Programme Educational Objectives (PEOs)

The overall educational objective for **Master of Technology in CAD/CAM** is to educate students with excellent technical capabilities in the mechanical engineering discipline with the knowledge of computer aided design and manufacturing, who will be responsible citizens and continue their professional advancement through life-long learning.

As Mechanical engineers with expertise in CAD/CAM, post graduates are prepared with following educational objectives:

1. ACADEMIC APTITUDE

   To impart the knowledge of engineering subject matter incorporating computer as a tool and building a bright career in the area of design, simulation, manufacturing and production.

2. TECHNICAL COMPETENCE

   To create technical ability in students by exposure of on hand practice in laboratory, operating CNC machines and conducting various experiments using latest infrastructure to enhance research approach.

3. CREATIVITY

   To construct the confidence by employing various learning resources for solving engineering/ industrial problems, designing products for social economic issues to explore skill of entrepreneur.

4. EXPERTISE

   To develop professionalism to formulate and solve problems of interest individually and in team with high value of ethics.

5. COMMUNICATION

To apply an environment of communication through oral and written presentation of technical reports derived research reports so as to interact with academicians, researchers, and industrial practices.

COURSE STRUCTURE FOR M. TECH.
(CAD/CAM)
SEMESTER – I

Code No.	Subject	L	T	P	Exam Scheme				Total	Credits
					Theory		Tuto.	Pract.		
					Hrs.	Marks	Marks	Marks		
ME 601	Finite Element Methods	3	0	2	2	100	-	50	150	4
ME 761	Computer Aided Design	3	0	2	2	100	-	50	150	4
ME 763	Concurrent Engineering	3	0	0	2	100	-	-	100	3
ME 765	Computer Aided Production Planning	3	0	0	2	100	-	-	100	3
ME 767	CAD/CAM Software Practice	0	0	4	-	-	-	100	100	2
	Elective – I	3	0	0	2	100	-	-	100	3
ME 769 **ME 770** **ME 771** **ME 773**	Mechatronics in Manufacturing Systems Industrial Robotics Rapid Prototyping and Tooling Data Communications in CAD/CAM									

SEMESTER – II

Code No.	Subject	L	T	P	Exam Scheme				Total	Credits
					Theory		Tuto.	Pract.		
					Hrs.	Marks	Marks	Marks		
ME 762	Computer Aided Machine Design	3	0	2	2	100	-	50-	100	4
ME 764	Computer Aided Manufacturing	3	0	2	2	100	-	50	150	4
ME 766	Advance Tool Design	3	0	0	2	100	-	-	100	3
ME 768	CAD/CAM Projects	0	0	4	-	-	-	100	100	2
	Elective – II	3	0	0	2	100	-	-	100	3
ME 772 **ME 774** **ME 776** **ME 778** **ME 782** **ME 784**	Modeling & Simulation Flexible Manufacturing Systems Design for Manufacture, Assembly and Environment Metrology and Non - Destructive Testing Maintenance Engineering Total Quality Management									
	Elective - III	3	0	0	2	100	-	-	100	3
ME 654 **ME 676** **ME 786** **ME 788** **ME 792** **ME 794**	Mechanical Vibrations Design of Material Handling Equipment Design of Hydraulic and Pneumatic Systems Non -Traditional Optimization Techniques Advance Mechanisms Design Tribology in Design									

SEMESTER – III

Code No.	Subject	L	T	P	Exam Scheme				Total	Credits
					Theory		Tuto.	Pract.		
					Hrs.	Marks	Marks	Marks		
ME 801	Dissertation Preliminaries	0	0	16	-	-	-	400	400	8
ME 803	Seminar	0	0	4	-	-	-	100	100	2

SEMESTER - IV

Code No.	Subject	L	T	P	Exam Scheme				Total	Credits
					Theory		Tuto.	Pract.		
					Hrs.	Marks	Marks	Marks		
ME 802	Dissertation	0	0	24	-	-	-	600	600	12

M. Tech (CAD/CAM), Semester - I	L	T	P	C
ME 601: FINITE ELEMENT METHODS	**3**	**0**	**2**	**4**

- **INTRODUCTION (9 Hours)**
  Relevance of finite element analysis in design, Modeling and discretization, Interpolation, Elements, Nodes and degrees-of-freedom, Applications of FEA.
  One-Dimensional Elements and Computational Procedures: Bar elements, Beam elements, Bar and beam elements of arbitrary orientation, Assembly of elements, Properties of stiffness matrices, Boundary conditions, Solution of equations, Mechanical loads and stresses, Thermal loads and stresses, Example problems.

- **BASIC ELEMENTS (7 Hours)**
  Interpolation and shape functions, Element matrices, Linear triangular elements (CST), Quadratic triangular elements, Bilinear rectangular elements, Quadratic rectangular elements, Solid elements, Higher order elements, Nodal loads-stress calculations, Example problems.

- **ISOPERIMETRIC ELEMENTS (7 Hours)**
  Introduction, Bilinear quadrilateral elements, Quadratic quadrilaterals, Hexahedral elements, Numerical integration, Quadrature, Static condensation, Load considerations, Stress calculations, Examples of 2D and 3D applications.

- **FINITE ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS (10 Hours)**
  Solid and Structural Mechanics Applications: One dimensional problems static analysis of trusses, Analysis of plates, Solid of revolution.
  Dynamic analysis: Dynamic equations, Mass and damping matrices, Natural frequencies and modes, Damping, Reduction of number of degrees-of-freedom-response history, Model methods, Ritz vectors, Component mode synthesis, Harmonic response, Direct integration techniques, Explicit and implicit methods, Analysis by response spectra, Example problems.

- **HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS (7 Hours)**
  Heat Transfer, Element formulation, Reduction-nonlinear problems, Transient thermal analysis, Acoustic frequencies and modes, Fluid structure interaction problems, Plane incompressible and rotational flows, Example problems.

- **FEA APPLICATIONS IN OTHER FIELDS (5 Hours)**
  Applications of FEA in torsion, Potential flow seepage, Fluid flow in ducts, Metal forming and metal cutting problems

(Total Lecture Hours: 45)

PRACTICALS:

1. Analysis of 2-D Truss.
2. Analysis of 2-D Frame.
3. Analysis of L Shaped Bracket.
4. Analysis of Square plate with circular hole.
5. Analysis of Solid.
6. Analysis of 2-D heat flow problem.
7. Analysis of 2-D transient heat flow in plate.
8. Simulation of flow over car body.

BOOKS RECOMMENDED:

1. Cook Robert Davis, “Concepts and Applications of Finite Element Analysis”, John Wiley & Sons, 1999.
2. Reddy J.N., “An Introduction to the Finite Element Method”, McGraw Hill, International Edition, 1993.
3. Chandrupatla & Belagundu, “Finite Elements in Engineering”, Prentice Hall of India Private Ltd., 1997.
4. George R. Buchaman, “Schaum’s Outline of Finite Element Analysis”, McGraw Hill Company, 1994.
5. Rao S.S., “Finite Element Method in Engineering”, Elsevier Pergaman Press, 1997.

M. Tech (CAD/CAM), Semester – I	L	T	P	C
ME 761: COMPUTER AIDED DESIGN	**3**	**0**	**2**	**4**

- Basics of Computer Aided Design, Introduction to Computer graphics, DDA and Bresenhams algorithm for generating various figures, 2D & 3D Transformations, Basics of CAD/CAM hard-wares , Representation of curves and surfaces. **(7 Hours)**

- Introduction to modeling techniques, Coordinate system, Modeling features, Feature entities, Drafting features, Customization, 3D sketches, Feature manipulation, Datum features, Modeling operation Strategy, Geometric constraints, Modeling aids & tools, Generalized views, Presentation of dimensioning / tolerances/symbols & annotation, Associatively, Parent child relationship, Parametric design, Programming techniques in drafting/ modeling/analysis, Concept of computer animation, Properties calculation, Surface design, Surface theory, Surface analysis, Fundamentals of solid modeling, Different approaches of creating an assembly. **(15 Hours)**

- Standards in CAD, Graphics and computing standards, Data exchange standards, Design database, Interfacing design and drafting, Mechanical assembly. **(8 Hours)**

- CAD/CAM Exchange**:** Evaluation of data, Exchange format, IGES data representations and structure, STEP architecture, Implementation, ACIS. **(8 Hours)**

- Capabilities of various commercially available software s in the area of CAD **(7 Hours)**

(Total Lecture Hours: 45)

PRACTICALS:

1. Introduction to drafting technologies & drafting practice.
2. Introduction interfacing of drafting package using program techniques.
3. Sketching/Drafting of assigned problem using programming.
4. Practice for 3-D modeling.
5. Modeling of assigned problem.
6. Modeling using parametric relations.
7. Modeling using linkage options.
8. Practice for assembly creation.
9. Practice for view generation.
10. Model/View associatively.

BOOKS RECOMMENDED:

1. Hearn Donald & Baker M. Pauline, "Computer Graphics", Prentice-Hall of India Pvt. Ltd., 2nd Edition, 1997.
2. David F. Rogers & J. Alan Adams, "Mathematical Elements for Computer Graphics" McGraw Hill, 2nd Edition, 1990.
3. Zeid Ibrahim, "CAD/CAM - Theory and Practice", McGraw Hill, International Edition, 1998
4. McMohan Chris, "CAD/CAM: Principles, Practice and Manufacturing", Prentice Hall, 1999.
5. Rao, P.N. "CAD/CAM: Principles and Applications", McGraw Hill Publication, 2nd Edition, 2004.

M. Tech (CAD/CAM), Semester – I	L	T	P	C
ME 763 : CONCURRENT ENGINEERING	**3**	**0**	**0**	**3**

- Historical background of Concurrent Engineering (CE), sequential and concurrent processes; Definition and framework of CE; Decomposition of product development stages, CE team, Implementation of CE; Role of Information Technology in CE; Examples of CE app lications. **(6 Hours)**

- Concurrent Engineering Tools, Design for manufacturing and assembly (DFMA), Design for quality, Design for cost, Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA), Design of Experiments, Taguchi's meth ods, Quality function deployment (QFD), Simulation, etc. **(13 Hours)**

- Design evaluation for manufacturing cost, Design process optimization for CE, Role of CAD/CAM and automation in CE, Virtual reality tools and techniques for product develo pment and interactive modeling and visualization, Rapid Prototyping. Design for manufacturing -case studies; Design for reliability, maintainability and a vailability and their implication on CE and case studies. **(13 Hours)**

- CE application to composite structures, Structural design using composite materials, Mechanical properties and design parameters of composite materials, Composite manufacturing processes with emphasis on manufacturing time, Quality and cost; Case studies on design for manufacturing of composite structural elements. **(13 Hours)**

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Biren Prasad, "Concurrent Engineering Fundamentals", Vols. I & II, Prentice Hall, New Jersey, 1996.
2. Andrew Kusiak, "Concurrent E ngineering, Automation, Tools and Techniques", Interscience, 1992.
3. Backhouse, C.J. and Brookes, "Concurrent Engineering", Gower Publishing House, 1996.
4. Hamid R. Parsaei, William G. Sullivan, "Concurrent Engineering: Contemporary Issues and Modern Design Tools", Springer, 1993.
5. Moustapha, I., "Concurrent Engineering in Product Design and Development", New Age International, New Delhi, 1998.

M. Tech (CAD/CAM), Semester – I	L	T	P	C
ME 765: COMPUTER AIDED PRODUCTION PLANNING	**3**	**0**	**0**	**3**

- **INTRODUCTION (7 Hours)**
  Introduction to Process planning in manufacturing, Computer aided production management and computer aided production planning, Process planning and production planning, Process planning and Concurrent engineering, Information requirement for process planning system, Role of process planning, Advantages of conventional process planning over CAPP.

- **COMPUTER AIDED FORECASTING (7 Hours)**
  Introduction to forecasting, sources of data, Demand patterns, Forecasting models, selection of forecasting technique, Computerized relative allocation of facility technique, Automated layout design program and computerized relationship layout planning for facility location and layout

- **GROUP TECHNOLOGY (7 Hours)**
  Introduction, Significance, Structure, Relative advantages, Implementation and applications, Algorithms and models for G.T, Rank order clustering, Bond energy, Mathematical model for machine, Component cell formation, Design and manufacturing attributes, Parts classification and coding, Concept of composite job machine group, Cell group tooling, Design rationalization, CAD/CAM and GT benefits.

- **COMPUTER AIDED PROCESS PLANNING, OPERATIONS MANAGEMENT (12 Hours)**
  MRP: Introduction, Objective, Input, Computational procedure, Information provided by the system. Detailed capacity planning, Manufacturing resources planning.
  ERP: Introduction, Main features, Generic model of ERP system, Selection of ERP, Proof of concept approach, Analytic hierarchy approach, ERP implementation, Job sequencings, scheduling, Simulation of machining processes, NC tool path generation, Graphical implementation, Determination of optimal index positions for executing fixed sequence, Quantitative methods.

- **COMPUTER AIDED MEASUREMENT AND INSPECTION (12 Hours)**
  Computer Aided Testing, Contact type, Non-contact type simulation, Major activities, Purpose, Simulation process, Types methodology, Simulation packages, Process quality simulator, Computer requirements trends and applications simulation of machine shop.
  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.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Gideon Halevi and Roland D. Weill, “Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.
2. Mahapatra P.B., “Computer Aided Production Management”, Printice Hall of India Pvt. Ltd., 2004.
3. Tien – Chien Chang and Richard A wysk, “An introduction to Automated Process Planning” Prentice Hall of India Pvt. Ltd., 1985.
4. Groover M.P., “Automation production systems and computer Integrated manufacturing”, Prentice Hall, 2001.
5. P.N.Rao, N.K.Tewari, Kundra T.K., “Computer Aided Manufacturing”, TMH, 2000.

M. Tech (CAD/CAM), Semester - I	L	T	P	C
ME 767: CAD/CAM SOFTWARE PRACTICE	**0**	**0**	**4**	**2**

Practice/Exercises for Modeling and Analysis of Mechanical Elements using Parametric and feature based software listed below:

- **EXSL SIM** **(3 Hours)**
- **MSM** **(3 Hours)**
- **UNIGRAPHICS – CAD/ CAM** **(4 Hours)**
- **HYPERFORM – LS DYNA** **(3 Hours)**
- **DYNAFORM** **(4 Hours)**
- **PRO ENGINEER** **(4 Hours)**
- **CATIA** **(4 Hours)**
- **INVENTOR SERIES WITH MECHANICAL DESKTOP & AUTOCAD** **(4 Hours)**
- **SOLID – EDGE** **(4 Hours)**
- **FEM LAB** **(4 Hours)**
- **IDEAS** **(4 Hours)**
- **ANSYS** **(4 Hours)**

(Total Lecture Hours: 45)

M. Tech (CAD/CAM), Semester – I, Elective - I	L	T	P	C
ME 769: MECHATRONICS IN MANUFACTURING SYSTEMS	**3**	**0**	**0**	**3**

- **INTRODUCTION** **(5 Hours)**
  Introduction to Mechatronics, Need of Mechatronics in measurement systems, Control systems, Traditional design.

- **FEEDBACK DEVICES** **(10 Hours)**
  Introduction of sensors and transducers, Performance terminology, Displacement, Position and proximity, Velocity and motion, Fluid pressure, Temperature sensors - Light sensors, Selection of sensors, Signal processing, Servo systems.

- **ROLE OF MICROPROCESSORS IN MECHATRONICS** **(15 Hours)**
  Introduction of microprocessors and microcontrollers, 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.

- **PROGRAMMABLE LOGIC CONTROLLERS(PLC)** **(10 Hours)**
  Introduction, Basic structure, Input/output processing, Programming, Mnemonics timers, Internal relays and counters, Data handling, Analog input/output, Selection of PLC.

- **DESIGN AND MECHATRONICS** **(5 Hours)**
  Designing, Possible design solutions, Case studies of Mechatronics systems.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Histand Michael B. and Alciatore David G., “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., "Introduction to Microprocessors for Engineers and Scientists, (0000 to 8085)", Second Edition, Prentice Hall, 2004.

M. Tech (CAD/CAM), Semester – I, Elective – I	L	T	P	C
ME 771 : RAPID PROTOTYPING AND TOOLING	**3**	**0**	**0**	**3**

- **INTRODUCTION** **(6 Hours)**
  Need for time compression in product development, Product development conceptual design, Development, Detail design, Prototype, Tooling, Applications of RP.

- **STEREO LITHOGRAPHY SYSTEMS**: Principle, Process parameters, Process details, Machine details, Applications. **(6 Hours)**
-
- **LASER SINTERING SYSTEMS**: Principle, Process parameters, Process details, Machine details, Applications. **(6 Hours)**

- **FUSION DEPOSITION MODELING** **(6 Hours)**
  Principle, Process parameters, Process details, Machine details, Applications.

- **LAMINATED OBJECT MANUFACTURING** **(6 Hours)**
  Principle, Process parameters, process details, Machine details, Applications.

- **LASER ENGINEERING NET SHAPING (LENS)** **(10 Hours)**
  Ballistic Particle Manufacturing (BPM), Principle, Introduction to rapid tooling, Direct and indirect method, Commercial softwares for RP, STL file generation.

  Rapid tooling techniques (vacuum casting, DMLS, etc.) **(4 Hours)**
  Introduction to reverse engineering **(1 Hour)**

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Pham, D.T. & Dimov.S.S., "Rapid manufacturing", Springer-Verlag, London, 2001.
2. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA, 2007.
3. Ghosh A., "Rapid Protopyping: A Brief Introduction", Affiliated East West,
4. Kenneth G. Cooper, "Rapid Prototyping Technology: Selection and Application", CRC Press, 2001.
5. Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.

M. Tech (CAD/CAM), Semester – I, Elective – I	L	T	P	C
ME 773: DATA COMMUNICATIONS IN CAD/CAM	**3**	**0**	**0**	**3**

- **DIGITAL COMPUTERS & MICRO PROCESSORS (15 Hours)**
  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

- **OPERATING SYSTEM & ENVIRONMENTS (8 Hours)**
  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.

- **COMMUNICATION MODEL (8 Hours)**
  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.

- **COMPUTER NETWORKS (7 Hours)**
  Network structure, Network architecture, The OSI reference model services, Network standardization, Example, Managing remote systems in network , Network file systems, Net working in manufacturing.

- **INTERNET (7 Hours)**
  Internet services, Protocols, Intranet information services, Mail based service system and network requirements, Internet tools, Usenet, E-mail , IRC, WWW, FTP, Telnet.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.
2. Peterson J.L., Galvin P. and Silberschaz, A., "Operating System s Concepts", Addison Wesley, 1997.
3. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997.
4. Andrew S. Tanenbanum "Computer Networks", Prentice Hall of India 3rd Edition, 1996.
5. Christian Crumlish, "The ABC's of the Internet", BPB P ublication, 1996.
6. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", Penram International, 1997

M. Tech (CAD/CAM), Semester – I, Elective – I	L	T	P	C
ME 770: INDUSTRIAL ROBOTICS	**3**	**0**	**0**	**3**

- **INTRODUCTION AND ROBOT KINEMATICS (8 Hours)**
  Definition need and scope of Industrial robots, Robot anatomy, Work volume, Precision movement, End effectors, Sensors. Robot Kinematics, Direct and inverse kinematics, Robot trajectories, Control of robot manipulators, Robot dynamics, Methods for orientation and location of objects.

- **ROBOT DRIVES AND CONTROL (10 Hours)**
  Controlling the Robot motion, Position and velocity sensing devices, Design of drive systems, Hydraulic and Pneumatic drives, Linear and rotary actuators and control valves, Electro hydraulic servo valves, electric drives, Motors, Designing of end effectors, Vacuum, magnetic and air operated grippers.

- **ROBOT SENSORS (10 Hours)**
  Transducers and Sensors, Sensors in Robot, Tactile sensor, Proximity and range sensors, Sensing joint forces, Robotic vision system, Image gribbing, Image processing and analysis, Image segmentation, Pattern recognition, Training of vision system.

- **ROBOT CELL DESIGN AND APPLICATION (7 Hours)**
  Robot work cell design and control, Safety in Robotics, Robot cell layouts, Multiple Robots and machine interference, Robots cycle time analysis, Industrial application of robots.

- **ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXP ERT SYSTEMS (10 Hours)**
  Methods of Robot Programming, Characteristics of task level languages lead through programming methods, Motion interpolation, Artificial intelligence, Basics, Goals of artificial intelligence, AI techniques, Problem representation in AI, Problem reduction and solution techniques, Application of AI and ES in Robots.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Fu K.S., Gonzalez R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987.
2. Richard D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
3. Deb S.R.” Robotics Technology and Flexible Automation”, Tata McGraw-Hill, 1994.
4. Groover Mikell, P., Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial Robotics Technology, Programming and Applications”, McGraw-Hill, Int. 1986.
5. Timothy Jordanides et al,”Expert Systems and Robotics “, Springer –Verlag, New York, May 1991.

M. Tech (CAD/CAM), Semester – II	L	T	P	C
ME 762: COMPUTER AIDED MACHINE DESIGN	3	0	2	4

- **INTRODUCTION (10 Hours)**
  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.

- **SHAFTING (10 Hours)**
  Analysis and Design of shafts for different applications, detailed design, Preparation of production drawings, integrated design of shaft, Bearing and casing, Design for rigidity.

- **GEARS AND GEAR BOXES (15 Hours)**
  Principles of gear tooth action, Gear correction, Gear tooth failure modes, Stresses and loads, Component design of spur, helical, Bevel and worm gears, Deign for sub assembly, Integrated design of speed reducers and multi-speed gear boxes, application of software packages.

- **CLUTCHES AND BRAKES (15 Hours)**
  Integrated design of automobile clutches and over running clutches. Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

(Total Lecture Hours: 45)

PRACTICALS:

1. Practice/Study of Programming Language C, C++, VB etc.
2. Computer Aided Design of Spur Gear.
3. Computer Aided Design of Helical Gear.
4. Computer Aided Design of Worm Gear.
5. Computer Aided Design of Bevel Gear.
6. Optimum Design of kinematics layout of Gear boxes.
7. Computer Aided Design of Brakes.
8. Computer Aided Design of Clutches.

BOOKS RECOMMENDED:

1. Newcomb, T.P. and Spur, R.T., “Automobile Brakes and 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 of Gear Design”, Tata McGraw Hill, 1985.
4. Shigley J.E., “Mechanical Engineering Design”, McGraw Hill, 1986.
5. Tech. P.S.G., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.

M. Tech (CAD/CAM), Semester – II	L	T	P	C
ME 764: COMPUTER AIDED MANUFACTURING	**3**	**0**	**2**	**4**

- **INTRODUCTION (5 Hours)**
  Introduction to Control, Open loop and Closed Loop control Systems, Drives and Controls Interpolators for CNC machine tools. Numerical Control, Types of CNC systems.

- **NC / CNC MACHINES (15 Hours)**
  Components of NC/CNC system, Specification of CNC system, Classification of NC /CNC machines, Tape, Tape codes and tape readers used in NC machines constructional de tails of CNC machines, axis designation, NC/CNC tooling. Fundamentals of manual part programming, types of format, word address format manual part programming for drilling, lathe and milling machine operations, subroutines, do loops, canned cycles, paramet ric sub routines. Computer assisted part programming: need, list of computer assisted programming languages, Automated Programmed Tools language - its types of statement, command and programming CAD based CNC programming using CAM software.

- **FLEXIBLE MANUFACTURING SYSTEM (10 Hours)**
  Introduction of FMS, Need of FMS, General Considerations for FMS, types of FMS, flexibilities, their measurements, various mathematical techniques for flexibility measurements. Manufacturing cells, cellular v/s flexible manufacturing, Application of JIT and GT to FMS

- **COMPUTER INTEGRATED MANUFACTURING SYSTEMS (15 Hours)**
  Basic information of CIMS, hardware and software requirement for CIMS, benefits, scope and needs, CIMS wheel, elements of CIMS and their role, computer technology and manufacturing, database requirement, fundamentals of communication, data base management, database models, DBMS architecture, SQL, Steps to implement CIM, its management, Personnel, emerging technologies like expert systems, Computer vision, lasers in manufacturing (machinery and metrology), Multimedia communications, etc. CAD/CAM Integration programming, Post processors, CNC part programming with CAD/CAM systems.

(Total Lecture Hours: 45)

PRACTICALS:

1. Demonstration of CNC Milling machine with user interface and calculating the Co - ordinates of given geometry in absolute end increment mode for cutter path.
2. Introduction of G codes and M codes and write the CNC part programming for a given geometry using linear, Circular interpolation.
3. Write the CNC programming for a given geometry using Mirror and Subroutine.
4. Write the CNC programming for a given geometry using Polar Co -ordinate for drilling cycles.
5. Write the CNC programming for a given geometry using Tool Radius Compensation and Repeat loop for Peck drilling cycles.
6. Introduction and programming of all canned cycle of milling machine .
7. Demonstration and study of CNC Lathe machine with sample programming.
8. Demonstration of HINUMERIK-2000 T Control system with sample programming.
9. Write CNC programming for given geometry (Lathe) using stock removal cycles for HINUMERIK-2007 T.
10. Demonstration of As /Rs and AVG operation.

BOOKS RECOMMENDED:

1. David Bedworth, “Computer Integrated Design and Manufacturing” Tata McGraw Hill, New Delhi, 1998.
2. Ranky, Paul G., “Computer Integrated Manufacturing” Prentice Hall International, 1986.
3. William W. Luggen, “Flexible Manufacturing Cells and System” Prentice Hall, England Cliffs, Newjersy, 1991.
4. Radhakrishan P., Subramaniyam S., “CAD CAM and CIM”, New Age International, 2002.
5. Vajpayee S. Kant, “Computer integrated Manufacturing” Prentice Hall of India, 1995.

M. Tech (CAD/CAM), Semester – II	L	T	P	C
ME 766 : ADVANCE TOOL DESIGN	3	0	0	3

- **TOOL DESIGN METHODS (7 Hours)**

  Introduction, Design procedure, Statement of the problem, Needs Analysis – Tentative design solutions, Finished design, Drafting and design techniques in tooling drawings, Punch and die Manufacturing Techniques.

- **TOOLING MATERIALS (7 Hours)**

  Introduction, Properties of tool materials, Metal cutting tools, Single-point cutting tools, Milling cutters, Drills and Drilling, Reamer classification, Taps, Tap classification, The selection of carbide cutting tools, Determining the insert thickness for carbide tools, Various heat treatments.

- **GAGES AND GAGE DESIGN (5 Hours)**

  Introduction, Fixed Gages, Gage Tolerances, The selection of material for Gages, Indicating Gages, and Automatic gages.

- **DESIGN OF DRILL JIGS, FIXTURES AND DIES (17 Hours)**

  DRILL JIGS

  Principles of location, Locating methods and devices, Principles of clamping, Drill jigs, Chip formation in drilling, General considerations in the design of drill jigs, Drill bushings, Methods of construction, Drill jigs and modern manufacturing, Computer aided Jig design.

  FIXTURES

  Introduction, Fixtures and economics, Types of Fixtures, Vise Fixtures, Milling Fixtures, Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding Fixtures, Types of Die construction, Computer aided Fixture Design,

  DIES

  Die-design fundamentals, Blanking and Piercing die construction, Pilots, Strippers and pressure pads, Presswork materials, Strip layout, Short-run tooling for Piercing, Bending dies, Forming dies, Drawing operations.

- **TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINES (9 Hours)**

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

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Donaldson, Cyrll, George H. LeCain, Goold, V.C., "Tool Design", Tata McGraw Hill Publishing Company Ltd., 36th Reprint 2006.
2. Joshi, Prakash Hiralal, "Tooling data", Wheeler Publishing, 2000
3. Sharma, P.C., "Machine Tool and Tool Design ", S Chand Company. 2004.
4. Mehta N.K., "Machine Tool Design", Tata McGraw Hill, 1989.
5. Paquin, J. R. and Crowley, R. E., Die design fundamentals, Ind. Press Inc., New York, 1987

M. Tech (CAD/CAM), Semester - I	L	T	P	C
ME 768 : CAD/CAM Projects	**0**	**0**	**4**	**2**

- Exploring available facilities of CAD Packages and Assignment of Design Problem
- Machining Practice based on CAD data
- Exploring CAM systems and sophisticated measuring instruments such as CMM, etc.
- Practice of solving problems using Object Oriented Programming.

M. Tech (CAD/CAM), Semester – II, Elective – II	L	T	P	C
ME 772 : MODELLING AND SIMULATION	**3**	**0**	**0**	**3**

- Introduction to modeling: Concept of system, Continuous and discrete systems, Types of models, Steps in simulation study, Statistical models in simulation, Discrete, Continuous, Poisson and empirical distributions. **(12 Hours)**

- Simulation programming techniques, Output data analysis for a single system, Comparing alternative system configurations. **(08 Hours)**

- Statistical procedure for comparing real world observations with simulation output data, Generation of arriving processes, Verification and validation of simulation models . **(10 Hours)**

- Monte Carlo simulation and its application in queuing models and inventory models, Simulation of manufacturing and material handling system . **(09 Hours)**

- Case studies on simulation packages. **(06 Hours)**

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Law A.M. & Kelton W.D. "Simulation Modeling and Analysis", McGraw Hill Publication, 1991
2. Jerry Banks, "Discrete event System simulation", 2nd edition, Prentice Hall of India Ltd.,2000
3. Geoffrey Gorden, "System Simulation", 2nd edition, Prentice Hall of India Ltd., 2007.
4. Sunil Saigal, Stefan Thynell, Harold S. Morgan, Ken Chong, **"**Modeling and Simulation Based Life-Cycle Engineering", Taylor and Francis, 2001.
5. Neelam Kavil K., "Computer Simulation and Modeling", John Wiley & Sons, 1987.

M. Tech (CAD/CAM), Semester – II, Elective – II	L	T	P	C
ME 774 : FLEXIBLE MANUFACTURING SYSTEM S	**3**	**0**	**0**	**3**

- **MANUFACTURING IN A COMPETITIVE ENVIRONMENT (9 Hours)**
  Automation of manufacturing process, Numerical control, Adaptive control, Material handling and movement, Industrial robots, Sensor technology, Flexible fixturing, Design for assembly, Disassembly and service.

- **PLANNING ISSUES IN FMS (18 Hours)**
  Introduction, Components of FMS, Application workstations, Computer control and functions, Planning, scheduling and control of FMS, Scheduling and knowledge-based scheduling, Hierarchy of computer control, Supervisory computer, Introduction to Turning center, Machining center, Cleaning and debarring equipment, Coordinate measuring machines: Types, Working, Capabilities etc.
  System support equipment, Automated material movement and automated storage and retrieval systems, Scheduling of AGVs, Cutting tools and tool management, Work holding considerations, FMS computer hardware & software, General structure and requirements, PLCs, FMS installation and implementation, Acceptance testing, maintenance concern

- **COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS (10 Hours)**
  System issues, Types of software, Specification and selection, Trends, Application of simulation, Software, Manufacturing data systems, Data flow, CAD/CAM considerations, Planning FMS database.

- **JUST IN TIME CONCEPT (8 Hours)**
  Characteristics of JIT, Pull method, Quality, Small lot sizes, Work station loads, Close supplier, Flexible work force, Line flow strategy, Preventive maintenance - Kanban system, Strategic implications, Implementation issues, MRD JIT, Lean manufacture.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing ", Prentice-Hall of India Pvt. Ltd., New Delhi, 1996.
2. Jha N.K. “Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.
3. Kalpakjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
4. Taiichi Ohno, Toyota, “Production System Beyond Large-Scale production ", Productivity Press (India) Pvt. Ltd., 1992.
5. Talayage Joseph and Hanman G. Roger, “Flexible Manufacturing Systems in Practice: Application Design and Simulations”, CRC Press, 1987.

M. Tech (CAD/CAM), Semester - II, Elective – II	L	T	P	C
ME 776: DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT	**3**	**0**	**0**	**3**

- **INTRODUCTION (7Hours)**
  General design principles for manufacturability, Strength and mechanical factors, mechanisms selection, Evaluation method, Process capability, Feature tolerances, Geometric tolerances , Assembly limits -Datum features, Tolerance stacks.

- **FACTORS INFLUENCING FORM DESIGN (8 Hours)**
  Working principle, Material, Manufacture, Design, Possible solutions, Materials choice, Influence of materials on form design, Form design of welded members, Forgings and castings.

- **COMPONENT DESIGN - MACHINING CONSIDERATION (10 Hours)**
  Design features to facilitate machining, Drills, Milling cutters, keyways, Doweling procedures, Counter sunk screws, Reduction of machined area, Simplification by separation, Simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility, Design for assembly.

- **COMPONENT DESIGN - CASTING CONSIDERATION (10 Hours)**
  Redesign of castings based on parting line considerations, Minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, Group technology, Computer Applications for DFMA

- **DESIGN FOR THE ENVIRONMENT (10 Hours)**
  Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Applications, Lifecycle assessment: Basic method, AT&T's environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly: Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Bralla, "Design for Manufacture handbook", McGraw hill, 1999.
2. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, 1994.
3. Dixon, John. R, and Corroda Poli, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 1995.
4. Fixel, J. "Design for the Environment", McGraw Hill., 1996.
5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, 2004.

M. Tech (CAD/CAM), Semester - II, Elective – II	L	T	P	C
ME 778 : METROLOGY AND NON-DESTRUCTIVE TESTING	3	0	0	3

- **STATISTICAL QUALITY CONTROL (08 Hours)**
  Data presentation, Statistical measures and tools, Process capability, Confidence and tolerance limits, Control charts for variables and for fraction defe ctives, Theory of probability, Sampling, ABC standard, Reliability and life testing.

- **METROLOGY (07 Hours)**
  Contact and non-contact type measurements, computational metrology with respect to CMM

- **SURFACE INSPECTION TECHNIQUES (10 Hours)**
  Liquid Penetrant and Magnetic Particle Tests: Characteristics of liquid penetra nts, Different washable systems, Developers, Applications, Methods of Production of magnetic fields, Principles of operation of magnetic particle test, Applications, Advantages and limi tations, Eddy current inspection, Visual inspection.

- **VOLUME INSPECTION TECHNIQUES (10 Hours)**
  Radiography: Sources of *y*-ray, X-ray production, Properties of *y*-ray and X-rays, Film characteristics, Exposure charts, Contrasts, Operational characteristic s of X-ray equipment, *y*-ray equipment, Digital radiography, Applications, Image analysis.

  ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES (10 Hours)
  Production of ultrasonic waves, Different types of waves, General characteristics of waves, Pulse echo method, A, B, C and P scans and TOFD, Principles of acoustic emission techniques, Kaiser effects, Advantages and limitations, Instrumentation, applications.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Barry Hull and Vernon John, " Non Destru ctive Testing ", MacMillan, 1988.
2. American Society for Metals, “Metals Hand Book ", Vol.II, 19 99.
3. Baldev Raj, “Practical Non Destructive Testing"", Narosa Publishers, 1997.
4. Gupta T.C., “Engineering Metrology”, Dhanpat Rai & Sons, New Delhi, 1994.
5. Mainsaw, E, Chetwynd D.G., Greenwood J.A., “Metrology and Properties of Engineering Surfaces”, Chapman and Hall, 1998

M. Tech (CAD/CAM), Semester - II, Elective - II	L	T	P	C
ME 782: MAINTENANCE ENGINEERING	**3**	**0**	**0**	**3**

- **INTRODUCTION** **(5 Hours)**
  Maintenance functions, Taro technology, Maintenance costs, Organization for maintenance, Japanese concept.

- **RELIABILITY CONCEPT** **(7 Hours)**
  Reliability function, Failure rate, Mean time between failures (MTBF), Mean time to f ailure (MTTF), A priori and a posteriori concept, Mortality curve, Useful life availability, Maintainability, System effectiveness.

- **RELIABILITY ANALYSIS** **(4 Hours)**
  Repair time distribution, Weibull application - Standby systems, Maintainability and availability, RCM.

- **MAINTENANCE POLICIES** **(10 Hours)**
  Maintenance types, Preventive maintenance, PM for functional characteristics and large scale systems, Repair policy, PM and break down maintenance, Statistical applications, and Replacement models.

- **LOGISTICS** **(7 Hours)**
  Spare parts control, Overall/optimum availability, Maintenance planning, Priority rules, Maintenance staffing, UMS, Maintenance manual.

- **ADVANCED TECHNIQUES** **(8 Hours)**
  Condition monitoring, WDM, SPM, Vibration monitoring, Maintenance information system, TPM, Maximize equipment effectiveness

- **RISK ASSESSMENT** **(4 Hours)**
  Definition and measurement of risk, Risk analysis techniques, Risk redu ction resources, Industrial safety and risk assessment.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Edward Hartman, "Maintenance Management", Productivity and Quality Publishing Pvt. Ltd., Madras, 1995.
2. Smith D.J. "Reliability and Maintainability i n perspective", Mac Millan Ltd., London, 1985.
3. Seiichi Nakagrima, "Introduction to Total Productive Maintenan ce", Productivity press (India), Pvt. Ltd., 1993.
4. Mobley Kaith R., “Maintenance Fundamental”, Elsevier Butterworth -Heinemann, 2004.
5. Hinggins Lindey R., “Maintenance Engineering Hand Book”, McGraw Hill, 2001.

M. Tech (CAD/CAM), Semester - II, Elective - II	L	T	P	C
ME 784: TOTAL QUALITY MANAGEMENT	**3**	**0**	**0**	**3**

- Quality concepts, Philosophies of Quality Gunus like Deming, Juran, Taguchi, Ishikawa, Shigeo Shingo etc., Concepts & Features of TQM. Models of TQM such as Kano Model, Westinghouse Model etc. **(05 Hours)**
- Quality costs: Factors influencing quality costs **(01 Hour)**
- Seven tools of quality, Seven new management tools of quality **(04 Hours)**
- Continuous process improvement : PDCA (PDSA) cycle, Kaizen, Gemba Kaizen, Lean Kaizen Quality circles, Reengineering, 5 S of Housekeeping **(06 Hours)**
- Quality Function Deployment (QFD), VOC, QFD Process, House of Quality **(03 Hours)**
- Total Productive Maintenance (TPM): Features of TPM, Autonomous Maintenance, Kobestu - Kaizen, OEE, Implementation of TPM **(03 Hours)**
- Failure Mode & Effect Analysis (FMEA) – FMEA processes, Failure Mode Effect & Criticality Analysis. **(03 Hours)**
- Design of Experiments: Completely randomized design, Factorial experiments **(03 Hours)**
- Taguchi Methods: Parameter Design, Quality Loss Function, orthogonal arrays, Signal to Noise ratio **(03 Hours)**
- Six Sigma- methodology, infrastructure, implementation **(06 Hours)**
- Quality awards like The Deming prize, Malcolm Baldrige National Quality Award (MBNQA) EFQM, The Golden Peacock National Quality Award etc. **(03 Hours)**
- Quality Management Systems (QMS): ISO 9000:2000 Quality System, documentation **(03 Hours)**
- Environmental Management systems – ISO 14000 requirements, benefits etc. ISO 18000 OHSAS **(03 Hours)**

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. R. Ramakrishnan, “Total Quality Management”, Es war Press, Chennai, 2005.
2. P. N. Mukharjee, “Total Quality Management”, PHI, New Delhi, 2006.
3. N.S. Sreenivasan & V. Narayana, “Total Quality Management with Six Sigma – A Practical Guide to be a world class company”, Quality Circle forum of India, Hyderabad, 2003.
4. Subbaraj Ramasamy, “Total Quality Management”, Tata McGraw Hill, New Delhi, 2005
5. R. Evans & W. M. Lindsay, “The Management & Control of Quality”, Thomson, 2006

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 654: MECHANICAL VIBRATIONS	**3**	**0**	**0**	**3**

- **FUNDAMENTALS OF VIBRATION** **(10 Hours)**
  Review of Single degree freedom systems, Response to arbitrary periodic Excitations, Duhamel's Integral, Impulse Response function, Virtual work, Lagrange's equation, Single degree freedom forced vibration with elastically coupled viscous dampers, System Identification from frequency response, Transient Vibration, Laplace transformation formulation.

- **TWO DEGREE FREEDOM SYSTEM** **(8 Hours)**
  Free vibration of spring coupled system, Mass coupled system, Vibration of two degree freedom system, Forced vibration, Vibration Absorber, Vibration isolation.

- **MULTI-DEGREE FREEDOM SYSTEM** **(10 Hours)**
  Normal mode of vibration, Flexibility Matrix and Stiffness matrix, Eigen values and eigen vectors, Orthogonal properties, Modal matrix-Modal Analysis, Forced Vibration by matrix inversion, Modal damping in forced vibration, Numerical methods for fundamental frequencies.

- **VIBRATION OF CONTINUOUS SYSTEMS** **(9 Hours)**
  Systems governed by wave equations, Vibration of strings, Vibration of rods, Euler Equation for Beams, Effect of Rotary inertia and shear deformation, Vibration of plates.

- **EXPERIMENTAL METHODS IN VIBRATION ANALYSIS** **(8 Hours)**
  Vibration instruments, Vibration exciters Measuring Devices, Analysis, Vibration Tests: Free and Forced Vibration tests. Examples of Vibration tests : Industrial case studies.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Rao, J.S., & Gupta, K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
3. Den Hartog, J.P, "Mechanical Vibrations," Dover Publications, 1990.
4. Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.
5. Shriniwasan P., "Mechanical Vibration Analysis", Tata McGraw Hill, 1982.

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 786: DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	**3**	**0**	**0**	**3**

- **OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTU ATORS (7 Hours)**
  Hydraulic Power Generators: Selection and Specification of Pumps, Pumps characteristics, Linear and Rotary Actuators: Selection, Specification and characteristics.

- **CONTROL AND REGULATION ELEMENTS (7 Hours)**
  Pressure, Direction and flow control valves, Relief valves, Non-return and safety valves, Actuation systems, Pressure switches.

- **HYDRAULIC CIRCUITS (12 Hours)**
  Reciprocation, Quick return, Sequencing, Synchronizing circuits, Accumulator circuits, Industrial circuits, Press circuits, Hydraulic milling machine, Grinding, planning, copying, Hydraulic lift, Earth mover circuits, Design and selection of components, Safety and emergency mandrels.

- **PNEUMATIC SYSTEMS AND CIRCUITS (12 Hours)**
  Pneumatic fundamentals, Control elements, Position and pressure sensing, Logic circuits, Switching circuits, Fringe conditions modules and these integration, Sequential circuits, Cascade methods, Mapping methods, Step counter method, Compound circuit design, Combination circuit design.

- **INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS (7 Hours)**
  Pneumatic equipments: Selection of components, Design calculations, Application, Fault finding, Hydro pneumatic circuits, Use of microprocessors for sequencing, PLC, Low cost automation, Robotic circuits.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Antony Espossito, “Fluid Power with Applications”, 6th Edition, Prentice Hall, 2002.
2. Dudley A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hal l, 1987.
3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
5. Parr Andrew, “Hydraulic and Pneumatic: A Technical and Engineering’s Guide”, Elsevier, 1999.

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 788: NON -TRADITIONAL OPTIMIZATION TECHNIQUES	**3**	**0**	**0**	**3**

- Principles of optimization, Classification of optimization problems, Formulation of objective function, Constraints **(10 Hours)**

- Single variable and multivariable Optimization, techniques of unconstrained / constrained optimization, Direct and indirect methods **(10 Hours)**

- Multi objective optimization, Simple and complex genetic algorithms, Simulated Annealing technique, Tabu search technique, ant colony algorithms, Fuzzy and neuro-fuzzy algorithms, Particle swarm optimization technique, and Hybrid methods of optimization **(25 Hours)**

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers, 2000.
2. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989.
3. Kalyanamoy Deb, "Optimization for Engineering design algo rithms and Examples", Prentice Hall of India, 1995.
4. Unwubolu Godfrey C. and Babu B.V., “New Optimization Techniques in Engineering”, Springer, 2004.
5. Reklaitis G.V., Ravindran A., and Ragsdell K. M., “Engineering Optimization Methods and applications”, Wiley-Interscience, 1993.

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 792: ADVANCE MECHANISM DESIGN	**3**	**0**	**0**	**3**

- **INTRODUCTION** **(5 Hours)**
  Review of fundamentals of kinematics, Mobility analysis, Formation of one D.O.F. multi loop kinematics chains, Network formula: Gross motion concepts.

- **KINEMATIC ANALYSIS** **(10 Hours)**
  Position Analysis: Vector loop equations for four bar, Slider crank, inverted slider crank, Geared five bar and six bar linkages, Analytical methods for velocity and acceleration Analysis, Four bar linkage jerk analysis, Plane complex mechanisms.

- **PATH CURVATURE THEORY** **(6 Hours)**
  Fixed and moving centroids, Inflection points and inflection circle, Euler Savary equation, Graphical constructions, Cubic of stationary curvature.

- **SYNTHESIS OF MECHANISMS** **(12 Hours)**
  Type synthesis, Number synthesis, Associated Linkage Concept, Dimensional synthesis, function generation, Path generation, Motion generation, Graphical Methods, Cognate linkages, Coupler curve synthesis, Design of six-bar mechanisms. Algebraic methods, Application of instant center in linkage design. Cam Mechanisms, determination of optimum size of Cams.

- **DYNAMICS OF MECHANISMS AND SPATIAL MECHANIS MS & ROBOTICS** **(12 Hours)**
  Static force analysis with friction, Inertia force analysis, combined static and inertia force analysis, Shaking force, Kinetostatic analysis, Introduction to force and moment balancing of linkages, Kinematic Analysis of Spatial RSSR mechanism, Denavit– Hartenberg Parameters. Forward and Inverse Kinematics of Robotic Manipulators, Study and use of Mechanism using Simulation Soft-ware packages.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

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 Asok 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.

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 676: DESIGN OF MATERIAL HANDLIN G EQUIPMENTS	3	0	0	3

- **MATERIALS HANDLING EQUIPMENT** **(2 Hours)**
  Types, Selection and applications.

- **DESIGN OF HOISTS** **(15 Hours)**
  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.

- **DRIVES OF HOISTING GEAR** **(9 Hours)**
  Hand and power drives, Traveling gear, Rail traveling mechanism, Cantilever and monorail cranes, Slewing, Jib and luffing gear, Cogwheel drive, selecting the motor ratings.

- **CONVEYORS** **(9 Hours)**
  Types, Description, Design and applications of Belt Conveyors, Apron Conveyors and Escalators Pneumatic Conveyors, Screw conveyors and vibratory conveyors.

- **ELEVATORS** **(10 Hours)**
  Bucket elevators: design, Loading and bucket arrangements, Cage elevators, Shaft way, Guides, counter weights, Hoisting machine, Safety devices, Design of form lift trucks.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. ASME, “Materials Handling Handbook”, Wiley-Interscience, 1985.
2. Spivakovsy A.O. and Dyachkov, V.K., “Conveying Machines”, Volumes I and II, MIR Publishers, 1985.
3. Alexandrov M., “Materials Handling Equipments”, MIR Publishers, 1981.
4. Tech. P.S.G., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.
5. Chary, S. N, “Production and Operations Management”, Tata McGraw Hill, New Delhi, 2004.

M. Tech (CAD/CAM), Semester - II, Elective - III	L	T	P	C
ME 794: TRIBOLOGY IN DESIGN	**3**	**0**	**0**	**3**

- **SURFACES, FRICTION AND WEAR (12 Hours)**
  Topography of 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.

- **LUBRICATION THEORY (11 Hours)**
  Lubricants and their physical properties lubricants standards, Lubrication Regimes in Hydrodynamic lubrication, Reynolds Equation, Thermal, inertia and turbulent effects, Elasto-hydrodynamic (EHD) magneto hydrodynamic lubrication, Hydro static lubrication, Gas lubrication, Solid lubrication.

- **DESIGN OF FLUID FILM BEARINGS (12 Hours)**
  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 of steady and dynamically loaded journal bearings, Special bearings, Hydrostatic Bearing design.

- **ROLLING ELEMENT BEARINGS (10 Hours)**
  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.

- **TRIBO MEASUREMENT AND INSTRUMENTATION (10 Hours)**
  Surface Topography measurements, Electron microscope and friction and wear measurements, Laser method, Instrumentation, International standards, Bearings performance measurements, Bearing vibration measurement.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED:

1. Cameron A., "Basic Lubrication Theory", Ellis Horwood Ltd., UK, 1981
2. Halling J. (Editor) – "Principles of Tribology ", Macmillian, 1984.
3. Williams J.A., "Engineering Tribology", Oxford Univ. Press, 1994.
4. Neale, M.J., "Tribology Hand Book", Butterworth Heinemann, 1995.
5. Stolarski T.a., "Tribology in Machine Design ", Industrial Press Inc., 1990.

Programme Outcomes (PO)

a) Student will be able to demonstrate knowledge of computer aided design and manufacturing.

b) Student will demonstrate skill of design and analysis for solving engineering problems.

c) Student will exhibit capability of handling laboratory work, experiments and sophisticated instruments for research.

d) Student will be sound enough for simulation and interpretation of results.

e) Student will be efficient in programming for design, manufacturing analysis with methodical advance.

f) Student will show capability to operate CNC and latest machines for manufacturing and research.

g) Student will be effective in handling technical and managerial responsibilities with ethics.

h) Student will be able to solve social economic problems and for challenges in production.

i) Student will exhibit skill of operating high end learning resources and professionalism with ethics.

j) Student will show honesty and decorum in creativity of knowledge and activities.

k) Student will be proficient in communication of technical and research outputs.