SCHEME OF INSTRUCTION

AND

DETAILED SYLLUBUS

of

M.Tech Degree

in

'CAD / CAM'

From 2004-2005

DEPARTMENT OF

MECHANICAL ENGINEERING

[Accredited 'A' grade for 5 years in 2002
and 'A' grade for 3 years in 1999 by NBA, AICTE , New Delhi]

R.V.R.& J.C.COLLEGE OF ENGINEERING

(Sponsored by Nagarjuna Education Society)
(Affiliated to Nagarjuna University :: Approved by AICTE)

Chandramoulipuram,CHOWDAVARAM, GUNTUR-522 019 :: ANDHRA PRADESH

Phones: (0863) 2288254, 2288273, 2232505 Fax: 0863 2350343, 2288274 :: E-mail: rvrjcce @hotmail.com

Scheme of INSTRUCTION and EVALUATION [Semester wise]

FIRST SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	Lecture	Tutorial	Practical		Internal	External		Total
						Theory	Practical	
1.MT/ME511: Computer Graphics	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
2.MT/ME512: CNC & Part Programming	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
3.MT/ME513: CAD	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
4.Mt/ME514: Optimization Techniques	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
5.MT/ME515: Design of Mechanisms & Manipulators	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
6.Mt/ME516: Elective-I A) Computer Aided Process Planning B) Mechanical Vibrations C) Concurrent Engineering	**4**	**--**	**--**	**4**	**30**	**70**	**--**	**100**
7. Mt/ME551: CAD Lab	**--**	**--**	**6**	**2**	**25**	**--**	**50**	**75**
8. Mt/ME552: CAM Lab	**--**	**--**	**6**	**2**	**25**	**--**	**50**	**75**
Total	**24**	**--**	**12**	**28**	**230**	**420**	**100**	**750**

SECOND SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	Lecture	Tutorial	Practical		Internal	External		Total
						Theory	Practical	
1.MT/ME521: Computer Integrated Manufacturing	4	--	--	4	30	70	--	100
2.MT/ME522: Finite Element Analysis	4	--	--	4	30	70	--	100
3.MT/ME523: Fluidics and Control Systems	4	--	--	4	30	70	--	100
4.MT/ME524: Robotics	4	--	--	4	30	70	--	100
5.MT/ME525: Mechatronics	4	--	--	4	30	70	--	100
6.MT/ME526: Elective-II A) Reliability Engg B) Adv. Machine Tool Design C) Adv. Mechanisms Design	4	--	--	4	30	70	--	100
7.MT/ME561: Automation Lab	--	--	6	2	25	--	50	75
8.MT/ME562: Mini Project & Seminar	--	--	6	2	25	--	50	75
Total	**16**	**--**	**12**	**20**	**170**	**280**	**100**	**550**

THIRD SEMESTER & FOURTH SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	Lecture	Tutorial	Practical		Internal	External		Total
						Theory	Practical	
MT/ME651: Major Project	--	--	24	12	50	--	--	50 [end of III sem]
	--	--	24	12	50	--	200	250 [end of IV sem]

MT/ME511: COMPUTER GRAPHICS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. GEOMETRY AND LINE GENERATION: Introduction, Lines, Line segments, Perpendicular Lines, Distance between a point and a Line, Vectors, Pixels and Frame Buffers. **7**

2. GRAPHIC PRIMITIVES: Introduction, Display devices, Primitive operations, The Display-File Interpreter, Normalized Device Coordinates, Display-File structures. **7**

3. POINT PLOTTING TECHNIQUES: Coordinate system, Incremental methods, Line Drawing Algorithms, Circle generators. **5**

4. LINE DRAWING DISPLAYS: The CRT, Inherent-Memory devices, The storage-Tube display, The Refresh Line-Drawing Display. **5**

5. POLYGONS: Introduction to Polygons, Polygon representation, Polygon Interfacing Algorithms, Filling Polygons, Filling with a pattern, Initializing, Anti-aliasing **7**

6. TRANSFORMATIONS: Introduction, Scaling Transformations, Rotation, Homogeneous Coordinates and Translations, Coordinate Transformations, Rotation about an arbitrary point, Inverse Transformations. **7**

7. WINDOWING AND CLIPPING: Introduction, The Viewing Transformation, Viewing transformation implementation, Clipping, The Cohen-Sutherland Algorithm, Clipping of Polygons. **7**

TOTAL NO.OF PERIODS: 45

Reference Books:

1. Procedural elements for Computer Graphics by Rogers.
2. Principles of Interactive Graphics by Newman and Sproull.
3. Computer Graphics by Steven Harrington.

MT/ME512: COMPUTER NUMERICAL CONTROL & PART PROGRAMMING

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION: Basic concepts in manufacturing systems, fundamentals of numerical control, advantages of NC systems, classification of NC systems, point to point and contouring NC systems, incremental and absolute systems, open loop and closed loop systems, encoder, punched tape. **8**

2. FEATURES OF NC MACHINE TOOLS: Fundamentals of machining, design considerations of NC Machine tools, methods of improving machine accuracy, tool deflection and chatter, lead screw, thermal deformations, increasing productivity with NC machines, machining Centres. **7**

3. NC PART PROGRAMMING: Introduction, NC coordinate system, Manual part programming, Codes and concepts, types of tape formats, Tool Length and radius compensation, point to point and contour programming examples, canned cycles, Subroutines, MACROS, simple problems of Drilling, Turning and two-dimensional Milling. **10**

4. COMPUTER AIDED PART PROGRAMMING: advantages of computer aided programming, post processor, APT programming, Geometric statements, motion statements, additional APT statements, simple problems of APT programming. **10**

5. CNC, DNC AND ADAPTIVE CONTROL: Introduction, problems with conventional NC, principles of operation of CNC, features of CNC, advantages of CNC, direct numerical control, types and functions of DNC, advantages of DNC, Adaptive Control machining systems, types, benefits of Adaptive control systems. **10**

TOTAL NO.OF PERIODS: 45

Reference Books:

1. *Numerical Control & Computer Aided Manufacturing – T.K.Kundra, P.N.Rao & N.K.Tewari.*
2. *Computer Aided Manufacturing – T.K.Kundra, P.N. Rao & N. K. Tiwari (T.M.H)*
3. *Computer Control of Manufacturing Systems - Y. Koren*
4. *CAD/CAM - M.P.Groover & E.W.Zimmers.(PHI)*
5. *Automation, Production Systems and CIM – M.P.Groover (P.H.I)*
6. *" CAD / CAM "- PN Rao (PHI)*

MT/ME513: COMPUTER AIDED DESIGN

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION TO CAD SOFTWARE

Writing interactive programs to solve design problems and production of drawings, using any languages like Auto LISP/C/FORTRAN etc., for a] Helical Compression Spring b] Flat belt Drive c] Muff coupling d] Flange coupling e] Spur Gears f] Fly Wheel

Typical Product Cycle, Implementation of a typical CAD process, Applications of CAD and their advantages, creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts) **12**

2. VISUAL REALISM

Hidden - Line - Surface - solid removal algorithms shading - coloring. Introduction to parametric and variational geometry based on softwares and their principles creation of prismatic and lofted parts using these packages. **12**

3. ASSEMBLY OF PARTS

Assembly of parts, Assembly modeling, tolerance analysis mass property calculations, mechanism simulation **11**

4. SOLID MODELING

Solid modeling - Rapid prototyping - Data exchange (IGES & DXF) - Documentation - Customizing - solid modeling system **10**

TOTAL NO OF PERIODS: 45

References:

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

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

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

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

5. " CAD / CAM "- PN Rao (PHI)

MT/ME514: OPTIMIZATION TECHNIQUES

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints -Classification of optimization problems. **5**

2. OPTIMIZATION TECHNIQUES

Single variable and multivariable optimization, Techniques of unconstrained minimization - Golden Section - Random , pattern and gradient search methods -Interpolation methods; optimization with equality and inequality constraints - Direct methods - Indirect methods using penalty functions Lagrange multipliers; Geometric programming and stochastic programming; Multi objective optimization, Genetic algorithms, Simulated Annealing techniques, Neural Networks and Fuzzy Logic. **20**

3. ENGINEERING APPLICATIONS

Structural applications - Design of simple truss members. Design application - design of simple axial, transverse loaded members for minimum cost, maximum weight, - Design of shafts and torsionally loaded members - Design of springs, Dynamic Applications - Optimum design of single, two degree freedom system, vibration absorbers. Application in Mechanism - Optimum design of simple linkage mechanism **20**

TOTAL NO OF PERIODS: 45

Text Books:

1. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd.Publishers, 2000*

References:

1. *Johnson Ray, C., "Optimum design of mechanical elements", John Wiley & Sons, 1981*
2. *Goldberg, D.E., "Genetic algorithms in search, optimization and machine learning", Addison-Wesley, NewYork, 1989*
3. *Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India, 1995*

MT/ME515: DESIGN OF MECHANISMS AND MANIPULATORS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. Mobility analysis – Degree of freedom (DOF), mixed mobility, total, partial and ractional DOF. Closed and open chain systems, structural analysis and synthesis of mechanisms. **7**

2. Alternative design solutions, coding, evaluation and selection of optimum mechanism, type synthesis, number synthesis and design of mechanisms. **8**

3. Indexes of merit, graphical, algebraic and optimization techniques, matrix methods of design and analysis, design of function, path and motion generators, structural and mechanical error, design and analysis using software like ADAMS **15**

4. Manipulators – Classification, actuation and transmission systems, coordinate transformation – DH notations, inverse and forward kinematics, manipulator dynamics from Lagrangian and Newtonian point of view. **15**

TOTAL NO. OF PEROIDS: 45

References:

1. *George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 1, PHI, 1988*
2. *George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 2, PHI, 1988*
3. *Mechanisms & Mechines (Analysis & Syntheis)by Arthur Erdman*
4. *Klafter R.D., Cmielewski T.A. and Negin M ., "Robot Engineering An Intergrated approach", Prentice Hall of India,New Delhi,1994*
5. *Deb S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd.,1994*

MT/ME516 A : COMPUTER AIDED PROCESS PLANNING

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

The Place of Process Planning in the Manufacturing cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Group Technology **5**

2. PART DESIGN REPRESENTATION

Design Drafting-Dimensioning-Conventional Tolerance- Geometric Tolerance-CAD-input/output devices-Topology- Geometric transformation-Perspective transformation-Data Structure-Geometric modeling for process planning--GT Coding-The OPITZ system-The MICLASS System **10**

3. PROCESS ENGINEERING AND PROCESS PLANNING

Experience based planning-Decision table and Decision trees-Process capability analysis-Process planning-Variant process planning-Generative approach-Forward and backward planning, Input format, AI **10**

4. COMPUTER AIDED PROCESS PLANNING SYSTEMS

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 **10**

5. AN INTERGARTED PROCESS PLANNING SYSTEMS

Totally integrated process planning systems-An Overview-Modulus structure-Data Structure-Operation-Report Generation, Expert process planning **10**

TOTAL NO OF PERIODS: 45

References:

1. Gideon Halevi and Roland D. Weill, "Principle of process planning- A Logical Approach", Chapman & Hall, 1995

2. –Chang T. C. & Richard A.Wysk, "An Introduction to automated process planning systems", PrenticeHall1985

3. Chang,T.C., "An Expert Process Planning System", Prentice Hall,1985

4. Nanua Singh, "Systems Approach to Computer Intergrated Design and Manufacturing", John Wiley &Sons,1996

5. Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

Web References:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm

2. http://Estraj.ute.sk/journal/engl-027/027.htm

MT/ME516 B : MECHANICAL VIBRATIONS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. FUNDAMENTALS OF VIBRATION 8

Review of Single degree system - 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.

2. TWO DEGREE OF FREEDOM SYSTEMS 7

Free vibration of spring - coupled system - mass coupled system - Bending vibration of two degree of freedom system - forced vibration - Vibration Absorber - Vibration isolation

3. MULTI-DEGREE OF FREEDOM SYSTEM 12

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.

4. VIBRATION OF CONTINUOUS SYSTEMS 8

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

5. EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 10

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

TOTAL NO OF PERIODS: 45

References:

1. Thomson, W.T. - "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990
2. Rao, J.S., & Gupta, K. - "Introductory Course on Theory and Practice of Mechanical Vibrations", New Age International Ltd., 1984
3. Den Hartog, J.P. "Mechanical Vibrations", Dover Publication, 1990
4. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995

Web References:

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/
3. http://www.vibetech.com/techpaper.htm

MT/ME516 C : CONCURRENT ENGINEERING

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development **5**

2. USE OF INFORMATION TECHNOLOGY

IT support - Solid modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design **5**

3. DESIGN STAGE

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 **7**

4. MANUFACTURING CONCEPTS AND ANALYSIS

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 **14**

5. PROJECT MANAGEMENT

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 **14**

Total No of periods: 45

References:

1. Anderson MM and Hein, L. Berlin, "Integrated Product Development", Springer Verlog, 1987
2. Cleetus, J, "Design for Concurrent Engineering", Concurrent Engg. Research Centre, Morgantown, WV, 1992
3. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", John Wiley and Sons Inc., 1992
4. Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development", Prentice Hall, 1996
5. Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", John Wiley and Sons Inc., 1999

Web Reference:

1. *www.tm.tue.nl/race/ce/ce95.html*

MT/ME551: CAD LAB

Practicals : 6 periods / Week *Sessional Marks : 25*

University Exam : 3 hrs *University Exam Marks : 50*

Exercises will be given on Modeling of mechanical Components using packages like AutoCAD, IDEAS, PRO-ENGINEER, Unigraphics, CATIA, ANSYS, Autodesk INVENTOR, Autodesk MECHANICAL DESKTOP , Gibbs CAD/CAM, IronCAD etc..

1. Creation of working drawings of components and preparation of assembly models of screw
jack, leaf jig, plummer block, lathe chuck, machine-vice, box type drilling jig assembly etc. by using the following techniques:

-Generation of surfaces of revolution
-Generation of surfaces of extrusion
-Generation of surfaces by skinning operation
-Generation of solid models using constructive solid geometry, method shading and rendering

2. Generation of Ferguson's cubic surface patches, Generation of Bezier UNISURF surface
patches, Generation of Coon's patches.

3. Finite element modeling of two dimensional problems in heat transfer, plane elasticity, viscous fluid flow, etc.,

4. Finite element analysis of time dependent problems in incompressible viscous fluid flow,
heat transfer, plane elasticity, etc.,

5. Familiarization of available artificial intelligence interpreters and compilers.

6. Familiarization with file inquiry, access to data sorting & indexing.

7. Exercises in database management, Familiarization with multiple file operations and preparation of various reports with respect to CIM.

TOTAL NO OF PERIODS: 30

MT/ME552 : CAM LABORATORY

Practicals : 6 periods / Week *Sessional Marks : 25*

University Exam : 3 hrs *University Exam Marks : 50*

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. Integration of CAD/CAM.

TOTAL NO OF PERIODS: 30

MT/ME521: COMPUTER INTEGRATED MANUFACTURING

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems-analysis of manufacturing operations **5**

2. COMPUTER AIDED PLANNING AND CONTROL 10

Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology-automated data collection system

3. COMPUTER MONITORING 10

Types of production monitoring systems-structure model of manufacturing process-process control & strategies-direct digital control-supervisory computer control-computer in QC - contact inspection methods, non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM

4. INTEGRATED MANUFACTURING SYSTEM. 3

Definition - application - features - types of manufacturing systems-machine tools-materials handling system-computer control system - DNC systems manufacturing cell Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM

5. MATERIAL HANDLING IN MANUFACTURING SYSTEMS 7

Material handling function, Types of material handling equipment, AGV Systems, Automated Storage/ Retrieval Systems, Interfacing handling and storage with Manufacturing

TOTAL NO OF PERIODS: 45

Text Books:

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.

References:

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi,
2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.
6. PN RAO , " CAD/CAM ", (PHI)

MT/ME522 : FINITE ELEMENT ANALYSIS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. 1D FINITE ELEMENT ANALYSIS

Historical Background - Weighted Residual Methods - Basic Concepts of FEM - Variational Formulation of B.V.P - Ritz Method - Finite Element Modeling - Element Equations - Linear and Quadratic Shape functions - Bar, Beam Elements - Applications to Heat Transfer. **5**

2. FINITE ELEMENT ANALYSIS OF 2D PROBLEMS

Basic Boundary Value Problems in 2 Dimensions - Triangular, quadrilateral, higher order elements - Poisson's and Laplace Equations - Weak Formulation - Elements Matrices and Vectors - Application to Solid mechanics, Heat transfer, Fluid Mechanics. **10**

3. ISO PARAMETRIC FORMULATION

Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements - Formulation - Numerical Integration - 1D -2D Triangular elements - rectangular elements - Illustrative Examples. **10**

4. SOLUTION TO PLANE ELASTICITY PROBLEMS

Introduction to Theory of Elasticity - Plane Stress - Plane Strain and axi-symmetric Formulation - Principle of virtual work - Element matrices using energy approach **8**

5. SPECIAL TOPICS

Dynamic Analysis - Equation of Motion - Mass Matrices - Free Vibration analysis - Natural frequencies of Longitudinal - Transverse and torsional vibration - Introduction to transient field problems. Non linear analysis - Use of software - h & p elements - special element formulation **12**

TOTAL NO OF PERIODS: 45

Text Books:

1. Reddy J.N. "An Introduction to the Finite Element Method", Mc Graw Hill, International Edition, 1993

References:

1. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984
2. Rao S.S., "Finite Element Method in Engineering" , Pergamon Press, 1989
3. Chandrupatla & Belagundu , "Finite Elements in Engineering", P HI Pvt Ltd., 1997
4. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons,1999
5.George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994

MT/ME523 : FLUIDICS & CONTROL SYSTEMS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. OIL HYDRAULIC SYSTEMS

Hydraulic power generators-selection and specification of pumps, pump characteristics **2**

2. HYDRAULIC ACTUATORS

Linear and Rotary Actuators-Selection, Specification and Characteristics **2**

3. CONTROL AND REGULATION ELEMENTS

Pressure-direction and flow control valves-relief valves, non return and safety valves-actuation systems **12**

4. HYDRAULIC CIRCUITS

Reciprocation, quick return, Sequencing synchronizing circuits-accumulator circuits-industrial circuits-press circuits-hydraulic milling machine-grinding, planning, copying, forklift, earth mover circuits-design and selection of components-safety and emergency mandrels. **4**

5. PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals-control elements position and pressure sensing-logic circuits-switching circuits-fringe condition modules and their integration- sequential circuits-cascade methods-mapping methods- step counter method-compound circuit design-combination circuit design. **18**

6. INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

Pneumatic equipments-selection of components-design calculations-application-fault finding-hydro pneumatic circuits-use of microprocessors for sequencing-PLC-Low cost automation-Robotic circuits. **7**

TOTAL NO OF PERIODS: 45

References:

1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987
3. Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999
4. Bolton. W. "Pneumatic and Hydraulic systems", Butterworth - Heinneman, 1997

Web References:

1. http:// www.pneumatics.com
2. http:// www.fluidpower.com.tw

MT/ME524 : ROBOTICS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-Material Handling-Processing-Assembly and Inspection -Safety considerations **6**

2. TRANSFORMATIONS AND KINEMATICS

Vector operations-Translational transformations and Rotational transformations-Properties of transformation matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution **12**

3. CONTROLS AND END EFFECTORS

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 **10**

4. ROBOT PROGRAMMING **7**

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

5. SENSORY DEVICES

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 **10**

TOTAL NO OF PERIODS: 45

References:

1. Fu K.S.,Gonzalez R.C.., Lee C.S.G., "Robotics control,sensing,vision,and Intelligence", McGraw Hill Book Co.,,1987

2. Klafter R.D., Cmielewski T.A. and Negin M ., "Robot Engineering An Intergrated approach", Prentice Hall of India,New Delhi.2,1994

3. Deb S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd.,1994

4. Craig J.J., "Introduction to Robotics Mechanics and Control", Addison Wesley,1999

5. Groover M.P., "Industrial robotics Technology,programming and applications", McGraw Hill Book Co.,1995.

Web Reference:

1. http://www.robotics.com

MT/ME525 : MECHATRONICS

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION

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

2. SENSORS AND TRANSDUCERS

Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors-Signal processing-Servo systems **12**

3. MICROPROCESSORS IN MECHATRONICS

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

4. PROGRAMMABLE LOGIC CONTROLLERS

Introduction-Basic structure-input/output processing-programming-Mnemonics Timers, Internal relays and counters-Data handling-Analog input/output-Selection of PLC. **8**

5. DESIGN AND MECHATRONICS

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

Total No of periods: 45

References:

1. Bolton.W ,"Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering" Addison Wesley Longman,1999

2. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems",McGraw Hill International Editions,1999

3. Bradley, D.A.,. Dawspn, D, Buru, N.C. and Loader, AJ., "Mechatronics", Chapman and Hall,1993

4. Ramesh,S,Gaonkar, "Micrprocessors Architecture, Programming and Applications", Wiley Eastern,1998

5. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics", Prentice Hall 2000.

6. Ghosh,P.K. and Sridhar, P.R., 8000 to 8085 " Introduction to Micrprocessors for Engineers and Scientists"Second Edition, Prentice Hall, 1995.

Web Reference:

1. http://www. cs. indiana.edu.

MT/ME526 A : RELIABILITY ENGINEERING

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. RELIABILITY CONCEPT

Reliability function - failure rate - Mean time between failures (MTBF) - Mean time to failure (MTTF) – a priori and a posteriori concept - mortality curve - useful life availability - maintainability – system effectiveness **7**

2. RELIABILITY DATA ANALYSIS

Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting **10**

3. RELIABILITY PREDICTION MODELS

Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations. **12**

4. RELIABILITY MANAGEMENT

Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs –Reliability allocation - Replacement model **10**

5. RISK ASSESSMENT

Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment. **6**

TOTAL NO OF PERIODS: 45

References:

1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.
2. John Davidson, " The Reliability of Mechanical system ", published by the Institution of Mechanical Engineers, London, 1988.
3. Smith C.O." Introduction to Reliability in Design ", McGraw Hill, London, 1976.

MT/ME526 B : ADVANCED MACHINE TOOL DESIGN

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION 5

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

2. DESIGN OF MACHINE TOOLS, SPINDLES, FRAMES, SLIDEWAYS 20

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

3. DESIGN OF DRIVES AND CONTROL MECHANISMS 16

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

4. TESTING AND STANDARDISATION 4

Acceptance tests and standardisation of machine tools - machine tools reconditioning

TOTAL NO OF PERIODS: 45

References:

1. Mehta,N.K.,"Machine Tool design",Tata McGraw Hill, 1989

2. Koenisberger,F., "Design Principles of Metal cutting Machine Tools",Pergamon Press, 1964.

3. Acherkan,N.,"Machine Tool Design",Vol.3&4,MIR Publishers,Moscow, 1968

4. Sen.G. and Bhattacharya,A.,"Principles of Machine Tools",Vol.2,NCB.Calcutta, 1973

MT/ME526 C : ADVANCED MECHANISMS DESIGN

Lecturers : 4 periods / Week *Sessional Marks : 30*

University Exam : 3 hrs *University Exam Marks : 70*

1. INTRODUCTION 5

Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematic chains, network formula – Gross motion concepts.

2. KINEMATIC ANALYSIS

Position Analysis – vector loop equations for four bar, slider crank, inverted slider crank, geared five bar, and six bar linkages. Analytical solutions for velocity and acceleration analysis – human tolerance for acceleration – four bar linkage jerk analysis. Plane complex mechanisms – auxiliary point method **5**

3. PATH CURVATURE THEORY

Fixed and moving centroids, inflection points and inflection circle, Euler savary equation, graphical constructions – cubic stationary curvature. **6**

4. SYNTHESIS OF MECHANISMS

Type synthesis – case study of casement window mechanisms Number synthesis – Associated linkage concept Dimensional synthesis – function generation, path generation, motion generation - Graphical methods – two, three positions, circle point and centre point circles – order synthesis of four bar function generation – four positions, special cases of four position synthesis – Finite Ball's point – five positions – cognate linkages, geared five bar and parallelogram six bar cognates, six bar parallel motion generator – coupler curve synthesis, design of six bar mechanisms for different applications including dwell. Algebraic methods – using vector loop equations and complex algebra, synthesis of multi loop linkage mechanisms, geared linkages, application of instant centre in linkage design. Practical considerations in mechanism design, mechanism defects. **12**

5. DYNAMICS OF MECHANISMS

Static force analysis with friction – inertia force analysis – slider crank mechanism, four bar mechanism, crank – shaper mechanism – combined static and inertia force analysis, shaking force, kinetostatic analysis of a card bunch – time response of a four bar linkage, modification of the time response of a mechanism – virtual work. Introduction to force and moment balancing of linkages **7**

6. SPATIAL MECHANISMS AND ROBOTICS

Kinematic analysis of spatial RSSR mechanism – Denavit - Hartenberg parameters - Forward and inverse kinematics of robotic manipulators **4**

7. STUDY AND USE OF MECHANISM SOFTWARE PACKAGES 6

TOTAL NO OF PERIODS: 45

Reference books:

1. *Sandor G.N, and Erdman A.G. Advanced Mechanism Design : Analysis and Syntheis, PHI, 1984.*
2. *Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, EWLP, Delhi, 1994*
3. *Shigley, J.e., and Vicker, J.J. Theory of Mechanisms, McGrawHill, 1995.*
4. *Norton R.L. Design of machinery, McGrawHill, 1992.*

ME561 : AUTOMATION LAB

Practicals : 6 periods / Week *Sessional Marks : 25*

University Exam : 3 hrs *University Exam Marks : 50*

1. Robot.
2. Simulation of a Manufacturing System.
3. Flow Force analysis.
4. Simulation of Linear and Rotary actuators.
5. Programming of Micro Processors using 8085 instructions.
6. Programming of Mechatronics system.
7. Programmable logic controller.

TOTAL NO. OF PERIODS: 30

ME562 : MINI PROJECT / SEMINAR

Periods : 6 periods / Week *Sessional Marks : 25*

University Exam : 3 hrs *University Exam Marks : 50*

III & IV SEMESTERS

ME651 :: MAJOR PROJECT

Periods : 24 periods / Week *Sessional Marks : 100*

50 [at the end of III semester]

50 [at the end of IV semester]

University Exam : Viva-voce *University Exam Marks : 200*