Biju Patnaik University of Technology, Orissa

Rourkela

Syllabus

of

M.Tech

in

CAD/CAM

From 2009 -2010 Academic Session

M.Tech in CAD/CAM

SYLLABUS

First Semester

CMPC 101: Computer graphics

CMPC 102: Computer Applications in Design

CMPC 103: Data communication in CAD/CAM

Elective – I

CMPE 101: Tribology

CMPE 102: Finite element Analysis

CMPE 103: Management Information System

CMPE 104: Robotics

Elective – II

CMPE 105: Advanced Mechanism Design

CMPE 106: Computational Fluid Dynamics

CMPE 107: Industrial Safety Management

CMPE 108: Computer Integrated Design

CMPR101: CAD laboratory

CMPT101: Pre- Thesis Work & Seminar.

Second Semester

CMPC201: Computer Numerical Control Part programming

CMPC202: Advanced Strength of Materials

CMPC203: Computer Integrated Manufacturing

Elective – I

CMPE201: Mechantronics and Manufacturing Systems

CMPE202: Manufacturing Systems and simulation

CMPE203: Metrology and Non-destructive testing

CMPE204: Design for Manufacture

Elective – II

CMPE205: Manufacturing Information System

CMPE206: Design of Material Handling equipment

CMPE207: Performance modeling and analysis of manufacturing systems

CMPE208: Computer Aided Process Planning

CMPR201: CAM laboratory

CMCV201: Seminar - II

CMCV202: Comprehensive Viva Voce -II

COMPUTER GRAPHICS (3 – 1 – 0 : 4)

1. INTRODUCTION

Definition and scope of CAD/CAM .Introduction to Design process and role of computer in design process .Hardware and software in CAD/CAM application.

2. GEMETRICAL MODELING CURVES AND SURFACES

Representation, wire frame models ,Intrinsic and parametric representation ,analytic and paramedic curve and surface, Manipulations of curve and surface.

3. GEOMETRIC SOLID MODLING

Solid models Fundamentals of solid modeling .Half-spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), sweep representation, analytic solid modeling, solid manipulations.

4. CAD/CAM DATA EXCANGE FORMATES

5. INTRODUCTION TO DESIGN AND ENGINEERING APPLICATION.

6. INTRODUCTION TO REVERSE ENGINEERING TOOLS

Total number of periods: 45

Recommended books:

1. *Ibrahim Zeid,CAD/CAM,Tata Mc Graw hill, New Delhi.*
2. *J.Rooney and P.Steadman,Principals of computer aided design, pitman/open university, London.*
3. *Joe Rooney and Philip Steadman, computer aided design pitman/open university, London.*
4. *Glen Mallineuse , Computational concepts and methods , Kogan page ltd.london.*
5. *Daniel mallineuse, Computer Aided Graphical design, marcel dekker, New York.*
6. *p.Radhakrishna and C.P.Kothandaraman,Computer Graphics and design (cadd),Dhanpat Rai pup,New Delhi.*
7. *.C.S.Krishnamoorathy , J.S. Rajeev, Computer Aided design (Software and Analysis tools),Narosa pub house, New Delhi.*

COMPUTER APPLICATIONS IN DESIGN (3 – 1 – 0: 4)

1. INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS **10**

Output primitives (points,lines,curves Etc.,) , 2-D transformation (Translation, scaling, rotators) windowing , view ports clipping transformation.

2. INTRODUCTION TO CAD SOFTWARE **10**

Writing interactive programs to solve design problems and production of drawings, using any languages like Auto LISP/C/FORTRAN etc. , creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts).

3. VISUAL REALISM **10**

Hidden - Line - Surface - solid removal algorithms shading - coloring. Introduction to parametric and variational geometry based on softwares and their principles creation of prismatic and lofted parts using these packages.

4. ASSEMBLY OF PARTS **8**

Assembly of parts , tolerance analysis mass property calculations, mechanism simulation.

5. SOLID MODELING **7**

Solid modelling - Rapid prototyping - Data exchange - Documentation - Customizing - solid modelling system.

Total No of periods: 45

References:

1. William .M. Neumann and Robert .F. Sproul " Principle of Computer Graphics ", McGraw Hill Book Co. Singapore ,1989.

2. Donald Hearn and .M. Pauline Baker " Computer Graphics " Prentice Hall ,Inc., 1992.

3. Mikell .P. Grooves and Emory .W. Zimmers Jr. " CAD/CAM Computer -- Aided Design and Manafacturing"Prentice Hall ,Inc., 1995.

4. Ibrahim Zeid " CAD/CAM -- Thoery and Practice " - McGraw Hill , International Edititon , 1998.

DATA COMMUNICATION IN CAD/CAM (3 – 1 – 0 : 4)

1. DIGITAL COMPUTERS & MICRO PROCESSORS **8**

Block diagram - register transfer language - arithmetic, logic and shift micro operations - instruction code - training and control instruction cycle - I/O and interrrupt design of basic computer., Machine language - assembly language - assembler.Registers ALU and Bus Systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 80 x 86 and modes of operation. Features of Pentium Processors.

2. OPERATING SYSTEM & ENVIRONMENTS **9**

Types - functions - UNIX & WINDOWS NT - Architecture - Graphical User Interfaces.
Compilers - Analysis of the Source program - the phases of a compiler - cousins of the compiler, the grouping of phases - compiler construction tools.

3. COMMUNICATION MODEL **10**

Data communication and networking - protocols and architecture - data transmission concepts and terminology - guided transmission media - wireless transmission - data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface.

4. COMPUTER NETWORKS **10**

Network structure - network architecture - the OSI reference model services - network standardization - example- Managing remote systems in network - network file systems - net working in manufacturing.

5. INTERNET **8**

Internet services - Protocols - intranet information services - mail based service - system and network requirements - internet tools - usenet - e.mail - IRC - www - FTP - Telnet.

Total No of periods: 45

References:

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", Penram International, 1997
3. Peterson J.L., Galvin P. and Silberschaz, A., "Operating Systems Concepts", Addison Wesley, 1997.
4. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, "Compilers Principles Techniques and Tools", Addison Wesley, 1986.
5. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997.
6. Andrew S. Tanenbanum "Computer Networks", Prentice Hall of India 3rd Edition, 1996.
7. Christian Crumlish, "The ABC's of the Internet", BPB Publication, 1996.

TRIBOLOGY (3 – 1 – 0 : 4)

1. **SURFACES,FRICTION AND WEAR** **8**

Topography of the surfaces - Surface features - Surface interaction - Theory of Friction - Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions - Wear, types of wear - Mechanism of wear - Wear resistance materials - Surface treatment - Surface modifications - Surface coatings.

2. LUBRICATION THEORY **8**

Lubricants and their physical properties lubricants standards - Lubrication Regimes Hydrodynamic lubrication - Reynolds Equation, Thermal, inertia and turbulent effects - Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication - Hydro static lubrication - Gas lubrication.

3. DESIGN OF FLUID FILM BEARINGS **12**

Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature rotating loads and dynamic loads in journal bearings - special bearings - Hydrostatic Bearing design.

4. ROLLING ELEMENT BEARINGS **10**

Geometry and Kinamatics - Materials and manufacturing processes - contact stresses - Hertzian stress equation - Load divisions - Stresses and deflection - Axial loads and rotational effects, Bearing life capacity and variable loads - ISO standards - Oil films and their effects - Rolling Bearings Failures.

5. TRIBO MEASUREMENT IN INSTUMENTATION **7**

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Instrumentaton - International standards - Bearings performance measurements - Bearing vibration measurement.

Total No of periods: 45

References:

1. Cameron, A. "Basic Lubricaton Theory", Ellis Herward Ltd. , UK,1981.

2. Hulling , J. (Editor) --"Principles of Tribology", MacMillan ,1984.

3. Williams J.A . "Engineering Tribology" ,Oxford Univ. Press ,1994.

4. Neale M.J , "Tribology Hand Book ", Butterworth Heinemann, 1995. Web References:

1. http://www.csetr.org/link.htm

2. http://www.me.psu.edu/research/tribology.htm

FINITE ELEMENT ANALYSIS (3 – 1 – 0 : 4)

1. 1D FINITE ELEMENT ANALYSIS **10**

Historical Background - Weighted Residual Methods - Basic Concepts of FEM - Variational Formulation of B.V.P - Ritz Method - Finite Element Modeling - Element Equations - Linear and Quadratic Shape functions - Bar, Beam Elements - Applications to Heat Transfer.

2. FINITE ELEMENT ANALYSIS OF 2D PROBLEMS **10**

Basic Boundary Value Problems in 2 Dimentions - Triangular, quadrilateral, higher order elements - Poissons and Laplace Equations - Weak Formulation - Elements Matrices and Vectors - Application to Solid mechanics, Heat transfer, Fluid Mechanics.

3. ISO PARAMETRIC FORMULATION **8**

Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements - Formulation - Numerical Intergration - 1D -2D Triangular elements - rectangular elements - Illustrative Examples.

4. SOLUTION TO PLANE ELASTICITY PROBLEMS **9**

Introduction to Theory of Elasticity - Plane Stress - Plane Strain and Axisymmetric Formulation - Principle of virtual work - Element matrices using energy approach.

5. SPECIAL TOPICS **8**

Dynamic Analysis - Equation of Motion - Mass Matrices - Free Vibration analysis - Natural frequencies of Longitudinal - Transverse and torsional vibration - Introduction to transient field problems. Non linear analysis. Use of software - h & p elements - special element formulation.

Total No of periods: 45

Text Books:

1. Reddy J.N. " An Introduction to the Finite Element Method " , Mc Graw Hill, International Edition, 1993. References:
1. Segerlind L.J., " Applied Finite Element Analysis " , John Wiley, 1984.
2. Rao S.S., " Finite Element Method in Engineering " , Pergamon Press, 1989.
3. Chandrupatla & Belagundu , " Finite Elements in Engineering ", Prentice Hall of India Private Ltd., 1997.
4. Cook, Robert Davis et al, " Concepts and Applications of Finite Element Analysis " , Wiley, John & Sons,1999.
5.George R Buchanan, " Schaum's Outline of Finite Element Analysis ", McGraw Hill Company, 1994.

Web References:

1. http://www.vector-space.com
2. http://www.mech.port.ac.uk/sdalby/mbm/CTFRProg.htm

MANAGEMENT INFORMATION SYSTEM (3 – 1 – 0 : 4)

1. INTRODUCTION: Concepts of management, Information and systems, History of information systems. Philosophies governing the development of information systems. Role of information systems in Organizations: Local and Global context. Additional perspectives as benefits from technical trends and innovations, special characteristics and enigmas of information .Information system and Business processes: Analyzing information system from a business perspective using work centered analysis of systems.

2. INFORMATION SYSTEM TAXONOMIES: Transaction processing system, management information systems. Decision support system, Executive information systems. Artificial intelligence, Expert Systems and Office automation system.

3. SYSTREM ANALYSIS AND DESIGN: Information system planning ,introduction challenges, strategic issues, selecting systems, project management issues. Methodology and implication of system analysis and design ,SDLC, prototyping . End user development, off-the self software, out sourcing and application software.

4. TOOLS FOR INFORMATION SYSTEM DEVELOPMENT: Structural tools for analysis and design, tools to represent system data and process, tools for structured programming ,tools to convert programs specified into code.

5. DATA BASE DESIGN AND MANGEMENT : Components of DBMS , database models, Principle of DBMS.

6. STRATEGIC INFORMATION SYSTEMS: Characteristics, and plan. Business Information systems, MARIS, Information systems for manfuctring ,human resource, Finance and accounts, and quality.

7. VLIENT SERVER COMPUTING : Developing , Clint server, organizational implication of c/s computing. Information system security and control.

8. ERP: Introduction, concepts, application advantages and disadvantages

Total number of periods: 45

Recommended books:

1. Uma G Guptha , Management information systems- a managerial perspective, Galgotia puplishers, New Delhi.

2. Edward Yourdon, structured analysis, prentice hall of India , New Delhi.

3. James A.O'Brien ,management information system (information system Technology in the Internet worked enterprises. Tata Mc Graw hills, New Delhi.

4. Steve Alter, Management information system Benjamin Cummins, new york.

5. Gerald V post and david L Anderson,Mangement information systems,solveing busnisses problem with information technology, Tata Mc Graw Hills, New Delhi

6. Davis and Olson , management information systems Mc Graw Hills, New York

7. Jawedkar, management information systems,Tata Mc Graw Hills, New Delhi

8. Schultheis and sumner ,management information system (A management perspective),Tata Mc Graw Hills, New Delhi

9. Landon and Landon, Management information systems , Prentic hall of India New Delhi .

ROBOTICS (3 – 1 – 0 : 4)

1. INTRODUICTION: Definition of a robot, Difference between hard automation and robotic automation, Characteristics of a robot .Need for robots and their benefits, economic aspects in robot applications. Robot classification and their application, Robot generations.

2. ROBOT IN WORK PLACE: Need for interfacing, part feeding, magazines, and Orienting devices. Special fixtures conveyor belts, Overhead transport, Work cell organization in robotic environment, Work cell design and control.

3. REPRESENTATION OF A ROBOT: Fundamental and graphical representation of Robots, Arm structures in use , structure to end effectors , Degrees of freedom of a rigid of body, degrees of a robot ,Degree of freedom and mobility.

4. ROBOT TECHNOLOGY: Robot anatomy and units ,work volume, Element and type of drive and control systems, precision of movement, Actuators , power transmission systems, Manipulator kinematics and path control, configuration of robot controller.

5. TYPES OF GRIPPERS: Mechanical grippers, consideration in gripper selection and design.

6. SENSORS AND VISION: Tactile, proximity and range sensors in robot ,Velocity sensors, Robot Vision, Introduction to motion planning and image processing.

7. METHOD OF ROBOT PROGRAMMING: Robot programming languages, introduction to intelligent Robots.

8. ROBOT APPLICATIONS IN INDUSTARIES: Material handling and processing, metal cutting processing, welding, spray coatings, inspection, Assembly and Hazardous operating conditions, safety in robot, social and labor issues in robotics. Material handling using AGVs automated storages system using mobile robots, Issues in implementation of robotics in industry.

Total number of periods: 45

Recommended books:

1. *Groover,weiss,Nagel and Odrey, Industrial Robotics:Technology, programming and Application,McGraw Hill,New York.*
2. *Lee , Fu and Gangalase, Robotics: Scontrol, sensing , vision, and intelligence, McGraw Hill,New York.*
3. *Robert J.Schilling , fundamental of Robotics Analysis and control, prentice Hall India ,New Delhi.*
4. *Klafter, chmielewski and negui, Robotic engineering :An integrated approach prentice Hall India ,New Delhi.*
5. *Y.Koren, Robotics for engineers , McGraw Hill,New York*
6. *J.J.Craig ,Introduction to Robotics , Addison- Wesley publishing company.*
7. *S.R>Deb Robotics and Flexible Automation, Tata McGraw Hill,New York.*
8. *William. C. BVurns Jr and Janet Evens werthington, practical robotics – systems,interfacing and applications, prentice Hall,New Jersy*
9. *Coiffet and chirouze, introduction to Robot Technology, McGraw Hill,New York*
10. *Heath. L. Reston, Fundamentals of robotics : Theory and applications, Reston Prentice Hall, Virginia.*
11. *Bernard Hodges, Industrial Robotics, Jaic publishing house, Bombay*

ADVANCED MECHANISM DESIGN (3 – 1 – 0 : 4)

1. INTRODUCTION **5**

Review of fundamentals of kinematics--Mobility analysis --Formation of one D.O.F. multiloop kinematics chains, Network formula - Gross motion concepts.

2. KINEMATIC ANALYSIS **5**

Position analysis -Vectorloop equations for four bar, slider crank, inverted slider crank - Geared five bar and six bar linkages. Analytical method for velociy and acceleration analysis - Four bar linkage jerk analysis - Plane complex mechanism

3. PATH CURVATURE THEORY **6**

Fixed and Moving centrodes, inflection points and inflection circle. Euler Savary equation, Graphical constructions - Cubic of stationary curvature.

4. SYNTHESIS OF MECHANISMS **15**

Type synthesis - Number sythesis - Assosiated linkage concept. Dimensional systhesis - Function generation , path generation, motion generation. Graphical methods. Cognate linkage - Coupler curve synthesis, design of six bar mechanisms .Algebraic methods. Application of instant centre in linkage design. Cam mechanism - Determination of optimum size of Cams.

5. DYNAMIC OF MECHANISMS **9**

Static force analysis with friction - Inertia force analysis - combined static and inertia force analysis.shaking force, Kinetostactic analysis. Introduction to force and moment balancing of linkages.

6. SPATIAL MECHANISM AND ROBOTICS **5**

Kinematic analysis of spatial RSSR mechanism - Denavit - Hartenberg parameters. Forward and inverse Kinematics of robotic manipulators

Total No of periods: 45

References:

1. Sandor G.N. and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall,1984.

2. Shigley, J.E., and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw Hill, 1995.

3. Amitabha Ghosh and Ashok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.

4. Nortron R.L., "Design of Machinery", McGraw Hill, 1999.

5. Kenneth J. Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons,1999.

Web References:

1. http://www.machinedesign.com

COMPUTATIONAL FLUID DYNAMICS (3 – 1 – 0 : 4)

1. GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD **10**

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

2. CONDUCTION HEAT TRANSFER **10**

Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one- dimensional problem, Two-dimensional Transient Problems.

3. INCOMPRESSIBLE FLUID FLOW **10**

Governing Equations, Stream Function - Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite deference approach.

4. CONVECTION HEAT TRANSFER AND FEM **10**

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one-dimensional convection - Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

5. TURBULENCE MODELS **5**

Algebraic Models - One equation model, K-I Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Total No of periods: 45

References:

1. Muralidhar, K.,and Sundararajan,T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing
House ,New Delhi1995.
2. Ghoshdasdidar, P.S.,"Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
4. Taylor, C and Hughes J.B.,Finite Element Programming of the Navier Stock Equation, Pineridge Press Ltd.,U.K.1981.
5. Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Hemishphere Publishing Corporation, New York, USA, 1984.
6. Fletcher, C.A.J.,"Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer-Verlag,1987.
7. Flectcher, C.A.J., "Computational Techniques for Different Flow Categories, Springer-Verlage 1987.
8. Bose,T.K.,"Numerical Fluid Dynamics" Narosa Publishing House, 1997

INDUSTRIAL SAFETY MANAGEMENT (3 – 1 – 0 : 4)

1. SAFETY MANAGEMENT **8**

Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

2. OPERATIONAL SAFETY **10**

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation-electroplating-hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines.

3. SAFETY MEASURES **8**

Layout design and material handling - Use of electricity - Manaagement of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments , on- site and off site. Control of major industrial hazards.

4. ACCIDENT PREVENTION **9**

Human side of safety - personal protecive equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Fire fighting devices - Accident reporting, investigation.

5. SAFETY, HEALTH, WELFARE & LAWS **10**

Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety-pressure vessel act-Indian boiler act - The environmental protection act - Electricity act - Explosive act.

Total No of periods: 45

Text Books:

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, NewDelhi-1989.

2. Krishnan N.V., "Safety in Industry", Jaico Publishery House, 1996. References:

1. Occupational Safety Manual BHEL.

2. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum.

3. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999.

4. Safety security and risk management by U.K. Singh & J.M. Dewan, A.P.H. Publishing company, NewDelhi, 1996.

5. Singh, U.K. and Dewan, J.M., "Safety, Security and risk management", APH Publishing Company, NewDelhi, 1996.

COMPUTER INTEGRATED DESIGN (3 – 1 – 0: 4)

1. INTRODUCTION **6**

Phases of design - Standardization and interchangeability of machine elements - Tolerances for process and function - Individual and group tolerances - Selection of fits for different design situations - Design for assembly and modular constructions - Concepts of integration.

2. SHAFTING **6**

Analysis and design of shafts for different applications - detailed design - preparation of production drawings - Integrated design of shaft, bearing and casing - Design for rigidity.

3. GEARS AND GEAR BOXES **18**

Principles of gear tooth action - Gear correction - Gear tooth failure modes - Stresses and loads - Component design of spur, helical, bevel and worm gears - Design for sub assembly - Integrated design of speed reducers and multispeed gear boxes - application of software packages.

4. CLUTCHES **5**

Integrated design of automobile clutches and over running clutches.

5. BRAKES **10**

Dynamic and thermal aspects of vehicle braking - Integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

Total No of periods: 45

References:

1. Newcomb, T.P. and Spur, R.T. , "Automobile brakes ad braking systems", Chapman and Hall ,2nd Edition , 1975.

2. Juvinall, RL.C. ,"Fundamentals of Machine Component Design", John Wiley ,1983.

3. Maitra G.M. , "Hand Book for Gear Design", Tata McGraw Hill , 1985.

4. Shigley , J.E. ,"Mechanical Engineering Design ", McGraw Hill , 1986.

Web References:

http://www.agma.org/

CAD LABORATORY (0 – 0 – 3 : 3)

The following experiments are to be conducted using appropriate software

1. Use of computer in the design process.
2. Wire-frame modeling of objects.
3. Solid modeling
4. Hidden line removal and shading
5. Rendering
6. Geometry and mass property calculations.

COMPUTER NUMERICAL CONTROL PART PROGRAMMING

(3 – 1 – 0: 4)

1. INTRODUICTION:
Basic concepts in manufacturing systems, fundamentals of numerical control advantages of NC systems, Classification of NC systems, point to point and countering systems, incremental and absolute systems, open loop and close loop systems, encoder, punched tape.

2. FEATURES OF NC MACHINE TOOLS:
Fundamental of machining , design consideration of NC Machine tools , methods of improving machine accuracy, tool deflection and chatter, lead screw, thermal deformations, increasing productivity with NC machines, machining centers.

3. NC PART PROGRAMMING :
Introduction, NC coordinate system, manual part programming , coe and concepts types to tape formats, Tool length and radius compensation , point to point and contour programming examples, caned cycles, Subroutine, MACROS simple problems of drilling , turning , and two- dimensional milling.

4. COMPUTER AIDED PART PROGRAMMING:
Advantages of computer aided programming, post processor, APT programming, Geometric statements, motion statements, additional AAAAPT statements, simple problems of APT programming.

5. CNC, DNC, AND ADAPTIVE CONTROL:
Introduction, problems with conventional NC, principles of operation of CNC, features of CNC, advantages of CNC , direct numerical control, types and functions of DNC, advantages of DNC, Adaptive control machining systems, types, benefits of Adaptive control systems.

Total number of periods: 45

Reference books

1. *Numerical control and computer aided manufacturing –T.K.Kundra.P.N.Tao and N.K.Tewari.*
2. *Computer aided manufacturing –T.K.Kundra,P.N.Rao, and N.K.Tiwari(T.M.H)*
3. *Computer control of manufacturing systems –Y.Koren.*
4. *CAD/CAM-M.P.Groover and E.W.Zimmers(PHI)*
5. *Automation, production systems and CIM-M.P.Groover(P.H.I)*
6. *CAD/CAM-P.N.Rao(PHI*).

ADVANCED STRENGTH OF MATERIALS (3 – 1 – 0 : 4)

1. ELASTICITY **7**

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.

2. SHEAR CENTRE **4**

Location of shear centre for various sections -shear flows.

3. UNSYMMETRICAL BENDING **4**

Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.

4. CURVED FLEXIBLE MEMBERS **5**

Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.

5. STRESSES IN FLAT PLATES **5**

Stresses in circular and rectangular plates due to various types of loading and end conditions buckling of plates.

6. TORSION OF NON-CIRCULAR SECTIONS **10**

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 **5**

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

8. CONTACT STRESSES **5**

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

Total No of periods: 45

***References**:*

1. Seely and Smith, "Advanced Mechanics of Materials", John Wiley International Edn, 1952.

2. Rimoahwnko, "Strenbgth of Materials", Van Nostrand.

3. Timoshenko and Goodier, "LTheory 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.

COMPUTER INTEGRATED MANUFACTURING

(3 – 1 – 0 : 4)

1. INTRODUICTION: Types of production system and their automation. CAD/CAM integration. Concept of FMS and CIMS.

2. ELEMENTS OF A GENERAL CIM SYSTEM: Type of the CIM systems. CAD?CAM link for CIMS> Manufacturing data base in a systems, equipment and their functions. Integration of robot in CIMS, Automatic storage and Retrieval system (AS/RS). Carousel, palletization and fixtures in process interfacing of storage with manufacture.

3. GROUP TECHNOLOGY: Co0ncept and terminology, part family formation , classification and coding systems for components ,Group Technology machine cells. Computer Aided process planning and route sheet development, CAPP system, Computer aided plant layout.

4. COMPUTER AIDED PRODUCTION PLANNING AND CONTROL: Inventory control and MRP, Computer aided cost estimation. Computer aided shop floor control, process monitoring , Computer aided inspection and quality control, SQC, SPC.

5. NET WORKING: Introduction to fundamentals of computer communications, networking, computer-machine –personnel communication links. Network architectures and techniques, Information flow in networks, network standards.

6. CIM DATABASE AND DATA BASE MANAGEMENT SYSTEM: Types, Management Information system, Manufacturing data preparation. Shop floor data collection systems, shop-floor control, sensors used ,tool management system automatic identification systems ,Barcode system.

7. CIMS CONFIGURATION: DNC based factory management and control, integrated CAD/CAM System and shared data base, Factories of the future. Impact of implementing CIMS on society. Introduction to rapid prototyping and rapid tooling Introduction to the concept of concurrent engineering.

Total number of periods: 45

Recommended books:

1. *M.P.Groover and E.W.Zimmers,CAD/CAM,Prentice hall of india, New Delhi.*
2. *M.P.Groover, Automation, production systems and computer Integrated Manufacturing , Prentice Hall of India ,New Delhi.*
3. *S. Kant Vajpayee, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi.*
4. *P. N. Rao, N. K. Tewari, T. K. Kundra, Computer Integrated Manufactring, Tata McGraw Hill, New Delhi.*
5. *Besant and Lui, CAD/CAM, Tata McGraw Hills, New Delhi.*
6. *H. Mitchell, CIM Systems – An Introduction to Computer Integrated Manufacturing, Prentice Hall, New Jersy.*
7. *P. Radhakrishnan and S. Subramanyan, CAD/CAM/CIM, New Age International P.ub, New Delhi.*
8. *Dr. Surender Kumar and Dr. A. K. Jha, CAD/CAM, Dhanpat Rai and Sons, New Delhi.*
9. *John Hartley, FMS at work, IFS Pub UK and North Holland, New York. Charles S. Knose, CAD/CAM System Planning & Implementation, Marcel Dekker, New York.*

MECHATRONICS IN MANUFACTURING (3 – 1 – 0 : 4)

1. INTRODUCTION **3**

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

2. SENSORS AND TRANSDUCERS **12**

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

3. MICROPROCESSORS IN MECHATRONICS **15**

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.

4. PROGRAMMABLE LOGIC CONTROLLERS **8**

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

5. DESIGN AND MECHATRONICS **7**

Designing - Possible design solutions - Case studies of Mechatronics systems.

Total No of periods: 45

Text Books:

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.
***Web Reference**: www.cs. indiana.edu.*

MANUFACTURING SYSTEMS AND SIMULATION

(3 – 1 – 0 : 4)

1. COMPUTER MODELING AND SIMULATION SYSTEMS **8**

Monte Carlo simulation, Nature of computer modelling and simulation. Limitation of simulation, areas of application. Components of a system - discrete and continuous systems. Models of a system - a variety of modelling approaches.

2. RANDOM NUMBER GENERATION **10**

Techniques for generating random numbers - midsquare method - the mid product method - constant multiplier technique - additive congruential method - linear congruential method - tests for random numbers - the Kolmogorov - Smirnov test - the Chi-Square test.

3. RANDOM VARIABLE GENERATION **8**

Inverse transform technique - exponential distribution - uniform distribution - Weibull distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution.

4. DISTRIBUTION AND EVALUATION OF EXPERIMENTS **10**

Discrete uniform distribution - Poisson distribution - geometric distribution - acceptance rejection technique for Poisson distribution gamma distribution. Simulation Experimenets - Variance reduction techniques - antithetic variables - verification and validation of simulation models. Variance reduction techniques - antithetic variables - verification and validation of simulation models.

5. DISCRETE EVENT SIMULATION **9**

Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. Programming for discrete event systems in GPSS - Case studies

Total No of periods: 45

Text Books:

1. Jerry Banks and John S. Carson, II, "Discrete Event System Simulation", Prentice Hall Inc. 1984.

2. Gordon G, " Systems Simulation", Pentice Hall of India Ltd., 1991. References:

1. Narsing Deo, "System Simulation with Digital Computer", Prentice Hall of India, 1979.

2. Francis Neelamkovil, "Computer Simulation and Modelling", John Wiley & Sons, 1987.

3. Ruth M. Davis and Robert M.O' Keefe, " Simulation Modelling with Pascal", Prentice Hall, Inc. 1989.

METROLOGY AND NON DESTRUCTIVE TESTING

(3 – 1 – 0 : 4)

1. **MEASURING MACHINES** **9**

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

2. STATISTICAL QUALITY CONTROL **9**

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

3. LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS **9**

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

4. RADIOGRAPHY **9**

Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

5. ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES **9**

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

Total No of periods: 45

References:

1. JAIN, R.K. " Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.
3. American Society for Metals, " Metals Hand Book ", Vol.II, 1976.
4. Progress in Acoustic Emission, " Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.

Web References:

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

DESIGN FOR MANUFACTURE (3 – 1 – 0 : 4)

1. INTRODUCTION 8

General design principles for manufacturability - strength and mechanical factors, mechanisms selectiion, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits - Datum features - Tolerance stacks.

2. FACTORS INFLUENCING FORM DESIGN 13

Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on from design - from design of welded members, forgings and castings.

3. COMPONENT DESIGN-MACHINING CONSIDERATION 8

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area - simplification by separation - simplificaation by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

4. COMPONENT DESIGN - CASTING CONSIDERATIONS 8

Redesign of castings based on parting line considerations - Minimising core requirements, machined holes, redesign of cast members to obviate cores.

5. REDESIGN FOR MANUFACTURE AND CASE STUDIES 8

Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

Total No of periods:45

Text Books:

1. Harry Peck, "Design for Manufacture", Pittman Publication, 1983.
2. Robert Matousek, "Engineering Design - A systematic approach", Blackie & sons Ltd., 1963.

References:

1. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co., 1986.
2. Swift K.G., "Knowledge based design for manufacture, Kogan Page Ltd., 1987

MANUFACTURING INFORMATION SYSTEMS

(3 – 1 – 0 : 4)

1. INTRODUCTION **5**

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

2. DATABASE **7**

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

3. DESIGNING DATABASE **13**

Hierarchical model - Network approach - Relational Data model -concepts, principles, keys, relational operations
- functional dependence -Normalisation, types - Query languages.

4. MANUFACTURING CONSIDERATION **10**

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

5. INFORMATION SYSTEM FOR MANUFACTURING **10**

Parts oriented production information system - concepts and structure -computerised production scheduling, on- line production control systems, Computer based production management system, computerised manufacturing information system - case study.

Total No of periods: 45

References:

1. Luca G. Sartori, " Manufacturing Information Systems ", Addison-Wesley Publishing Company, 1988.
2. Date.C.J., " An Introduction to Database systems ", Narosa Publishing House, 1997.
3. Orlicky.G., " Material Requirements Planning ", McGraw-Hill Publishing Co., 1975.
4. Kerr.R, " Knowledge based Manufacturing Management ", Addison-wesley, 1991.

Web Reference: *www.ist.psu.edu*

DESIGN OF MATERIAL HANDLING EQUIPMENT

(3 – 1 – 0 : 4)

(USE OF APPROVED DATA BOOK IS PERMITTED)

1. MATERIALS HANDLING EQUIPMENT **4**

Types, selection and applications

2. DESIGN OF HOISTS **15**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

3. DRIVES OF HOISTING GEAR **6**

Hand and power drives - Travelling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

4. CONVEYORS **10**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

5. ELEVATORS **10**

Bucket eleevators: design - loading and bucket arrangements - Cage elevators - shaftway, guides, counter weights, hoisting machine, safety devices - Design of form lift trucks.

Total No of periods:45

Text Books:

1. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.

2. Spivakovsy, A.O. and Dyachkov, V.K., LConveying Machines, Volumes I and II, MIR Publishers, 1985.

References:

1. Alexandrov, M., Materials Handling Equipments, MIR PUblishers, 1981.

2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958

PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEM

(3 – 1 – 0 : 4)

1. MANUFACTURING SYSTEMS & CONTROL **10**

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

2. MANUFACTURING PROCESSES **10**

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

3. QUEUING MODELS **8**

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

4. QUEUING NETWORKS **8**

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

5. PETRI NETS **9**

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

Total No of periods: 45

References:

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

2. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications",

Prentice Hall, New Jersey, 1982.

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

COMPUTER AIDED PROCESS PLANNING (3 – 1 – 0 : 4)

1. INTRODUCTION **5**

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

2. PART DESIGN REPRESENTATION **10**

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

3. PROCESS ENGINEERING AND PROCESS PLANNING **10**

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

4. COMPUTER AIDED PROCESS PLANNING SYSTEMS **10**

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

5. AN INTERGARTED PROCESS PLANNING SYSTEMS **10**

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

Total No of periods:45

References:

1. *Gideon Halevi and Roland D. Weill, " Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.*
2. *Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985.*
3. *Chang, T.C., " An Expert Process Planning System ", Prentice Hall, 1985.*
4. *Nanua Singh, "Systems Approach to Computer Intergrated Design and Manufacturing", John Wiley & Sons, 1996.*
5. *Rao, " Computer Aided Mnufacturing ", Tata McGraw Hill Publishing Co., 2000.*

Web References:

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

CAM Laboratory **(0-0-3:3)**

- Practical to be conducted covering various aspects of computer control in M/C tools and robotics including:
- Study of structure of NC system
- Introduction and use of NC codes
- NC part programming of various parts
- Too and zero pre setting
- Flexible tooling
- Different type of NC motions
- Study of various drives, counters. ADC and DAC Devices etc
- Visit to one facility where any of the above is in use and to prepare a report.