechanical Vibrations”, Addison-Wesley Publishing Company, 1995.

07PC012 CLEANER PRODUCTION AND CDM 3 0 0 100

INTRODUCTION: Industrial and commercial sector development and related energy and environmental issues. (4)

CLEANER PRODUCTION: Definition and its role in industrial and commercial sector, link with sustainable production and consumption concepts, life cycle analysis, extended producer responsibility, pollution prevention vs pollution control - overview on cleaner production. Explanation of pollution control and technologies associated; approaches and means of pollution prevention. (5)

ENERGY AND ENVIRONMENTAL PARAMETERS / CONCEPTS FOR CP: Basic terminology, units, measurement techniques, significance, (BOD, COD, TSS, TDS, Color, etc.) waste and energy audit methodologies, application of mass and energy balance in energy and environmental audit, sankey diagram. (6)

MAJOR INDUSTRIAL PROCESSES CONSIDERING ENERGY AND ENVIRONMENTAL POINTS OF VIEW: Identification of major unit processes associated with energy consumption and pollution generation. (8)

POLLUTION PREVENTION THROUGH PROCESS INTEGRATION (ENERGY AND ENVIRONMENT: Process optimization by integrating both energy and environmental aspects, energy management concepts and measures to improve energy efficiency. (6)

ENERGY AND WATER PINCH: An efficient waste minimization tool, occupational health and safety, quality of product, and other aspects of CP. (4)

FINANCIAL ANALYSIS OF CP OPTIONS: Cash flow, payback period, net present value, internal rate of return, profitability index, depreciation, etc. (4)

ENVIRONMENTAL POLLUTION AND RESOURCE USE: Design for recycling - life cycle studies - LCA package (5)

CLEAN DEVELOPMENT MECHANISM(CDM): Introduction ,Basic Requirements of CDM projects , Project cost and financing options , project design, selection of base line,Estimation of energy saving and GHG emissions reductions, carbon credit, case studies (5)

Total: 42

REFERENCES:

1. Modak P, Visvanathan C and Parasnis M, "Cleaner Production Audit", Review No:32, ENSIC, AIT, 1997
2. United Nations Environment Programme, Cleaner Production Training Manual, 1996.
3. United Nations Environment Programme, Industry and Environment, Company Environmental Reporting, A measure of the progress of Business and Industry towards Sustainable Development, 1994
4. UNEP/IE, Audit and Reduction Manual for Industrial Emissions and Wastes, Tech. Report No. 7, 1991.

07ED105 MICRO ELECTRO MECHANICAL SYSTEMS 3 0 0 100

MEMS AND MICROSYSTEMS: MEMS and microsystem products. Evaluation of microfabrication. Microsystems and microelectronics. Applications of microsystems. Working principles of microsystems-microsensors, microactuators, MEMS and microactuators, microaccelerometers. (5)

SCALINGLAWS IN MINIATURIZATION: Introduction. Scaling in geometry. Scaling in rigid body dynamics. The Trimmer force scaling vector-scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. (5)

MATERIALS FOR MEMS AND MICROSYSTEMS: Substrates and wafers-silicon as a substrate material, ideal substrates for MEMS. Single crystal Silicon and wafers crystal structure. Mechanical properties of Si. Silicon compounds-SiO_2, SiC, Si_3N_4 and polycrystalline Silicon. Silicon piezoresistors. Gallium arsenside. Quartz-piezoelectric crystals. Polymers for MEMS. Conductive polymers. (8)

ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN: Introduction. Static bending of thin plates-circular plates with edge fixed, rectangular plate with all edges fixed and square plates with all edges fixed. Mechanical vibration. Resonant vibration. Microaccelerometers-design theory and damping coefficients. Thermomechanics. Thermal stresses. Fracture mechanics-stress intensity factors, fracture toughness and interfacial fracture mechanics. (5)

BASICS OF FLUID MECHANICS IN MACRO AND MESO SCALES: Viscosity of fluids-flow patterns, Reynolds number. Basic equation in continuum fluid dynamics. Laminar fluid flow in circular conduits. Computational fluid dynamics. Incompressible fluid flow in microconducts-surface tension, capillary effect and micropumping. Fluid flow in submicrometer and nanoscale-rarefied gas, Kundsen and Mach number and modelling of microgas flow. Heat conduction in multilayered thin films. Heat conduction in solids in submicrometer scale. Thermal conductivity of thin films, heat conduction equation for thin films. (5)

MICROSYSTEM FABRICATION PROCESS: Photolithography. Photoresist and applications. Light sources. Ion implanation. Diffusion process. Oxidation-thermal oxidation. Silicon diode. Thermal oxidation rates. Oxide thickness by colour. Chemical vapour deposition-principle, reactants in CVD. Enhanced CVD physical vapour deposition. Sputtering. Deposition by epitaxy. Etching-chemcial and plasma etching. (7)

MICROMANUFACTURING AND MICROSYSTEM PACKAGING: Bulk micromachining. Isotropic and anisotropic etching-wet etchants, etch stops, dry etching comparison of wet and dry etching. Surface micromachining-process in general, problems associated in surface micromachining. The LIGA process-description, materials for substrates and photoresists, electroplating, the SLIGA process. Microsystem packaging-general considerations. The three levels of microsystem packaging-die level, device level and system level. Essential packaging technologies-die preparation-surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of microsytems-selection of packaging materials. (7)

Total 42

REFERENCES:

1. Mark Madou “Fundamentals of Microfabrication”, CRC Press, New York, 1997.
2. Julian W Gardner, “Microsensors: Principles and Applications”, John Wiley and Sons, New York, 2001.
3. Sze S M, “Semiconductor Sensors”, McGraw Hill, New York, 1994.
4. Chang C Y and Sze S M, “VLSI Technology”, Mc Graw Hill, New York, 2000.
5. Kovacs G T A, “Micromachined Transducers Sourcebook”, McGraw Hill, New York, 1998.

6. Tai-Ran Hsu, “MEMS and Microsystems Design and Manufacture“, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.