### Scheme of INSTRUCTION and EVALUATION [Semester wise]

#### FIRST SEMESTER:

<table>
<thead>
<tr>
<th>Name of the Subjects</th>
<th>Hrs/Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
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<tr>
<td>1. MECC1001: Optimization Techniques</td>
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<td>2. MECC1002: Computer Graphics</td>
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<td>3. MECC1003: CNC &amp; Part Programming</td>
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<td>4. MECC1004: Computer Aided Design</td>
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<td>5. MECC1005: Elective I</td>
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<td>6. MECC1006: Elective-II</td>
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<td>7. MECC1051: CAD Lab</td>
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<td>8. MECC1052: CAM Lab</td>
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<td><strong>Total</strong></td>
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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:

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<th>Name of the Subjects</th>
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<td>1. MECC2001:</td>
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<tr>
<td>Computer Integrated Manufacturing</td>
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<td>Finite Element Analysis</td>
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<td>3. MECC2003:</td>
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<tr>
<td>Fluidics and Control Systems</td>
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<td>4. MECC2004:</td>
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<td>5. MECC2005:</td>
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<td>Elective-III</td>
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<td>8. MECC2052:</td>
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<tr>
<td>Mini Project &amp; Seminar</td>
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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:

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<td>Lecture</td>
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<td>MECC3051: Major Project</td>
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</table>
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, Gomary cut plane method.

UNIT II
Assignment Problem: Hungarian’s algorithm, Maximization Problem, unbalanced problems.

UNIT III
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.

Text Books:
3. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers

References:
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

UNIT - II


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:
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:
2. Computer Control of Manufacturing Systems - Y. Koren

Reference Books:
1. CAD/CAM – M.P.Groover & E.W.Zimmers.(PHI)
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:
2. CAD/CAM, Mikel P Groover & W Zimmers Jr

References:
1. CAD/CAM, P.N.Rao (PHI)
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

UNIT - II

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

Text books:
5. Automation, Production systems and Computer Integrated Manufacturing System –Mikell P.Groover

References:

Web References:
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.


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

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:

References:

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

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:

Reference:
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
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:

References:
1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
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
Final Exam: 3 hrs
Credits: 2

Internal Assessment: 25
Final Examination: 50

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
Final Exam: 3 hrs
Credits: 2

Internal Assessment: 25
Final Examination: 50

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

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
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 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:

Reference books:
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

UNIT III

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:

References:
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
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

Textbook:
1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980

References:

Web References:
1. http://www.pneumatics.com
MECC2004: MECHATRONICS

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

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

UNIT - II

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:

References:

Web Reference:
MECC2005 A: RAPID PROTOTYPING

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

UNIT-I

UNIT II
Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.
Solid ground curing: Principle of operation, Machine 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
Allied Process: Vacuum casting, surface digitizing, and Surface generation from point cloud, Surface modification- Data transfer to solid models.

Text books:
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:**

**References:**
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

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

Text books:
3. Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI Publications

References:

Web Reference:
1. http://www.robotics.com
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

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

Text Book:

References:
MECC2006 B: MECHANICAL VIBRATIONS

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

UNIT I


UNIT II


UNIT III

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

Text Books:
1. Theory and application of Mechanical Vibrations:
2. Theory and application of Mechanical Vibrations:
   Dilip Kumar Adhwarjee, Laxmi publications (P) Ltd, Boston, USA

References:
MECC2006 C: ADVANCED MECHANISMS DESIGN

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

UNIT I
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:
2. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, EWLP, Delhi, 1994
MECC2051: AUTOMATION LAB

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

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

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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