**Dr.M.G.R.**
**EDUCATIONAL AND RESEARCH INSTITUTE**
**UNIVERSITY**
(Decl. U/S 3 of UGC Act 1956)
**DEPARTMENT OF MECHANICAL ENGINEERING**

# M.Tech – CAD/CAM (Full Time)
# Curriculum and Syllabus
# 2013 Regulation

| I SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MMA130002 | Applied Mathematics for Design Engineers | 3 | 1 | 0 | 4 |
| 2 | MME13C001 | Computer Integrated Manufacturing Systems | 3 | 0 | 0 | 3 |
| 3 | MME13DE07 | Robotics and Sensors | 3 | 0 | 0 | 3 |
| 4 | MME13D009 | Advanced Strength of Materials | 3 | 1 | 0 | 4 |
| 5 | MME13C002 | Manufacturing Information Systems | 3 | 0 | 0 | 3 |
| 6 | MME13DE06 | Product Design and Development Strategies | 3 | 1 | 0 | 4 |
| 7 | MME13DL01 | Design Analysis Lab | 0 | 0 | 4 | 2 |
| **TOTAL** | | | **18** | **3** | **4** | **23** |

| II SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MME13D003 | Advanced Finite Element Analysis | 3 | 1 | 0 | 4 |
| 2 | MME13D004 | Design for Manufacturing and Assembly | 3 | 1 | 0 | 4 |
| 3 | MME13C003 | Computer Aided Design | 3 | 0 | 0 | 3 |
| 4 | MME13C004 | Computer Aided Process Planning | 3 | 0 | 0 | 3 |
| 5 | MME13XXXX | Elective I (CAD) | 3 | 1 | 0 | 4 |
| 6 | MME13XXXX | Elective II (CAD) | 3 | 1 | 0 | 4 |
| 7 | MME13CL01 | CAM Laboratory | 0 | 0 | 4 | 2 |
| **TOTAL** | | | **18** | **4** | **4** | **24** |

| III SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MME13DE02 | Optimization in Design | 3 | 1 | 0 | 4 |
| 2 | MME13DE09 | Mechatronics in Manufacturing Systems | 3 | 0 | 0 | 3 |
| 3 | MME13XXXX | Elective III (CAM) | 3 | 0 | 0 | 3 |
| 4 | MME13XXXX | Elective IV (CAM) | 3 | 0 | 0 | 3 |
| 5 | MME13CL02 | Project Phase I | 0 | 0 | 6 | 3 |
| **TOTAL** | | | **12** | **1** | **6** | **16** |

| IV SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MME13CL03 | Project Phase II | 0 | 0 | 24 | 12 |
| | | TOTAL | 0 | 0 | 24 | 12 |

**Note:** Out of 4 Electives, 2 are to be taken from CAD area and 2 from CAM area.

* Student should have presented a paper on the project area in National or International conference/Journals and should attach the certificate in proof and the published paper in the project report.

**TOTAL NO. OF CREDITS : 75**

| List of Electives CAD | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MME13DE03 | Computational Fluid Dynamics | 3 | 1 | 0 | 4 |
| 2 | MME13DE04 | Tribology in Design | 3 | 1 | 0 | 4 |
| 3 | MME13DE05 | Advanced Machine Tool Design | 3 | 1 | 0 | 4 |
| 4 | MME13D007 | Advanced Mechanism Design | 3 | 1 | 0 | 4 |
| 5 | MME13D008 | Mechanical Vibrations | 3 | 1 | 0 | 4 |
| 6 | MME13D012 | Design of Material Handling Equipments | 3 | 1 | 0 | 4 |
| 7 | MME13CE01 | Design of Mechanical Drives | 3 | 1 | 0 | 4 |

| List of Electives CAM | | | | | | |
|---|---|---|---|---|---|---|
| **S.No** | **Subject Code** | **Title of Subject** | **L** | **T** | **P** | **C** |
| 1 | MME13CE02 | Data Communication in CAD/CAM | 3 | 0 | 0 | 3 |
| 2 | MME13CE03 | Manufacturing System and Simulation | 3 | 0 | 0 | 3 |
| 3 | MME13CE04 | Performance Modelling and Analysis of manufacturing System | 3 | 0 | 0 | 3 |
| 4 | MME13CE05 | Applied Materials Engineering | 3 | 0 | 0 | 3 |
| 5 | MME13CE06 | Flexible Competitive manufacturing system | 3 | 0 | 0 | 3 |
| 6 | MME13CE07 | Metrology and Non Destructive Testing | 3 | 0 | 0 | 3 |
| 7 | MME13CE08 | Concurrent Engineering | 3 | 0 | 0 | 3 |

**MMA130002 APPLIED MATHEMATICS FOR DESIGN ENGINEERS 3 1 0 4**

**OBJECTIVES:** The student will learn

- Analytical functions and different transform methods
- To solve the differential equations using finite difference methods

**UNIT I: ANALYTIC FUNCTIONS** **12 Hrs**

Analytic functions – Cauchy Riemann equations – Construction of analytic functions – Conformal Mapping – Simple Transformations – Standard transformations **: $w = z^2$, $w = e^z$, w = sin z, w = cosh z –** Bilinear transformations.

**UNIT II: TRANSFORM METHODS** **12 Hrs**

Laplace Transform methods for one dimensional wave equation – Displacements in a string – Fourier Transform methods – One dimensional heat conduction problems in infinite and semi- infinite rod.

**UNIT III: CALCULUS OF VARIATIONS** **12 Hrs**

Variation and its properties – Euler's equations – Functional dependent on First and higher order derivatives – Functional depend on functions of several independent variables – Problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

**UNIT IV: FINITE DIFFERENCE METHODS** **12 Hrs**

Finite difference methods – Solution of Laplace and Poisson equation – Leibmann's iteration process – Solution of heat equation: Schmidt explicit formula – Crank-Nicolson implicit scheme – Solution of wave equation.

**UNIT V: FAST FOURIER TRANSFORMS** **12 Hrs**

Discrete Fourier transform – linearity and periodicity – Inverse N-point DFT – DFT approximation of Fourier coefficients – Sampled Fourier series – Approximations of Fourier Transform by an N-point DFT – FFT – Computational efficiency of FFT.

**Total No. of Hrs : 60**

**REFERENCES**

1. Grewal.B.S (2012) "Higher *Engineering Mathematics*", Khanna Publishers.
2. Kreyszig E (2011) "*Advanced Engineering Mathematics (9th ed.)*", John Wiley & Sons.
3. Sneddon I.N (2006) *"Elements of Partial Differential Equations*", Dover Publications.
4. Sankara Rao K (2010) "Introduction *to Partial Differential Equations (3rd ed.)"*, Prentice Hall of India.
5. Gupta A.S (2004) *"Calculus of variations with applications"*, Prentice Hall of India.
6. James G (2007) *"Advanced modern Engineering Mathematics (3rd ed.)"*, Pearson.
7. Sastry S.S (2003) "*Introductory Methods of Numerical Analysis*", Prentice Hall of India.

**MME13C001 COMPUTER INTEGRATED MANUFACTURING SYSTEMS 3 0 0 3**

**OBJECTIVE:** The student will learn

- Computer integrated planning and manufacturing systems

**UNIT I: INTRODUCTION** **9 Hrs**

Modern Manufacturing – Sequence of functions in Computer Integrated Manufacturing – Elements of CIM system – The CIM Wheel – CIM- DBMS –LAN-WAN– Benefits of CIM

**UNIT II: GROUP TECHNOLOGY** **9 Hrs**

Introduction – Part families – PFA – Parts Classifications and Coding – Machine Cells – Coding Systems – Economics of GT – Benefits of GT – Applications, Advantages, Disadvantages of GT

**UNIT III: COMPUTER AIDED PROCESS PLANNING & PLANNING CONTRO** **9 Hrs**

Role of Process Planning – Approaches to Process planning – Process planning systems – Benefits of CAPP. Production control function – Business Planning - MRP

**UNIT IV: COMPUTER AIDED QUALITY CONTROL** **9 Hrs**

QC – Computer Aided Quality Control – Automated inspection principles and methods – Computer Aided Inspection – Computer Aided Testing- Integration of CAQC with CAD/CAM

**UNIT V: FLEXIBLE MANUFACTURING SYSTEMS** **9 Hrs**

Introduction – Elements of Flexible Manufacturing Systems – Classification, Operational aspects of FMS – Types of FMS – Work Stations Layout – Material Handling equipment – Analysis, applications of FMS

**Total No. of Hrs : 45**

**REFERENCES**

1. Groover. M.P (2006) "*Automation, Production System and CIM*", Prentice-Hall of India.
2. David Bedworth (1998) "*Computer Integrated Design and Manufacturing*", TMH, New Delhi.
3. Yorem Koren (1983) "*Computer Integrated Manufacturing Systems*", McGraw Hill.
4. Ranky, Paul G (1986) "*Computer Integrated Manufacturing*", Prentice Hall International.
5. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen (1985) "*Design rules for a CIM system*", North Holland Amsterdam.

**MME13DE07** **ROBOTICS AND SENSORS** **3 0 0 3**

**OBJECTIVE:** The student will learn

- Concepts, design, application and control of robotics

**UNIT I: INTRODUCTION** **9 Hrs**

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications Material Handling-Processing-Assembly and Inspection -Safety considerations.

**UNIT II: TRANSFORMATIONS AND KINEMATICS** **9 Hrs**

Vector operations-Translational transformations and Rotational transformations-Properties of transformation Matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution

**UNIT III: CONTROLS AND END EFFECTORS** **9 Hrs**

Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors- Classification-Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design

**UNIT IV: ROBOT PROGRAMMING** **6 Hrs**

Methods -Languages-Computer control and Robot Software-VAL system and Language

**UNIT V: SENSORY DEVICES** **12 Hrs**

Non-optical and optical position sensors-Velocity and Acceleration-Range-Proximity-touch-Slip-Force-Torque-Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and Categorization-Software consideration- Case Studies

**Total No. of Hrs : 45**

**REFERENCES**

1. Fu .K.S, Gonzalez. R.C, Lee. C.S.G (1987) "*Robotics control, sensing, vision, and Intelligence*", McGraw Hill Book Co.
2. Klafter .R.D, Cmielewski T.A and Negin M (1994) "*Robot Engineering An Integrated approach*", Prentice Hall of India, New Delhi.
3. Deb .S.R (1994) "*Robotics Technology and Flexible Automation*", Tata McGraw Hill Publishing Co., Ltd.
4. Craig .J.J "*Introduction to Robotics Mechanics and Control*", Addison Wesley.
5. Groover. M.P (1995) "*Industrial robotics Technology, programming and applications*", McGraw Hill Book Co.
6. http://www.robotics.com

**MME13D009 ADVANCED STRENGTH OF MATERIALS 3 1 0 4**

**OBJECTIVE:** The student will learn

- Behaviour of the material under different types of loads

**UNIT I: INTRODUCTION 12 Hrs**

Load-Stress and Load-Deflection, Stress-strain relations, Failure and limits on design Theories of Stress and Strain- Definition of stress at a point, Stress notation, Symmetry of the stress array and stress on an arbitrarily oriented plane, Transformation of stress, Principal stresses, Differential equations of a deformable body, Deformation of a Deformable body, Strain Theory, Transformation of strain, Principal strains, Small displacement theory, Strain measurement

**UNIT II: TORSION 12 Hrs**

Torsion of Prismatic bar of circular cross section, Saint-Venant's semi inverse method, Linear elastic solution, Narrow rectangular cross section, Hollow thin-wall torsion members, Multiply connected cross section, Thin wall torsion members with restrained ends, Numerical solution of torsion problems

**UNIT III: BENDING 12 Hrs**

Definition of shear center in bending, Symmetrical and non-Symmetrical bending, Bending stresses in beams subjected to non-Symmetrical bending, Deflections of straight beams subjected to non-Symmetrical bending, Effect of Inclined loads

**UNIT IV: CURVED BEAMS 12 Hrs**

Introduction, Circumferential stresses in a curved beam, Radial stresses in curved beams, Correction of circumferential stresses in curved beams, Deflection of curved beams, statically indeterminate curved beams, closing ring subjected to a concentrated load

**UNIT V: CONTACT STRESSES 12 Hrs**

Introduction, the problem of determining contact stresses, Geometry of the contact surface, Notation and meaning of terms, Expressions for Principal stresses, Method of computing contact stresses, Deflection of bodies in point contact, Stress for two bodies in line contact, Loads normal to contact area and Tangent to contact area , Problems

**Total No. of Hrs : 60**

**REFERENCES**

1. Arthur P.Boresh "*Advanced Mechanics of Materials*, John wiley & sons.Inc.
2. Egor P. Popov (1997) "Engineering *Mechanics of Solids*", Prentice Hall of India, New Delhi.
3. Srinath L.N "*Advanced Mechanics of Solids*, "Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Junarkar S.B (1995) "*Mechanics of Structures*", Vol. 1, 21st Edition, Charotar Publishing House, Anand, India.

**MME13C002 MANUFACTURING INFORMATION SYSTEMS 3 0 0 3**

**OBJECTIVE:** The student will learn

- Management information database used for manufacturing

**UNIT I: INTRODUCTION 9 Hrs**

The evolution of order policies, from MRP to MRP II. The role of production organization. operations control

**UNIT II: DATABASE 9 Hrs**

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

**UNIT III: DESIGNING DATA BASE 9 Hrs**

Hierarchical model-Network approach-Relational data model-Concepts, Principles, keys, relational operations functional dependence-Normalization, types-Query languages

**UNIT IV: MANUFACTURING CONSIDERATION 9 Hrs**

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

**UNIT V: INFORMATION SYSTEM FOR MANUFACTURING 9 Hrs**

Parts oriented production information system-Concepts and structure-Computerized production Scheduling, online production controlsystems, computer based production management system, computerized manufacturing information system - case study.

**Total No. of Hrs : 45**

**REFERENCES**

1. Luca G. Sartori (1989) "*Manufacturing Information systems*", Addison-Wesley Publishing Company.
2. Date.C.J (1997) "*An Introduction to Database systems*", Narosa Publishing House.
3. Orlicky.G (1994) "*Material Requirements Planning*", 'McGraw Hill Publishing Co.
4. Kerr.R (1991) "*Knowledge based Manufacturing Management*, "Addison-Wesley.
5. www.ist.psu.edu

**MME13DE06 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES 3 1 0 4**

**OBJECTIVE:** The student will learn

- Product design considerations and strategies of innovative product development

**UNIT I: INTRODUCTION 12 Hrs**

Essential factors of product design- requirements of good design- factors affecting product design- product development process tools- Design by evolution and innovation- Asimow's model- Journeys in product development- product engineering – nature and scope- Product design practice in industry.

**UNIT II: CREATIVITY 12 Hrs**

\

Creative thinking and organizing for product innovation criteria – method and tools for directed creativity – challenges of quality management – Case studies – Mumbai's Dabbawalas – creativity by less learned- Creativity on wheel chair – MARICO (case study)- Patent –design patents- patent application steps – sale of patent rights.

**UNIT III: DESIGN CONSIDERATIONS 12 Hrs**

Functional and production design – form design – influence4 of basic design, mechanical loading and material on form design – Design for manufacture and assembly – Design for robustness – Design for production – Design for stiffness and rigidity – strength consideration in product design – optimization in design – Project analysis – Mechanical estimating and costing.

**UNIT IV: PRODUCT DEVELOPMENT STRATEGIES 12 Hrs**

Planning and preparation – Resources – Talent –striving, thinking, relating – Quality assurance in product design – Strategy for product development – Case studies.

**UNIT V: HUMAN AND VALUE ENGINEERING 12 Hrs**

Human beings as applicator of forces – Anthropometry – design of controls and displays – man/machine information exchange – aesthetic and ergonomic considerations – Value engineering – maximum value-Normal degree of value – value analysis of job plan – Idea generation check-list – Cost reduction through value engineering case study on tap switch control assembly – Economic factors influencing design – Material and process selection

**Total No. of Hrs : 60**

**REFERENCES**

1. Kavin & Krishn "*Product Design Techniques in reverse engineering & New product*
1. *Development*", Pearson Education.
2. Paul E. Dlesk "*Creativity, Innovation and Quality*", Prentice - Hall of India Private Limited.
3. Jones J.C (1970) "*Design Methods*", Interscience.
4. Buhl. H.R (1960) "*Creative Engineering Design*", Iowa State University Press.
5. Dieter. G.E (1983) "*Engineering Design*", McGraw Hill.
6. Niebel. B.W. & Draper, A.B (1991) "*Product Design and Process Engineering*", McGraw Hill.
7. Harry Peck (1973) "*Designing for Manufacturing*", Sir Issac Pitman and Sons Ltd.

**MME13DL01** **DESIGN ANALYSIS LAB** **0 0 4 2**

**OBJECTIVE:** The student will learn

- Design , modelling and analysis using computer software and tools

**I. MODELLING:**

- Introduction to modelling techniques- Type of modelling- wire frame, surface and solid modelling—constructive solid modelling and B-rep modelling- Feature based and parametric modelling etc.
- Generation of surfaces of revolution, surfaces of extrusion, surfaces by skinning operation etc.
- Creation of different views-importing models from other softwares-Data base management.

(Exercises will be given using packages like PROE/CATIA/Unigraphics etc.)

**II. ANALYSIS:**

- Introduction to FEM-Analysis software – ANSYS / NASTRAN/NISA/COSMOS/I-DEAS etc.
- Structural and fluid analysis.-One dimensional, two dimensional and Three dimensional Elements Based Problems.
- Thermal Analysis-Conduction, Convection and Radiation heat transfer Problems.

**III. MATLAB:**

- Introduction to MATLAB
- Study of different MATLAB tools
- Arithmetic and logical operators
- Matrix operation using MATLAB
- Mathematical equations solution
- Generation of trigonometrically wave functions
- Introduction to SIMULINK
- Flow control statements and graphs

**Total No. of Hrs : 60**

**MME13D003 ADVANCED FINITE ELEMENT ANALYSIS 3 1 0 4**

**OBJECTIVE:** The student will learn

- Formulation and modelling of a problem and analyzing the dynamic, fluidics and heat transfer problems

**UNIT I: BENDING OF PLATES AND SHELLS 12 Hrs**

Review of Elasticity Equations-Bending of Plates and Shells-Finite Element Formulation of Plate and Shell Elements-Conforming and Non Conforming Elements - Co and C1 Continuity Elements-Application and Examples

**UNIT II: NON-LINEAR PROBLEMS 12 Hrs**

Introduction-Iterative Techniques-Material non-Linearity-Elasto Plasticity-Plasticity-Visco plasticity-Geometric Non linearity-large displacement Formulation-Application in Metal Forming Process and contact problems

**UNIT III: DYNAMIC PROBLEM 12 Hrs**

Direct Formulation - Free, Transient and Forced Response - Solution Procedures-Subspace Iterative Technique - Houbolt, Wilson, Newmark - Methods - Examples

**UNIT IV: FLUID MECHANICS AND HEAT TRANSFER 12 Hrs**

Governing Equations of Fluid Mechanics-Inviscid and Incompressible Flow-Potential Formulations-Slow Non-Newtonian Flow-Metal and Polymer Forming-Navier Stokes Equation-Steady and Transient Solutions.

**UNIT V: ERROR ESTIMATES AND ADAPTIVE REFINEMENT 12 Hrs**

Error norms and Covergence rates- high refinement with adaptivity-Adaptive refinement

**Total No of Hrs : 60**

**REFERENCES**

1. Zeinkiewicz. O.C and Taylor, R.L ( 1991) "*The Finite element Method*", Fourth Edition,Volumes 1 & 2, McGraw Hill International Edition, Physics service.
2. Cook R.D (1989) "*Concepts and Applications of Finite Element Analysis*", John Wiley and Sons Inc, New York.
3. Bathe K.J (1990) "*Finite Element Procedures in Engineering Analysis*", Prentice Hall.

**MME13D004 DESIGN FOR MANUFACTURING AND ASSEMBLY 3 1 0 4**

**OBJECTIVE:** The student will learn

- requirements of designing to ease manufacturing and assembly

**UNIT I: INTRODUCTION 12 Hrs**

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

**UNIT II: FORM DESIGN - CASTING 12 Hrs**

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

**UNIT III: FORM DESIGN - FORGING 12 Hrs**

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

**UNIT IV: FORM DESIGN - MACHINING 12 Hrs**

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

**UNIT V: DESIGN FOR ASSEMBLY METHODS 12 Hrs**

Approaches to design for assembly - Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product - Case studies.

**Total No of Hrs : 60**

**REFERENCES**

1. Harry Peck (1983) "*Design for Manufacture"*, Pittman Publication.
2. Alan Redford and Chal (1994) "*Design for Assembly - Principles and Procedures"*, McGraw Hill International Europe, London.
3. Robert Matousek (1963) "Engineering *Design - A Systematic Approach"*, Blackie & Sons Ltd.
4. James G. Bralla (1986) *"Hand Book of Product Design for Manufacturing"*, McGraw Hill Co.
5. Swift. K. G (1987) "*Knowledge Based Design for Manufacture"*, Kogan Page Ltd.

**MME13C003** **COMPUTER AIDED DESIGN** **3 0 0 3**

**OBJECTIVE:** The student will learn

- Use of computers in design of components and assembly

**UNIT I: INTRODUCTION TO COMPUTER AIDED DESIGN** **11 Hrs**

The design process-Application of computers in design-typical CAD System-CAE-Benefits of CAD-Concept of CAD as drafting and designing facility-drawing features in CAD-Translation, rotation, scaling-Layering-CAD Hardware-Design workstation-Graphic Terminal-Operator input devices-Output devices-CPU

**UNIT II: INTERACTIVE COMPUTER GRAPHICS** **12 Hrs**

Creation of Graphic primitives-Output primitives(Points,Lines,Curves)- Windowing, view ports-Clipping transformation- Data exchange standards-Geometric modelling- Wireframe, Surface, Solid Modelling –Data Structures-Engineering Data Management System-Hierarchical,Network,Relational data structure

**UNIT III: VISUAL REALISM** **7 Hrs**

Fundamentals -rendering techniques-lines and shaded images, dynamics, stereopsis, Improved display, aliasing and ant-aliasing.

**UNIT IV: ASSEMBLY OF PARTS** **8 Hrs**

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

**UNIT V: SOLID MODELING** **7 Hrs**

Solid modeling- Rapid Prototyping -CSG and B-REP Techniques-Features of Solid Modeling Packages- Case Studies

**Total No. of Hrs : 45**

**REFERENCES**

1. William .M. Neumann and Robert .F. Sproul (1989) "*Principle of Computer Graphics*" , McGraw Hill Book Co. Singapore.
2. Donald Hearn and .M. Pauline Baker (1992) "Computer *Graphics*", Prentice Hall, Inc.
3. Mikell .P. Grooves and Emory .W. Zimmers Jr. (1995) "CAD*/CAM Computer -- Aided Design and Manufacturing*", Prentice Hall, Inc.
4. Ibrahim Zeid (1998) *"CAD/CAM -- Theory and Practice*", McGraw Hill, International Edition.

**MME13C004 COMPUTER AIDED PROCESS PLANNING 3 0 0 3**

**OBJECTIVE:** The student will learn

- Process planning and usage of computers in process planning

**UNIT I: INTRODUCTION 5 Hrs**

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

**UNIT II: PART DESIGN REPRESENTATION 10 Hrs**

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 OPITZ system-The MICLASS System

**UNIT III: PROCESS ENGINEERING AND PROCESS PLANNING 10 Hrs**

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

**UNIT IV: COMPUTER AIDED PROCESS PLANNING SYSTEMS 10 Hrs**

Logical Design of process planning - Implementation considerations-Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

**UNIT V: AN INTERGARTED PROCESS PLANNING SYSTEMS 10 Hrs**

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

**Total No. of Hrs : 45**

**REFERENCES**

1. Gideon Halevi and Roland D. Weill (1995) "*Principle of process planning*", Alogical approach, chapman &Hall.
2. Tien-Chien-Chang, Richard A.Wysk (1985) "*An Introduction to automated process planning systems*", Prentice Hall.
3. Chang T.C (1985) "*An Expert Process Planning System*", Prentice Hall.
4. Nanua Singh (1996) "*Systems Approach to Computer Integrated Design and Manufacturing*", John Wiley & Sons.
5. Rao (2000) "*Computer Aided Manufacturing*", Tata McGraw Hill Publishing Co.
6. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
7. http://Estraj.ute.sk/journal/engl-027/027.htm

**MME13CL01** **CAM LABORATORY** **0 0 4 2**

**OBJECTIVE:** The student will learn

- Practically the method of writing programs for machining operations

1. Practice in part programme and operation of a turning center.
2. Diagnosis and trouble shooting in CNC machine.
3. Practice in part programming and operations of a machine center.
4. Tool planning and selection for machining center/turning center.
5. Programming using CAD based software.
6. Practice in APT based NC programming languages
7. Practice in robot programming and its languages
8. Preparation of various reports and route sheets.
9. Simulation of a manufacturing system.

**Total No. of Hrs : 60**

**MME13DE02** **OPTIMIZATION IN DESIGN** **3 1 0 4**

**OBJECTIVE:** The student will learn

- Optimization techniques and its application in design and manufacturing

**UNIT I: CLASSICAL OPTIMIZATION TECHNIQUES** **12 Hrs**

Single variable optimization with and without constraints, Multi–variable optimization without constraints, multi–variable optimization with constraints– method of Lagrange multipliers, Kuhn-Tucker conditions.

**UNIT II: NUMERICAL METHODS FOR OPTIMIZATION** **12 Hrs**

Nelder Mead's Simplex search method, Gradient of a function, steepest descent method, Newton's method, types of penalty methods for handling constraints.

**UNIT III: GENETIC ALGORITHM (GA)** **12 Hrs**

Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA, multi–objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

**UNIT IV: APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS** **12 Hrs**

Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

**UNIT V: INTRODUCTION TO NEURAL NETWORKS** **12 Hrs**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch- Pitts Model, Historical Developments, Potential Applications of ANN.

**Total No. of Hrs : 60**

**REFERENCES**

1. Jasbir Arora "*Optimal design*", Mc Graw Hill (International) Publishers.
2. Kalyanmoy Deb "*Optimization for Engineering Design*", PHI Publishers.
3. S.S.Rao "*Engineering Optimization*", New Age Publishers.
4. Johnson Ray. C (1990) "*Optimum Design of mechanical elements*", Wiley, John & Sons.
5. Kalyanmoy Deb. "*Multi objective Genetic algorithms*", PHI Publishers.
6. Hertz, Krogh, Palmer "*Introduction to the theory of Neural Computation".*
7. B. Yegnanarayana (PHI) "*Artificial Neural Networks".*
8. David E. Goldberg, Addison Wesley (1989) *"Genetic Algorithms"* New York.

**MME13DE09 MECHATRONICS IN MANUFACTURING SYSTEMS 3 0 0 3**

**OBJECTIVE:** The student will learn

- Usage of combination of mechanical and electronic systems in manufacturing

**UNIT I: INTRODUCTION 8 Hrs**

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

**UNITN II: SENSORS AND TRANSDUCERS 9 Hrs**

Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors-Signal processing-Servo systems

**UNIT III: MICROPROCESSORS IN MECHATRONICS 12 Hrs**

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

**UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS 8 Hrs**

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

**UNIT V: DESIGN OF MECHATRONICS SYSTEM 8 Hrs**

Designing-Possible design solutions-Case studies of Mechatronics systems

**Total No. of Hrs : 45**

**REFERENCES**

1. Michael B.Histand and David G. Alciatore (1999)"*Introduction to Mechatronics and Measurement Systems*", McGraw Hill International Editions.
2. Bradley, D.A.Dawspn, D, Buru, N.C. and Loader, AJ (1993) "Mechatronics", Chapman and Hall.
3. Ramesh, S, Gaonkar (1998) "*Microprocessors Architecture, Programming and Applications*", Wiley Eastern.
4. Lawrence J.Kamm (2000) "*Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics*", Prentice Hall.
5. Ghosh,P.K. and Sridhar, P.R (1995) "*8000 to 8085 Introduction to Microprocessors for Engineers and Scientists*", Second Edition, Prentice Hall.
6. http://www. cs.indiana.edu.

**MME13CL02** **PROJECT PHASE I** **0 0 6 3**

- Students should select the area of the project work and complete the literature survey.
- Student should identify the problem of study and start the project work.
- Students are expected to do the project work individually.
- A guide will be allotted to each student based on the area of the Project work.
- Project reviews will be conducted once in a fortnight to asses the development of the project work.
- At the end of the semester students should submit a report of the work completed and should appear for a Project Viva-voce examination conducted by the internal examiner.
- Continous assessment mark (50 marks) will be awarded based on the performance in the reviews.
- End semester mark (50 marks) will be awarded based on project viva voce examination.

| | | | | | |
|---|---|---|---|---|---|
| **MME13CL03** | **PROJECT PHASE II** | **0** | **0** | **24** | **12** |

- Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually.
- Each student will be allotted a guide based on the area of Project work
- Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

**It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.**

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.

**MME13DE03** **COMPUTATIONAL FLUID DYNAMICS** **3 1 0 4**

**OBJECTIVE**: The student will learn

- Formulation and analysis of problems on fluid dynamics

**UNIT I: GOVERNING DIFFERENTIAL EQUATIONS AND FDM** **12 Hrs**

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.

**UNIT II: CONDUCTION HEAT TRANSFER** **12 Hrs**

Steady one-dinensional conduction ,Two and Three dimensional Steady state problems , Transient One dimensional and Two dimensional problems.

**UNIT III: INCOMPRESSIBLE FLUID FLOW** **12 Hrs**

Governing Equations, Stream function – Vorticity Method, Determination of Pressure for Viscous flow, Simple procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite Difference Approach.

**UNIT IV: CONVECTION HEAT TRANSFER AND FEM** **12 Hrs**

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.

**UNIT V: TURBULENCE MODELS** **12 Hrs**

Algebraic models –One Equation model, K-I Models, Standard, High and Low Reynolds Number models, Prediction of Fluid flow and Heat transfer using Standard Codes.

**Total No. of Hrs : 60**

**REFERENCES**

1. Muralidhar K and Sundararajan T (1995) "*Computational Fluid Flow and Heat Transfer*" , Narosa Publishing House, New Delhi,.
2. Ghoshdasdidar P. S (1998) "*Computer Simulation of Flow and Heat Transfer*", Tata McGraw Hill Publishing Company Limited.
3. Subhas,V Patankar (1980) "*Numerical Heat Transfer Fluid Flow*" , Hemisphere Publishing Corporation.
4. Taylor C and Hughes J.B (1981) "*Finite Element Programming of Navier Stoke Equation*", Pine Ridge Press Ltd,U.K,.
5. Anderson D.A,Tannehill I.I and Pletcher R.H ( 1984) "*Computational Fluid Mechanics and Heat transfer*",Hemisphere Publishing Corporation,.
6. Fletcher C.A.J (1987) "*Computational Techniques for Fluid Dynamics-Fundamental and General Techniques*", Springer –Verlag.
7. Fletcher C.A.J (1987) "*Computational Techniques for Different Flow Catagories*", Springer –Verlag.
8. Bose T.K (1997) "*Numerical Fluid Dynamics*", Narosa Publishing House.

**MME13DE04** **TRIBOLOGY IN DESIGN** **3 1 0 4**

**OBJECTIVE**: The student will learn

- Influence of behaviour of friction, wear and lubrication on mechanical system design

**UNIT I: SURFACES, FRICTION AND WEAR** **12 Hrs**

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.

**UNIT II: LUBRICATION THEORY** **12 Hrs**

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 .

**UNIT III: DESIGN OF FLUID FILM BEARINGS** **12 Hrs**

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 - Hydrostatic Bearing design.

**UNIT IV: ROLLING ELEMENT BEARINGS** **12 Hrs**

Geometry and Kinematics - 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.

**UNIT V: TRIBO MEASUREMENT IN INSTRUMENTATION** **12 Hrs**

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

**Total No. of Hrs : 60**

**REFERENCES**

1. Cameron. A (1981) "*Basic Lubricaton Theory*", Ellis Herward Ltd. , UK.
2. Hulling , J. (Editor) ( 1984) --"*Principles of Tribology*", MacMillan .
3. Williams J.A ( 1994) "*Engineering Tribology*" ,Oxford Univ. Press .
4. Neale M.J (1995) "*Tribology Hand Book* ", Butterworth Heinemann.
5. http://www.csetr.org/link.htm
6. http://www.me.psu.edu/research/tribology.htm

**MME13DE05 ADVANCED MACHINE TOOL DESIGN 3 1 0 4**

**OBJECTIVE:** The student will learn

- Designing of different types of machine tools and their drives and controls
- Testing of machine tools under erection and commission.

**UNIT I: INTRODUCTION 10 Hrs**

Introduction to Metal Cutting Machine tools, Kinematics, Basic Principles of Machine tool design, estimation of drive power.

**UNIT II: DESIGN OF MACHINE TOOLS-I 13 Hrs**

Design of Machine tool spindle and bearings, Design of power Screws - Static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections – correction coefficients.

**UNIT III: DESIGN OF MACHINE TOOLS-II 13 Hrs**

Design of beds, columns, tables and supports. Dynamics of cutting forces - tool chatter - design of slide ways. Concepts of aesthetics and ergonomics applied to machine tools, latest trends in Machine Tool Design, Introduction to CAD techniques

**UNIT IV: DESIGN OF DRIVES AND CONTROL MECHANISMS 17 Hrs**

Design considerations of electrical, mechanical and Hydraulic drives in machine tool, stepped and stepless arrangements and systems.
Design of control mechanisms - selection of standard components - Dynamic measurement of forces and vibrations in machine tools - Stability against chatter - use of vibration dampers.

**UNIT V: TESTING AND STANDARDISATION 07 Hrs**

Acceptance tests and standardization of machine tools - machine tools reconditioning.

**Total No. of Hrs : 60**

**REFERENCES**

1. Mehta. N.K (1989) "*Machine Tool design*",Tata McGraw Hill.
2. Koenisberger.F (1964) "*Design Principles of Metal cutting Machine Tools*", Pergamon Pres.
3. Acherkan.N (1968)"*Machine Tool Design*", Vol.3&4, MIR Publishers, Moscow.
4. Sen. G. and Bhattacharya,A (1973) "*Principles of Machine Tools*",Vol.2, NCB.Calcutta.

**MME13D007 ADVANCED MECHANISM DESIGN 3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Different types of advanced mechanisms analyze and synthesize mechanisms.

**UNIT I: INTRODUCTION TO KINEMATICS 12 Hrs**

Review of fundamentals of kinematics--Mobility ,kinematic inversion,Graphical position analysis,algegric position analysis,position analysis techniques,displacement difference between two points,rotation and translation,apparent displacement and absolute displacement.

**UNIT II: VELOCITY AND ACCELERATON 12 Hrs**

Velocity and acceleration of simple and complex mechanisms using graphical method.

**UNIT III: SYNTHESIS 12 Hrs**

Type , Number and. Dimensional synthesis - Function generation , path generation, body guidance.Two position synthesis of crank and rocker mechanism.Crank and rocker mechanism with optimum transmission angle.Three position synthesis,Four position synthesis,point precision reduction,precision position,structural error,chebychev spacing.

**UNIT IV: SYNTHESIS OF LINKAGES 12 Hrs**

Coupler curve synthesis, cognate linkages, Robert-Chebychev theorem, Blocks method of synthesis, Freudenstein's equation, Analytical synthesis using complex algebra, Synthesis of dwell mechanisms.

**UNIT V: SPATIAL MECHANISM 12 Hrs**

Introduction, exception in the mobility of mechanisms, the position analysis problem, Velocity and acceleration analysis.

**Total No. of Hrs : 60**

**REFERENCES**

1. Sandor G.N and Erdman A.G (1984)"*Advanced Mechanism Design Analysis and Synthesis*", Prentice Hall.
2. Shigley, J.E and Uicker, J.J (1995) "*Theory of Machines and Mechanisms*", McGraw Hill.
3. Amitabha Ghosh and Ashok Kumar Mallik (1999) "*Theory of Mechanism and Machines*", EWLP, Delhi.
4. Nortron R.L (1999) "*Design of Machinery*", McGraw Hill.
5. Kenneth J. Waldron, Gary L. Kinzel (1999)"*Kinematics, Dynamics and Design of Machinery*", John Wiley- sons.

**MME13D008** **MECHANICAL VIBRATIONS** **3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Various types of vibration and their analysis

**UNIT I: FUNDAMENALS OF VIBRATION** **12 Hrs**

Review of Single degree freedom systems - Response to aribitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identificaton from frequency response - Transient vibration - Laplace transformation formulation.

**UNIT II: TWO DEGREE FREEDOM SYSTEM** **12 Hrs**

Free vibration of spring-coupled system - Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.

**UNIT III: MULTI DEGREE FREEDOM SYSTEM** **12 Hrs**

Normal mode of vibration - Flexiblity matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies.

**UNIT IV: VIBRATION OF CONTINUOUS SYSTEMS** **12 Hrs**

Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear defomation - Vibration of plates.

**UNIT V: EXPERIMENTAL METHODS IN VIBRATION ANALYSIS** **12 Hrs**

Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of vibration tests - Industrial case studies.

**Total No. of Hrs : 60**

**REFERENCES**

1. Rao, J. S., & Gupta K (1984)"*Ind. Course on Theory and Practice Mechanical Vibration*", NewAge International (P) Ltd.
2. Thomson, W.T (1990)"*Theory of Vibration with Applications*" CBS Publishers and Distributers, NewDelhi,
3. Den Hartog. J.P (1990) "*Mechanical Vibrations*",Dover Publications.
4. Rao, S.S (1995)"*Mechanical Vibrations*", Addison Wesley Longman.

**MME13D012 DESIGN OF MATERIAL HANDLING EQUIPMENTS 3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Design of different types of material handling systems used for engineering and process industries

**UNIT I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT 12 Hrs**

Overview-consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

**UNIT II: DESIGN OF HOISTS 12 Hrs**

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.

**UNIT III: DRIVES OF HOISTING GEAR 12 Hrs**

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

**UNIT IV: CONVEYORS 12 Hrs**

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

**UNIT V: ELEVATORS 12 Hrs**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

**Total No. of Hrs : 60**

***NOTE:** Use of Approved Data Book is permitted

**REFERENCES**

1. Rudenko.N (1970) "*Materials handling equipment*", ELnvee Publishers.
2. Mikell.P.Groover (2006) "*Automation,Production system and computer integrated manufacturing ,second edition*",Prentice Hall of India Pvt Ltd.
3. Alexandrov.M (1981) "*Materials Handling Equipments*", MIR Publishers.
4. Boltzharol. A ( 1958) "*Materials Handling Handbook*", The Ronald Press Company.
5. P.S.G. Tech (2003 )"*Design Data Book*", Kalaikathir Achchagam, Coimbatore.
6. Lingaiah. K and Narayana Iyengar (1983)"*Machine Design Data Hand Book*", Vol.1 & 2, Suma Publishers, Bangalore.
7. Spivakovsy, A.O and Dyachkov, V.K (1985) " *Conveying Machines*", Volumes I and II, MIR Publishers.

**MME13CE01** **DESIGN OF MECHANICAL DRIVES** **3 1 0 4**

**OBJECTIVE**: At the end of this course the student will learn

- Concepts and analysis using computers for various mechanical elements design

**UNIT I: INTRODUCTION** **12 Hrs**

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

**UNIT II: SHAFTING** **12 Hrs**

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

**UNIT III: GEARS** **12 Hrs**

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 .

**UNIT IV: GEAR BOX** **12 Hrs**

Integrated design of speed reducers and multispeed gear boxes - application of software packages.

**UNIT V: CLUTCHES & BRAKES** **12 Hrs**

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

**Total No. of Hrs : 60**

**REFERENCES**

1. Newcomb.T.P. and Spur.R.T (1975)"*Automobile brakes ad braking systems*", Chapman and Hall 2nd Edition.
2. Juvinall. RL.C (1983)"*Fundamentals of Machine Component Design*", John Wiley.
3. Maitra. G.M (1985) "*Hand Book for Gear Design*", Tata McGraw Hill .
4. Shigley . J.E (1986)"*Mechanical Engineering Design* ", Tata McGraw Hill.
5. http://www.agma.org/

**MME13CE02 DATA COMMUNICATION IN CAD/CAM 3 0 0 3**

**OBJECTIVE:** At the end of this course the student will learn

- Usage of computers for communication of data related to CAD/CAM

**UNIT I: DIGITAL COMPUTERS & MICRO PROCESSORS 8 Hrs**

Block diagram - register transfer language - arithmetic, logic and shift micro operations - instruction code - training and control instruction cycle - I/O and interrupt 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.

**UNIT II: OPERATING SYSTEM & ENVIRONMENTS 9 Hrs**

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.

**UNIT III: COMMUNICATION MODEL 10 Hrs**

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.

**UNIT IV: COMPUTER NETWORKS 10 Hrs**

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

**UNIT V: INTERNET 8 Hrs**

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 Hrs : 45**

**REFERENCES**

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

**MME13CE03 MANUFACTURING SYSTEM AND SIMULATION 3 0 0 3**

**OBJECTIVE**: The student will learn

- To model and simulate the manufacturing systems

**UNIT I: COMPUTER MODELING AND SIMULATION SYSTEMS 8 Hrs**

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

**UNIT II: RANDOM NUMBER GENERATION 10 Hrs**

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.

**UNIT III: RANDOM VARIABLE GENERATION 8 Hrs**

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

**UNIT IV: DISTRIBUTION AND EVALUATION OF EXPERIMENTS 10 Hrs**

1Discrete uniform distribution - Poisson distribution - geometric distribution - acceptance rejection technique for Poisson distribution gamma distribution. Simulation Experiments - Variance reduction techniques - antithetic variables - verification and validation of simulation models. Variance reduction techniques - antithetic variables - verification and validation of simulation models.

**UNIT V: DISCRETE EVENT SIMULATION 9 Hrs**

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 Hrs : 45**

**REFERENCES**

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

**MME13CE04** **PERFORMANCE MODELLING AND ANALYSIS OF MANUFACTURING SYSTEM** **3 0 0 3**

**OBJECTIVE**: The student will learn

- Modeling and analyzing the manufacturing systems for its performance

**UNIT I: MANUFACTURING SYSTEMS & CONTROL** **10 Hrs**

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

**UNIT II: MANUFACTURING PROCESSES** **10 Hrs**

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.

**UNIT III: QUEUING MODELS** **8 Hrs**

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

**UNIT IV: QUEUING NETWORKS** **8 Hrs**

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

**UNIT V: PETRI NETS** **9 Hrs**

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

**Total No. of Hrs : 45**

**REFERENCES**

1. Viswanadham. N and Narahari. Y (1994) "*Performance Modelling of Automated Manufacturing Systems*", Prentice Hall of India, New Delhi.
2. Trivedi, K.S (1982) "*Probability and Statistics with Reliability, Queuing and Computer Science Applications*", Prentice Hall, New Jersey.
3. Gupta S.C & Kapoor V.K (1988) "*Fundamentals of Mathematical Statistics*", 3rd Edition, Sultan Chand and Sons, New Delhi.

**MME13CE05 APPLIED MATERIALS ENGINEERING 3 0 0 3**

**OBJECTIVE:** The student will learn

- Different types of materials and their behaviours under various types of loads

**UNIT I: ELASTIC AND PLASTIC BEHAVIOUR 10 Hrs**

Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors - Super plasticity - Deformation of non crystalline material.

**UNIT II: FRACTURE BEHAVIOUR 10 Hrs**

Griffith's theory, stress intensity factor and fracture toughness-Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law -Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials - Failure analysis sources of failure, procedure of failure analysis.

**UNIT III: SELECTION OF MATERIALS 10 Hrs**

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance - Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

**UNIT IV: MODERN METALLIC MATERIALS 8 Hrs**

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Marging steel - Intermetallics, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials.

**UNIT V: NON METALLIC MATERIALS 7 Hrs**

Polymeric materials - Formation of polymer structure - Production techniques of fibers, foams, adhesives and coatings - Structure , properties and applications of engineering polymers - Advanced Structural ceramics, WC,Tic,TaC,AI2O3,SiC, Si3N4, CBN and diamond - properties, processing and applications.

**Total No. of Hrs : 45**

**REFERENCES**

1. Thomas H.Courtney (2000) "*Mechanical Behaviour of Materials*", (2nd Edition), McGraw Hill.
2. Charles J.A.,Crane, F.A.A and Furness. J.A.G (1977) "*Selection and use of Engineering Materials*", (3rd Edition), Butterworth-Heiremann.
3. Flinn, R.A. and Trojan. P.K (1999) "*Engineering Materials and their Applications*", (4th Edition), Jaico.
4. George E.Dieter (1988) "*Mechanical Metallurgy*", McGraw Hill.
5. Metals Hand Book (1994) "*Failure Analysis and Prevention*", Vol 10, (10th Edition) .

**MME13CE06 FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM 3 0 0 3**

**OBJECTIVE**: The student will learn

- Techniques and methods of competitive manufacturing systems

**UNIT I: MANUFACTURING IN A COMPETITIVE ENVIRONMENT 9 Hrs**

Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixturing - Design for assembly, disassembly and service.

**UNIT II: GROUP TECHNOLOGY 9 Hrs**

Part families - classification and coding -Production flow analysis - Machine cell design - Benefits.

**UNIT III: FLEXIBLE MANUFACTURING SYSTEMS 9 Hrs**

Introduction - Components of FMS - application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - knowledge based scheduling - Hierarchy of computer control - Supervisory Computer.

**UNIT IV: COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS 9 Hrs**

System issues - Types of software - specification and selection - Trends - Application of simulation – software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

**UNIT V: COMPETITIVE MANUFACTURING 9 Hrs**

Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - TPM - Kanban system - strategic implications - implementation issues - MRD JIT – Six sigma ,Lean and agile Manufacturing.

**Total No. of Hrs : 45**

**REFERENCES**

1. Groover M.P (1996) "*Automation, Production systems and Computer Integrated Manufacturing*", Prentice-Hall of India Pvt.Ltd., New Delhi .
2. Jha . N.K (1991) "*Handbook of Flexible Manufacturing Systems*", Academic Press Inc.
3. Kalpakjian (1995) "*Manufacturing Engineering and Technology*", Addison-Wesley Publishing Co.
4. Taiichi Ohno, Toyota (1992) *"Production System Beyond Large-Scale Production"*, Productivity Press India Pvt.Ltd.
5. http.//www/engineeringtalk.com/news/lvd103.htm

**MME13CE07 METROLOGY AND NON DESTRUCTIVE TESTING 3 0 0 3**

**OBJECTIVE:** The student will learn
- Various measuring precision instruments and techniques
- Non destructive testing methods

**UNIT I: MEASURING SYSTEMS: 9 Hrs**

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

**UNIT II: STATISTICAL QUALITY CONTROL 9 Hrs**

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

**UNIT III: LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 9 Hrs**

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

**UNIT IV: RADIOGRAPHY 9 Hrs**

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

**UNIT V: ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES 9 Hrs**

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 Hrs : 45**

**REFERENCES**

1. Jain.R.K (1997) "*Engineering Metrology*", Khanna Publishers.
2. Barry Hull and Vernon John (1988) "*Non Destructive Testing*", MacMillan.
3. Metals Hand Book (1976) "American *Society for Metals*", Vol.II.
4. Proceedings of 10th International Acoustic Emission Symposium (1990) "Progress *in Acoustic Emission*", Japanese society for NDI.
5. http://www.metrology tooling.com
6. http://www.sisndt.com
7. http://www.iuk'tu-harburg.de

**MME13CE08** **CONCURRENT ENGINEERING** **3 0 0 3**

**OBJECTIVE**: The student will learn

- Concepts and analysis of latest method of manufacturing systems

**UNIT I: INTRODUCTION** **5 Hrs**

Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

**UNIT II: USE OF INFORMATION TECHNOLOGY** **10 Hrs**

IT support - Solid modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design.

**UNIT III: DESIGN STAGE** **10 Hrs**

Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

**UNIT IV: MANUFACTURING CONCEPTS AND ANALYSIS** **10 Hrs**

Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system - JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

**UNIT V: PROJECT MANAGEMENT** **10 Hrs**

Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development- Case Studies

**Total No. of Hrs : 45**

**REFERENCES**

1. Anderson MM and Hein. L. Berlin (1987) "*Integrated Product Development*", Springer Verlog.
2. Cleetus. J (1992) "*Design for Concurrent Engineering*", Concurrent Engg. Research Centre, Morgantown, WV.
3. Andrew Kusaik (1992) "*Concurrent Engineering: Automation Tools and Technology*", Wiley, John and Sons Inc.
4. Prasad (1996)"*Concurrent Engineering Fundamentals: Integrated Product Development*", Prentice Hall.
5. Sammy G Sinha (1998) "Successful Implementation of Concurrent Product and Process", Wiley, John and Sons Inc.
6. www.tm.tue.nl/race/ce/ce95.html