Scheme of INSTRUCTION and EVALUATION [Semester wise]

FIRST SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	L	T	P		Internal	External		Total
						Theory	Practical	
1.MECC1001: Optimization Techniques	4	--	--	4	40	60	--	100
2. MECC1002: Computer Graphics	4	--	--	4	40	60	--	100
3. MECC1003: CNC & Part Programming	4	--	--	4	40	60	--	100
4. MECC1004: Computer Aided Design	4	--	--	4	40	60	--	100
5. MECC1005: Elective I	4	--	--	4	40	60	--	100
6. MECC1006: Elective-II	4	--	--	4	40	60	--	100
7. MECC1051: CAD Lab	--	--	3	2	25	--	50	75
8. MECC1052: CAM Lab	--	--	3	2	25	--	50	75
Total	**24**	**--**	**6**	**28**	**290**	**360**	**100**	**750**

Elective I: A) Computer Aided Process Planning
B) Advances in Manufacturing Technology
C) Concurrent Engineering

Elective II: A) Mechanics & Manufacturing methods of composites
B) Nano Technology
C) Design for Manufacturing

SECOND SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	L	T	P		Internal	External		Total
						Theory	Practical	
1.MECC2001: Computer Integrated Manufacturing	4	-	-	4	40	60	--	100
2. MECC2002: Finite Element Analysis	4	-	-	4	40	60	--	100
3. MECC2003: Fluidics and Control Systems	4	-	-	4	40	60	--	100
4. MECC2004: Mechatronics	4	-	-	4	40	60	--	100
.5. MECC2005: Elective-III	4	-	-	4	40	60	--	100
.6. MECC2006: Elective-IV	4	-	-	4	40	60	--	100
.7. MECC2051: Automation Lab	-	-	3	2	25	--	50	75
.8. MECC2052: Mini Project & Seminar	-	-	3	2	25	--	50	75
Total	**24**	**-**	**6**	**28**	**290**	**360**	**100**	**750**

Elective III: A) Rapid Prototyping
B) Advanced Machine Tool Design
C) Robotics

Elective IV: A) Reliability Engineering
B) Mechanical Vibrations
C) Advanced Mechanisms Design

THIRD SEMESTER & FOURTH SEMESTER:

Name of the Subjects	Hrs/Week			Credits	Evaluation (marks)			
	Lecture	Tutorial	Practical		Internal	External		Total
						Theory	Practical	
MECC3051: Major Project	--	--	24	---	50	--	--	50 [end of III sem]
	--	--	24	24	50	--	200	250 [end of IV sem]

MECC1001: OPTIMIZATION TECHNIQUES

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT I

Linear Programming: Two-phase simplex method, Big-M method, duality, interpretation.
Integer Programming: Branch and bound method, Gommary cut plane method.

UNIT II

Assignment Problem: Hungarian's algorithm, Maximization Problem, unbalanced problems.
Dynamic Programming: Introduction, Recursive Relationship, Dynamic Programming Algorithm, Applications to linear programming.

UNIT III

Numerical Methods For Optimization: Interval halving method, Fibonacci method, Quadratic interpolation method, Newton method, Quasi Newton method, Secant method, Simmulated Annealing.
Particle Swarm Optimization
Genetic Algorithm (GA): 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.

UNIT IV

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.
Classical Optimization Techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Text Books:

1. *Engineering Optimization – S.S. Rao, New Age Publishers*
2. *Operations Research – Kanti swaroop, Gupta P K & Manmohan*
3. *Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers*

Referencess:

1. *Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers*
2. *Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers*
3. *Genetic Programming- Koza*
4. *Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers*

MECC1002: COMPUTER GRAPHICS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

Geometry and Line Generation: Introduction, Lines, Line segments, Perpendicular Lines, Distance between a point and a Line, Vectors, Pixels and Frame Buffers.

Graphic Primitives: Introduction, Display devices, Primitive operations, The Display-File Interpreter, Normalized Device Coordinates, Display-File structures.

UNIT - II

Point Plotting Techniques: Coordinate system, Incremental methods, Line Drawing Algorithms: DDA algorithm, Bresenham's line drawing algorithm: Circle generators.

Line Drawing Displays: Introduction, Principles of CRT, LCD display systems, Inherent-Memory devices, the storage-Tube display, The Refresh Line-Drawing Display.

UNIT -III

Polygons: Introduction to Polygons, Polygon representation, Polygon Interfacing Algorithms, Filling Polygons, Filling with a pattern, Initializing, Anti-aliasing

Windowing: Introduction, The Viewing Transformation, Viewing transformation implementation

UNIT - IV

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

Clipping: Clipping, the Cohen-Sutherland Algorithm, Clipping of Polygons.

Text Book:

Computer graphics by Steven Harrington

Reference Books:

1. Procedural elements for Computer Graphics by Rogers.

2. Principles of Interactive Graphics by Newman and Sproull.

MECC1003: COMPUTER NUMERICAL CONTROL AND PART PROGRAMMING

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

Introduction: Fundamental concepts in Manufacturing and Automation, types of Automation, 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.

UNIT - II

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.

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.

UNIT – III

NC Part Programming (Contd.): Canned cycles, Subroutines, MACROS, simple problems of Drilling, Turning and two-dimensional Milling.

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**.**

UNIT – IV

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.

Text Book:

1. *Automation, Production Systems and CIM – M.P.Groover (P.H.I).*
2. *Computer Control of Manufacturing Systems - Y. Koren*

Reference Books:

1. *CAD/CAM – M.P.Groover & E.W.Zimmers.(PHI)*
2. *"CAD / CAM " – PN Rao (PHI).*
3. *Numerical Control & Computer Aided Manufacturing – T.K.Kundra, P.N.Rao & N.K.Tewari.*
4. *Computer Aided Manufacturing – T.K.Kundra, P.N.Rao & N.K. Tiwari(T.M.H).*

MECC1004: COMPUTER AIDED DESIGN

Lectures:	*4 Periods / Week*	*Internal Assessment: 40*	
Final Exam:	*3 hrs*	*Final Examination: 60*	
Credits	*4:*		

UNIT-I

Introduction to CAD: Fundamentals of CAD, Applications of computer for design, benefits of CAD, design work station, graphics terminal, product cycle, input / output devices, Transformations-(translation, rotation, scaling & mirror)

UNIT-II

Geometric Modeling: Parametric equations of line, circle, ellipse, cubic spline, Bezier curve, B-spline curve.

Surfaces: Coon's surface, Bezier surface, B-spline surface, Surfaces of revolutions, Sweep surfaces, Tabulated cylinder.

UNIT-III

Visual Realism: Introduction, Hidden line removal algorithm - the priority algorithm; hidden surface algorithm- z-buffer algorithm; shading technique- Gourant shading & Phong shading; Coloring technique.

UNIT-IV

Assembly of Parts: Introduction, assembly modeling: part modeling representation, Hierarchical relationship, mating conditions; Generation of assembly sequence: Precedence diagram, liaison sequence analysis.

Text book:

1. *CAD/CAM – Theory & Practice, Ibrahim Zied, Mc Graw Hill, International edition*
2. *CAD/CAM, Mikel P Groover & W Zimmers Jr*

References:

1. *CAD/CAM, P.N.Rao (PHI)*
2. *Procedural elements for Computer Graphics by Rogers.*
3. *Principles of Interactive Graphics by Newman and Sproull.*
4. *CAD/CAM concepts & applications, Chennakesava R. Alavala,(PHI)*

MECC1005 A: COMPUTER AIDED PROCESS PLANNING

Lectures: 4 Periods / Week *Internal Assessment: 40*

Final Exam: 3 hrs *Final Examination: 60*

Credits: 4

UNIT - I

Introduction: The Place of Process Planning in the Manufacturing cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Structure of Automated process planning system, Group Technology.

UNIT - II

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.

UNIT - III

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.

UNIT - IV

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

An Integrated Process Planning Systems: Expert process planning, Totally integrated process planning systems.

Text books:

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

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

References:

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

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

3. Automation, Production systems and Computer Integrated Manufacturing System –Mikell P.Groover

4. Computer Aided Engineering – David Bed worth

Web References:

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

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

MECC1005 B: ADVANCES IN MANUFACTURING TECHNOLOGY

Lectures: 4 Periods / Week *Internal Assessment: 40*

Final Exam: 3 hrs *Final Examination: 60*

Credits: 4

UNIT - I

Welding Processes: Fusion and Solid state welding process, Automation in Welding, Design aspects of welds, Weld ability of aluminum alloys, titanium alloys, Non destructive testing of welds, Residual stresses and distortion in weldments.

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT – II

Un-Conventional Machining Methods-I:

Abrasive jet machining - Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT – III

Un-Conventional Machining Methods-II:

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.

Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT - IV

Un-Conventional Machining Methods-III:

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes.

Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.

Text Books:

1. Manufacturing Technology - P. N. Rao, TMH Publishers
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers

References:

1. Production Technology - HMT
2. Manufacturing Science - Cambel
3. Welding Technology - R.S, Parmar

MECC1005 C: CONCURRENT ENGINEERING

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

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

Use Of Information Technology: IT support - Solid modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design

UNIT - II

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

UNIT - III

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

UNIT - IV

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

Text Books:

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*

References:

1. *Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", John Wiley and Sons Inc., 1992*
2. *Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development", Prentice Hall, 1996*
3. *Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", John Wiley and Sons Inc., 1999*

Web Reference:

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

MECC1006A: MECHANICS AND MANUFACTURING METHODS OF COMPOSITES

Lectures:	*4 Periods / Week*	*Internal Assessment: 40*	
Final Exam:	*3 hrs*	*Final Examination: 60*	
Credits:	*4*		

UNIT: I

Basic Concepts and Characteristics: Geometric and Physical definitions, Classification and characteristics of composite materials, Mechanical behaviour of composite materials, Advantages and limitations of composite materials, Current and potential usage of composite materials.

UNIT: II

Reinforcements And Fabrication Of Composites: Different reinforcing fibers, Matrix materials, fabrication of thermosetting resin matrix composites, fabrication of thermoplastic resin matrix composites, fabrication of metal matrix composites, fabrication of ceramic matrix composites

UNIT: III

Coordinate Transformations: Hooke's law for different types of materials, Transformation of stress and strain.

Elastic Behavior of Unidirectional Composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

UNIT: IV

Strength of Unidirectional Lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design.

Text Books:

1. *Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.*
2. *B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.*

Reference:

1. *R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.*
2. *L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.*

MECC1006 B: NANO TECHNOLOGY

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT-I

Introduction: Size and shape dependence of material properties at the nanoscale, why is small good? Limits to smallness, scaling relations, can nanorobots walk and nanoplanes fly? Nanoscale elements in conventional technologies

Top-Down and Bottom-Up Nanofabrication: The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: nanoimprinting and micro contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT-II

Self Assembly And Self-Organization: Functional coatings with self assembled monolayers of molecules and nanoparticles Langmuir- Blodgett films, layer-by-layer growth.

Imaging/Characterization of Nanostructures: General considerations for imaging, scanning probe techniques: SEM, STM, AFM, and NSOM.

UNIT-III

Metal And Semiconductor Nanoparticles: Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nanoparticles, bioengineering applications, Catalysis.

Semiconductor And Metal Nanowires: Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT-IV

Carbon Nanotubes: Structure and synthesis, Electronic, vibrational, and mechanical properties, how can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

Mechanics at Nanoscale: Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nanomachines, Nanofluidics, filtration, sorting, Molecular motors

Text Books:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)

2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

References:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).

2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006).

MECC1006C: DESIGN FOR MANUFACTURING

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability basic principles of designing for economical production-creativity in design. Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT - II

Machining Processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts. Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design product design rules for sand casting.

UNIT - III

Metal Joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – IV

Extrusion & Sheet Metal Work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components design considerations for injection moulding – design guidelines for machining and joining of plastics.

Text Books:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

Reference Books:

1. ASM Hand book Vol.20

MECC1051: CAD LAB

Practicals: 3 periods / Week *Internal Assessment: 25*

Final Exam: 3 hrs *Final Examination: 50*

Credits: 2

1. Development of line drawing algorithms using Open GL software
2. Modeling using solid modeling packages

   (PRO-E/CATIA/IDEAS/UG/ INVENTOR/MDT)

   a) Solid Modeling, Part Modeling and Assembly of I/C Engine Components, Other Mechanical Components like Stuffing box, Screw jack, Pipe vice etc.

   b) Kinematics of Mechanisms

3. Finite Element Analysis using analysis packages

   (ANSYS/NISA/NASTRAN/ABAQUS)

   For different structures that can be described with 1-D, 2-D & 3-D elements to perform the following analysis:

   a) Static Analysis.

   b) Dynamic Analysis.

   c) Thermal Analysis.

   d) Coupled Analysis.

   e) Buckling Analysis.

   f) Analysis of Composite Structure.

   g) Case Studies.

MECC1052: CAM LABORATORY

Practicals: 3 periods / Week *Internal Assessment: 25*

Final Exam: 3 hrs *Final Examination: 50*

Credits: 2

LATHE

1. Step turning
2. Taper and profile turning

MILLING

3. Linear and circular interpolation
4. Mirror imaging
5. Circular Pocketing
6. Rectangular Pocketing
7. Drilling
8. Cutter radius left compensation
9. Cutter radius right compensation

MECC2001: COMPUTER INTEGRATED MANUFACTURING

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT – I

Introduction: Definition of Automation, Need for Automation, Advantages and Disadvantages of Automation, Types of Production, Functions in manufacturing, Automation Strategies, Introduction to CAD, Applications of Computers in Design, Introduction to CAM, Manufacturing Planning and control, Fundamentals of computer Integrated Manufacturing.

UNIT – II

Group Technology: Introduction, Part families, Parts classification and coding (OPITZ & MULTI CLASS), Production flow analysis, Machine cell design, Types of cell design, Benefits of Group Technology.

Robotics: Robot anatomy, Robot Configuration, Basic Robot motions, Types of drivers, End effectors.

UNIT – III

Flexible Machine Systems: What is FMS, FMS Workstations, Materials Handling and storage system, Computer Control System, Planning the FMS, Applications and Benefits.

Automated Material Handling: Introduction, Types of material handling equipment, automated guided vehicle system (AGVS), Applications, Vehicle guidance and routing, Traffic control and safety, System management.

UNIT – IV

Automated Storage Systems (As): Storage systems performance, Automated storage / Retrieval systems (AS / RS), Basic components of AS /RS, AS / RS controls, Special features, applications.

Automated Inspection & Testing: Automated inspection principles and methods, sensor technologies for automated inspection, Co-ordinate measuring machines (CMM), construction, operation & programming, CMM benefits and trends. Introduction to machine vision & non contact inspection methods.

Text book:

Automation, Production and Computer Integrated Manufacturing – by M.P.Groover (PHI).

Reference books:

1. *CAD/CAM - Mikell P.Groover, and Emory W.Zimmers.Jr. PHI Publishers*

2. *Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers*

3. *CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers*

MECC2002: FINITE ELEMENT ANALYSIS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT I

Analysis of Trusses, Beams and Frames: Introduction, Space truss element, Beam element, Space Frame element, Planar Frame element.

UNIT II

Analysis of Plates: Introduction, Triangular membrane element, Bending behavior of plates, Finite Element Analysis of plate bending, Triangular plate bending element.

UNIT III

Analysis of Three-dimensional problems: Introduction, Tetrahedron element, Hexahedron element, Analysis of solids of revolution.

UNIT IV

Dynamic Analysis: Dynamic equations of motion, consistent and lumped mass matrices, Consistent mass matrix of a space truss, space frame, planar frame, beam, triangular membrane, triangular bending, and tetrahedron elements.

Free vibration Analysis: longitudinal vibrations of a stepped bar, Dynamic response using FEM.

Text Book*:*

1. The Finite Element Method in Engineering – S. S. RAO, Butterworth-Heinemann publications.

References:

1. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor, McGraw-Hill.
2. J. N. Reddy, Finite Element Method.
3. Concepts and applications of Finite Element Analysis – R. D. COOK;Wiley-Eastern.

MECC2003: FLUIDICS & CONTROL SYSTEMS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT-I

Oil Hydraulic Systems: Introduction, Hydraulic power generators-selection and specification of pumps, pump characteristics

Hydraulic Actuators: Linear and Rotary Actuators-Selection, Specification and Characteristics

UNIT-II

Control and Regulation Elements: Pressure-direction and flow control valves-relief valves, servo and proportional valves

UNIT-III

Hydraulic Circuits: Reciprocation, quick return, sequencing and synchronizing circuits-accumulator circuits-industrial circuits-punching press circuit-hydraulic milling machine, shaper, forklift, safety circuits and selection of components.

Pneumatics: Basic Pneumatic system, Pneumatic valves, pneumatic circuits – Basic circuit, speed control circuit, Two step feed control circuit, Time delay circuit and selection of components.

UNIT-IV

Pneumatic Logic Controls: Position and pressure sensing-logic and switching circuits - sequential circuits

Design of pneumatic logic circuits: Classic methods cascade methods- step counter method-mapping method -combination circuit design.

Maintenance: Fault finding-hydro pneumatic circuits-use of microprocessors for sequencing-PLC-Low cost automation-Robotic circuits.

Textbook:

1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. R Srinivasulu,"Hydraulic Pneumatic Controls", 2nd edition, TMH, 2009

References:

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

Web References:

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

MECC2004: MECHATRONICS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

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

Microprocessors: Microprocessors, Control, Microprocessor systems, Architecture, Intel 8085A architecture.

UNIT - II

Sensors and Transducers: Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors-Signal processing.

UNIT - III

Programmable Logic Controllers: Introduction, Basic structure, input/output processing, programming, Mnemonics Timers, Internal relays and counters. Data handling.- Analog input/ output, D/A Converters and A/D Converters, Selection of PLC.

UNIT – IV

Design and Mechatronics: Designing, possible design solutions- Timed switch, wiper mechanism, Case studies of Mechatronics systems- Pick and place robot, Car park barrier, Automatic camera, Temperature control, Traffic light controller.

Text book:

1. *Bolton. W ,"Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering" Pearson Education*

References:

1. *Bradley, D.A.,. Dawspn, D, Buru, N.C. and Loader, AJ., "Mechatronics", Chapman and Hall,1993*
2. *Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw Hill International Editions,1999*
3. *Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics", Prentice Hall 2000.*

Web Reference:

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

MECC2005 A: RAPID PROTOTYPING

Lectures: 4 Periods / Week *Internal Assessment: 40*

Final Exam: 3 hrs *Final Examination: 60*

Credits: 4

UNIT-I

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.

Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

UNIT II

Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.

Solid ground curing: Principle of operation, Machine details, Applications,

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.

UNIT -III

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

Laser Engineering Net Shaping (LENS)

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

UNIT IV

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

Allied Process: Vacuum casting, surface digitizing, and Surface generation from point cloud, Surface modification- Data transfer to solid models.

Text books:

1. Paul F.Jacobs – "stereo lithography and other RP & M Technologies", SME, NY 1996
2. Flham D.T & Din joy S.S – "Rapid Manufacturing "Verlog London 2001
3. Lament wood, "Rapid automated ", Indus Press New York.

MECC2005 B: ADVANCED MACHINE TOOL DESIGN

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

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

UNIT - II

Design Of Machine Tools, Spindles, Frames, Slide ways: 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 slide ways. Concepts of aesthetics and ergonomics applied to machine tools, latest trends in Machine Tool Design, Introduction to CAD techniques

UNIT - III

Design of Drives and Control Mechanisms: 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 - IV

Testing And Standardization: Acceptance tests and standardization of machine tools - machine tools reconditioning

Text Book:

1. Mehta,N.K.,"Machine Tool design",Tata McGraw Hill, 1989
2. Koenisberger,F., "Design Principles of Metal cutting Machine Tools",Pergamon Press, 1964.

References:

1. Acherkan,N.,"Machine Tool Design",Vol.3&4,MIR Publishers,Moscow, 1968
2. Sen.G. and Bhattacharya,A.,"Principles of Machine Tools",Vol.2,NCB.Calcutta, 1973

MECC2005 C: ROBOTICS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT - I

Introduction: 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: Vector operations-Translational transformations and Rotational transformations-Properties of transformation matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution- Denavit-Hartenberg (D-H) representation of forward kinematic equations of robots.

UNIT - III

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

UNIT - IV

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

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

***Text books**:*

1. *Groover M.P., "Industrial robotics Technology, programming and applications", McGraw Hill Book Co., 1995.*
2. *Craig J.J., "Introduction to Robotics Mechanics and Control", Addison Wesley, 1999*
3. *Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI Publications*

***References**:*

1. *Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd., 1994*
2. *Fu K.S., Gonzalez R.C.., Lee C.S.G., "Robotics control, sensing, vision, and Intelligence", McGraw Hill Book Co., 1987*
3. *Klafter R.D., Cmielewski T.A. and Negin M., "Robot Engineering An Integrated approach", Prentice Hall of India, New Delhi.2, 1994*

Web Reference:

1. *http://www.robotics.com*

MECC2006 A : RELIABILITY ENGINEERING

Lectures: 4 Periods / Week *Internal Assessment: 40*

Final Exam: 3 hrs *Final Examination: 60*

Credits: 4

UNIT-I
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.

UNIT-I
Reliability Data Analysis: Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques.
UNIT-III
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.

UNIT-IV
Reliability Management: Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs –Reliability allocation - Replacement model.

Text Book:
1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.

References:
1. John Davidson, " The Reliability of Mechanical system ", published by the Institution of Mechanical Engineers, London, 1988.
2. Smith C.O." Introduction to Reliability in Design ", McGraw Hill, London, 1976.

MECC2006 B: MECHANICAL VIBRATIONS

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT I

Fundamentals of Vibration: Introduction, Importance of study of vibrations, Classifications of vibrations, Harmonic motion, Definitions and Terminology, Harmonic analysis, Modes of vibrations.

Single-degree of freedom Systems with out Damping: Introduction, Free vibrations with out damping: Newton's laws of motion, Energy method, Rayleigh's method, Equivalent stiffness of spring combination, Torsional systems .

UNIT II

Single-degree of freedom Systems with Damping: Logarithmic decrement, Coulomb damping, Harmonically exited vibrations: Rotor unbalance, Critical speeds of rotating shafts with and without damping, Reciprocating unbalance, Support motion, vibration isolation, Transmissibility.

Two-degree of Freedom Systems: Introduction, Normal mode of vibration, undamped vibration, Undamped forced vibration, Coordinate coupling, Semi-definite system, Torsionally equivalent shafts, Undamped Dynamic vibration absorber, Centrifugal pendulum absorber.

UNIT III

Multi-degree Freedom systems: Introduction, Influence coefficients, Orthogonality principle, Matrix iteration method, Rayleigh's method of approximation, Dunkerley's method of approximation, Stodola's method, Holzer's method, Torsional vibration of multi-rotor system.

UNIT IV

Continuous systems: Introduction, Vibration of strings, Longitudinal vibrations of Rod or bars, Torsional vibration of Rod, Lateral vibration of beam.

Non-linear Vibrations: Introduction, Difference between linear and non linear vibrations, Superposition principle, Examples: Simple pendulum, Vibrating string, Hard and soft spring, Abrupt non-linearity.

Text Books:

1. *Theory and application of Mechanical Vibrations:*
   William.W.Seto, McGrawHill, Schaum's outline series, Singapore.
2. *Theory and application of Mechanical Vibrations:*
   Dilip Kumar Adhwarjee, Laxmi publications (P) Ltd, Boston, USA

References:

1. *Mechanical Vibrations: V.P.singh, Dhanpat Rai & Co. (P) Ltd, Delhi.*

MECC2006 C: ADVANCED MECHANISMS DESIGN

Lectures: *4 Periods / Week* *Internal Assessment: 40*

Final Exam: *3 hrs* *Final Examination: 60*

Credits: *4*

UNIT I

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

Kinematic Analysis: Position Analysis – vector loop equations for four bars, slider crank, inverted slider crank, geared five bar, and six bar linkages.

UNIT II

Analytical Analysis Analytical solutions for velocity and acceleration analysis – human tolerance for acceleration – four bar linkage jerk analysis. Plane complex mechanisms – auxiliary point method

Path Curvature Theory: Fixed and moving centroids, inflection points and inflection circle, Euler savary equation, graphical constructions – cubic stationary curvature.

UNIT III

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.

UNIT IV

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

Spatial Mechanisms And Robotics: Kinematic analysis of spatial RSSR mechanism – Denavit - Hartenberg parameters - Forward and inverse kinematics of robotic manipulators

Text 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.*

MECC2051: AUTOMATION LAB

Practicals:	*3 periods / Week*	*Internal Assessment: 25*
Final Exam:	*3 hrs*	*Final Examination: 50*
Credits	*2:*	

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1. Logic gates using LSM controller package
    a) NOT
    b) AND
    c) OR
    d) NAND
    e) XOR
    f) Latching
    g) Cascade timers
    h) Single acting cylinder
    i) Double acting cylinder
    j) Sequencing of cylinders

2. Sensor Technology Package-using PLC
    a) Through Beam Optical Sensor
    b) Capacitive sensor
    c) Inductive sensor
    d) Retro-reflective optical sensor
    e) Diffused optical sensor
    f) Reed switches
3. Simulation soft wares
    a) Robot simulator
    b) H-simulator
    c) P-simulator
    d) PLC simulator

MECC2052: MINI PROJECT / SEMINAR

Practicals: 3 periods / Week *Internal Assessment: 25*

Final Exam: 3 hrs *Final Examination: 50*

Credits: 2

III & IV SEMESTERS

MECC3051 : MAJOR PROJECT

Practicals : 24 periods / Week *Internal Assessment: 100*

Credits : 24 *50 [at the end of III semester]*

50 [at the end of IV semester]

Final Exam: Viva-voce & Presentation *Final Examination: 200*