M.Tech. (Full Time) - Computer Aided Design (CAD)
Curriculum & Syllabus
2013 – 2014

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203
# M.Tech Computer Aided Design (CAD)
## Curriculum 2013– 2014
For students admitted from the academic year 2013 – 2014

<table>
<thead>
<tr>
<th>Type of course</th>
<th>Credits to be earned</th>
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<tr>
<td>Core courses</td>
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<tr>
<td>Optional / Elective Courses (Program Electives)</td>
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Total credits to be earned for the award of M.Tech degree – 71

### Core courses

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<tr>
<td>ME2101 / ME2102</td>
<td>Computer Graphics (or) Computer Applications in Design</td>
<td>3</td>
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<td>ME2103</td>
<td>Finite Element Analysis</td>
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<td>Mechanical Vibrations (or) Design of Material Handling Equipments</td>
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<td>ME2107 / ME2108</td>
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<td>ME2109 / ME2110</td>
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### Optional / Elective Courses (Program Electives)

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**Category**

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**CONTACT HOUR/CREDIT:**
L: Lecture Hours per week  
T: Tutorial Hours per week  
P: Practical Hours per week  
C: Credit
CORE COURSES

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<th>ME2101</th>
<th>COMPUTER GRAPHICS</th>
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**Prerequisites**
Nil

**PURPOSE**
To study how various graphics images can be created on the computer and its representation standards.

**INSTRUCTIONAL OBJECTIVES**
The students can understand the following
1. Basics of computer Graphics like drawing line, arc etc.
2. Drawing of spline curves
3. Creation of surfaces
4. Algorithms for 3D viewing
5. Available drawing standards
6. Basics of computer Graphics like drawing line, arc etc.

**UNIT I-INTRODUCTION** (15 hours)

Practical: Simple programs in C – drawing line & Circle – transformations.

**UNIT II-SPECIAL CURVES** (15 hours)
Curve representation – Bezier, cubic spline, B-spline, rational.

Practical: Drawing of these curves.

**UNIT III-SURFACES** (15 hours)
Surface modeling techniques: Coons patch, Bi-cubic patch, Bezier and B-spline surfaces.

Practical: Generation of these surfaces

**UNIT IV-THREE DIMENSIONAL COMPUTER GRAPHICS** (15 hours)
Volume modeling: boundary representation, CSG, hybrid - viewing transformations – techniques for visual realism: clipping, hidden line removal, algorithms for shading and rendering.
Practical: Exercise on the above algorithms.

UNIT V-GRAPHICS STANDARDS AND FUNDAMENTALS OF COMMUNICATIONS (15 hours)
GKS – bitmaps – Open GL
Data exchange standards – IGES – STEP – CALS – DXF – STL
Communication standards – LAN, WAN.
Practical: Study of the above data exchange standards.

REFERENCES
ME2102  COMPUTER APPLICATIONS IN DESIGN  

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Total Contact Hours-75

Prerequisites  
Nil

PURPOSE  
To study how computer can be used in Mechanical Engineering Design.

INSTRUCTIONAL OBJECTIVES

1. To familiarize the basics of CAD
2. Writing interactive programs in C++ for mechanical design problems
3. Various aspects of data storage, manipulation & expanding its capability

UNIT I-INTRODUCTION (9 hours)
The Design process and role of CAD – Types and applications of design models – Computer representation of drawings – Three-dimensional modeling schemes – Wire frame and surface representation scheme – solid modeling.

UNIT III-INTRODUCTION TO CAD SOFTWARE (9 hours)
Writing interactive programs to solve design problems using C++ - systems customization - Features of various solid-modeling packages.

UNIT III-COMPUTER AIDED DESIGN OF MACHINE ELEMENTS (9 hours)
Development of programs in C++ design, drawing & plotting of Machine Elements shafts gears, pulleys, flywheel, connecting rods.

UNIT IV-ENTITY MANIPULATION AND DATA STORAGE (9 hours)

UNIT V-EXPANDING THE CAPABILITY OF CAD (9 hours)

PRACTICAL (30 hours)
REFERENCES

WEB REFERENCES
1. http://www.machinedesign.com

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<thead>
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<th>L</th>
<th>T</th>
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<td>FINITE ELEMENT ANALYSIS</td>
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Prerequisites
Nil

PURPOSE
To study the basic principles and applications of the engineering analysis tool Finite Element Analysis.

INSTRUCTIONAL OBJECTIVES
1. Introduction to Engineering Analysis tool FEA its application in Linear static Analysis and 2D problems
2. Study of Finite Element modeling and simulation Techniques
3. Use of FEA in structural vibration and thermal Analysis
4. Study of Finite Element Software - ANSYS

UNIT I-INTRODUCTION (15 hours)
Practical:- Introduction to finite element software – ANSYS.

UNIT II-DLINEAR STATIC ANALYSIS (15 hours)
Bar and Beam elements, local and global coordinate system, transformation of coordinate systems, element stress. Analysis of truss. Natural coordinate system, Interpolation polynomial, Isoparametric elements and Numerical integration -Gaussian quadrature approach-simple problems in 1-D.
Practical: -1-D - Simple problems using software-ANSYS.
UNIT III-FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS (15 hours)
Review of the basic theory in 2-D elasticity, plane stress, 2-D problems using Constant Strain Triangles (CST), isoparametric representation, element matrices, stress calculations. Finite element modeling and simulation techniques-symmetry, Nature of FE solutions, error, convergence, adaptivity, substructures (super elements) in FEA.
Practical: - 2-D, 3-D, Symmetry in FEA – Simple problems using ANSYS

UNIT IV-STRUCTURAL VIBRATION AND DYNAMIC ANALYSIS (15 hours)
Review of basic dynamic equations, Hamilton’s principle, element mass matrices, free vibration (normal mode) analysis, Eigen values and Eigen vectors. Introduction to transient response analysis.
Practical: - Problems in structural and dynamic analysis using ANSYS, use of h & p elements.

UNIT V-THERMAL ANALYSIS (15 hours)
Review of basic equations of heat transfer, steady state one dimensional heat conduction, governing equations, boundary conditions, element characteristics-Simple problems in 1-D.
Practical: - 2-D, 3-D problems, introduction to transient heat transfer, simple problems using ANSYS.

REFERENCES

WEB REFERENCES

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<tr>
<th>ME2104</th>
<th>OPTIMIZATION IN ENGINEERING DESIGN</th>
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**Prerequisites**
Nil

**PURPOSE**
To study the principles of optimization and various techniques which can be used for Mechanical Engineering optimization along with applications.

**INSTRUCTIONAL OBJECTIVES**
1. Principles of optimization and its need.
2. Various conventional optimization techniques
3. Solving multivariable problems
4. Solving problems using Unconventional optimization techniques
5. Applications of optimization to design of machine elements

**UNIT I-INTRODUCTION**
(9 hours)

**UNIT II-CLASSICAL OPTIMIZATION TECHNIQUES**
(9 hours)

**UNIT III-MULTIVARIABLE UNCONSTRAINED AND CONSTRAINED OPTIMIZATION**
(9 hours)

**UNIT IV-NON-TRADITIONAL OPTIMIZATION TECHNIQUES**
(9 hours)
Genetic Algorithms - Simulated Annealing - Tabu search methods.
UNIT V-OPTIMUM DESIGN OF MACHINE ELEMENTS

(9 hours)


TUTORIAL (30 hours)

REFERENCES

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Prerequisites
Nil

PURPOSE
To study the vibrations in machine elements and how to control them.

INSTRUCTIONAL OBJECTIVES
1. Framing the equation of motion for the system using different method.
2. Solving the free and forced vibration of the system using different methods. (single, two and multi degree freedom systems.)

UNIT I-SINGLE DEGREE OF FREEDOM SYSTEM

(9 hours)
UNIT II- TWO DEGREE OF FREEDOM SYSTEM (9 hours)

Two degree of freedom system, Lagrange’s equation, modes of vibration, Principal of modes, Principles of orthogonality, Generalized coordinates, Coordinate coupling, Dynamic vibration Absorber, Semi definite system

UNIT III- MULTI DEGREE OF FREEDOM SYSTEM (9 hours)

Newton’s second law to derive equation of motion, Influence co-efficient - Stiffness influence co-efficient - Flexibility influence co-efficient - Inertia influence co-efficient, Eigen values & Eigen vectors, Methods of finding Natural Frequencies for problems including torsional vibration - Matrix iteration - Inverse matrix method - Stodolo’s method - Holzer’s method - Mechanical Impedance Method

UNIT IV-TRANSIENT VIBRATION OF CONTINUOUS SYSTEMS (9 hours)

Transient Vibration - Impulse excitation, Arbitrary excitation, Laplace Transform formulation -
Continuous System - Transverse Vibration of string, longitudinal Vibration of rods, Transverse Vibration of beams, Torsional Vibration of shaft, Vibration of membranes (plates)

UNIT V-EXPERIMENTAL METHODS IN VIBRATION ANALYSIS (9 hours)

Practical: Students may be asked to write computer programs for Two degree & Multi degree freedom Systems

PRACTICAL (30 hours)

REFERENCES
WEB REFERENCES

<table>
<thead>
<tr>
<th>ME2106</th>
<th>DESIGN OF MATERIAL HANDLING EQUIPMENTS</th>
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Prerequisites
Nil
(Students are permitted to use the approved data book in the examination)

PURPOSE
To study the design of material handling equipments like Elevators, cranes and its drives.

INSTRUCTIONAL OBJECTIVES
1. To study the material handling equipments Elevators, Cranes, its characteristics and applications
2. Selecting / designing various machine elements and components for material handling equipments

UNIT I-INTRODUCTION (9 hours)
Types of material handling equipments – Characteristics – applications – selection of the system.

UNIT II-DESIGN OF ELEVATORS (9 hours)

UNIT III-DESIGN OF CRANE STRUCTURES (9 hours)
Types – superstructure of rotary cranes with fixed radius – cantilever and overhead cranes – stability analysis.

UNIT IV-SELECTION OF DRIVES (9 hours)
Types of drive – rail traveling mechanisms – slewing mechanism with rotary pillar and turn tables – traveling gear
UNIT V-DESIGN OF GRABBING ATTACHMENTS  (9 hours)

TUTORIAL (30 hours)

REFERENCES
5. Spivakovsky, F. and Dyachkov, V., Conveyors and related equipments, MIR Publishers, Moscow, 1954

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PURPOSE
To study the application of computers in Manufacturing sector

INSTRUCTIONAL OBJECTIVES
1. Introduction of numerical control machine and automation.
2. Concept of Industrial robotics
3. Concepts of GI, FMS, AGV’s, AS / RS systems
4. Various planning systems and process monitoring
5. Control systems concepts.

UNIT I-AUTOMATION AND NUMERICAL CONTROL  (9 hours)
Automation – Definition. Type, Strategies – NC Systems –Types, Coordinate systems, Interpolation schemes – NC part programming –

UNIT II-INDUSTRIAL ROBOTICS (9 hours)
Introduction – Configuration – Accuracy & Repeatability - Robot control systems – Type of programming – End effectors – types, Drive systems – sensors – contact and Non-contact types – Robot Languages – Classification.

UNIT III-GROUP TECHNOLOGY AND FMS (9 hours)

UNIT IV-MANUFACTURING PLANNING SYSTEMS and PROCESS CONTROL (9 hours)
CAPP - Computer Integrated production planning systems – MRP – Capacity planning – Shop Floor control factory Data collection systems – Computer process interface types of computer process control – process monitoring, supervisory computer control.

UNIT V-CONTROL SYSTEMS (9 hours)

PRACTICAL (30 hours)

REFERENCES
2. S.R.Deb, “Robotic technology and Flexible automation”.
UNIT I-INTRODUCTION (9 hours)

UNIT II-FACTORS INFLUENCING FORM DESIGN (9 hours)

UNIT III-COMPONENT DESIGN – MACHINING CONSIDERATION (9 hours)

UNIT IV-COMPONENT DESIGN – CASTING CONSIDERATIONS (9 hours)
Redesign of castings based on parting line considerations – Minimizing core requirements, machined holes and redesign of cast members to obviate cores.
UNIT V-REDESIGN FOR MANUFACTURE AND CASE STUDIES
(9 hours)
Identification of uneconomical design – Modifying the design technology – Computer applications for DFMA.

TUTORIAL (30 hours)

REFERENCES

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<th>ME2109</th>
<th>MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS</th>
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PURPOSE
To study the behaviour of various materials, its failures and how to overcome it.

INSTRUCTIONAL OBJECTIVES
1. To study the structure and properties of engineering materials.
2. To study the failure theories and studying methods to avoid failures with respect to fatigue, creep and fracture.

UNIT I-STRUCTURE AND PROPERTIES
(9 hours)
Structure of metals, Defects in crystals, Deformation, Relationship between structure and properties, Mechanical properties of metals, Strain hardening, Strengthening mechanisms.
UNIT II-TENSION AND TORSION (9 hours)
Stress - Strain curve, Measures of yielding, Measures of ductility, Toughness, Flow curve, Effect of temperature on flow properties, Anisotropy, mechanical properties in torsion, Method of measuring shear stress, Types of torsion failures, Torsion test Vs Tension test, Hot torsion test.

UNIT III-FATIGUE (9 hours)
Fatigue phenomena, Theories of fatigue failure, Evaluation of fatigue resistance, Methods of presenting fatigue data, Fatigue crack propagation, Parameters influencing fatigue, Cyclic stress strain behavior, Design against fatigue, Low cycle fatigue.

UNIT IV-CREEP (9 hours)
Description of creep, Creep curve, Stress-rupture test, Creep mechanisms - Dislocation glide, Diffusion flow, Dislocation and Diffusion, Creep in two phase alloys, Deformation Mechanism Maps, Materials aspects creep design, Estimates of creep behavior, Presentation of Engineering creep data Super plasticity.

UNIT V-FRACTURE MECHANICS (9 hours)
Types of fracture, Theoretical strength of a solid, Griffith’s Theory, Irwin - Orowan Theory, crack propagation Modes, Dislocation Theories of Brittle fracture, Ductile fracture, Analysis of crack propagation, Stress intensity factor, Crack opening displacement, J integrals - Fracture toughness measurement methods.

TUTORIAL (30 hours)

REFERENCES
UNIT I-INTRODUCTION (9 hours)
Phases of design – properties of engineering materials – standardization and
interchangeability of machine elements – Classes of fit, selecting tolerances,
accumulation and non-accumulation of tolerance - Tolerance stack up stress
concentration – Theories of failure.

UNIT II-SHAFT (9 hours)
Design of shaft for different application – Design for rigidity – Integrated
design of shaft, key and bearing practical shaft Design using computer.

UNIT III-BELT DRIVES AND GEARS (9 hours)
Design of belt drives - Principle of gear tooth action – Gear correction - Gear
tooth failure modes – Stress and loads – component design of spur, helical,
bevel and worm gears, practical component design of gears using computer.

UNIT IV-GEAR BOXES (9 hours)
Integrated design of speed reducer and multi speed gear boxes - Housing,
Bearing, Shaft, Capacity of lubricant, Gasket.

UNIT V-CLUTCHES AND BRAKES (9 hours)
Integrated design of automobile components: Clutches – Dynamic and
thermal aspects of vehicle braking – Integrated design of brakes for machine
tools, automobiles and mechanical handling equipments.

PRACTICAL (30 hours)
REFERENCES

ELECTIVE COURSES

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<tbody>
<tr>
<td>ME2111</td>
<td>DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS</td>
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Total Contact Hours-45

Prerequisites
Nil

PURPOSE
To study the principles and applications of Hydraulic and Pneumatic systems.

INSTRUCTIONAL OBJECTIVES
1. Different types of pumps, motors, their construction and operations etc.
2. Different types of valves and its practical applications.
3. To design the hydraulic circuit for lift, press and other practical applications.
4. Basic concepts of pneumatic principles, circuits and its application.
UNIT I-PUMPS AND ACTUATORS (9 hours)

UNIT II-VALVES AND BOOSTERS (9 hours)
Valves: Pressure control valves, direction control valves, flow control valves, servo valves, and pressure compensated flow control valves, flow divider valves, valve actuation techniques.
Pressure Boosters: Pressure applied in one direction, Pressure applied in both directions, Pressure applied & intensified in both directions, Advantages of pressure boosters.

UNIT III-HYDRAULIC CIRCUIT (9 hours)
Accumulators: Accumulator types & its circuits

UNIT IV-HYDRAULIC CIRCUIT DESIGN (9 hours)
Electrical controls for fluid power Circuits, Design of hydraulic & Pneumatic circuit for specific application - Cascading - Ladder diagram (Electrical controls), Microprocessor controlled design of Circuits, Circuits for Copying Lathe, Broaching Machines & Milling Machines.

UNIT V-PNEUMATIC SYSTEMS (9 hours)
Pneumatic, Fundamentals, Merits & Demerits Over Hydraulic systems, Pneumatic Conditioners - Filters - Regulators - Lubricators - Mufflers - Air dryers, Types of Air Compressors, Pneumatic Actuators, Design of Pneumatic Circuits.


REFERENCES

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<tr>
<th>ME2112</th>
<th>ADVANCED FINITE ELEMENT ANALYSIS</th>
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Total Contact Hours-45

Prerequisites
Nil

PURPOSE
To study the advanced topics in the engineering analysis tool FEA.

INSTRUCTIONAL OBJECTIVES
1. FE analysis of plates and shells.
2. Use of FE tool in Non-linear problems, Dynamic problems, Fluid mechanics and Heat transfer Analysis.

UNIT I-BENDING OF PLATES AND SHELLS (9 hours)
Review of Elasticity Equations - Bending of Plates and Shells - Finite Element Formulation of Plate and Shell Elements - Confirming and non-Confirming Elements - C₀ and C₁ Continuity Elements - Application and examples.

UNIT II-NON - LINEAR PROBLEMS (9 hours)
UNIT III-DYNAMIC PROBLEM  (9 hours)
Direct formulation - Free, Transient and Forced Response - Solution
Procedures - Subspace Iterative Technique - Houbolt, Wilson, Newmark -
Methods - Examples.

UNIT IV-FLUID MECHANICS AND HEAT TRANSFER  (9 hours)
Governing Equations of Fluid Mechanics - Inviscid and Incompressible
Flow Potential formulations - Slow Non-Newtonian Flow - Metal and
polymer -Forming - Navier Strokes Equation - Steady and Transient
Solution.

UNIT V-ERROR ESTIMATES AND ADAPTIVE REFINEMENT  (9 hours)
Error norms and Convergence rates - h refinement with adaptivity - Adaptive
refinement.

REFERENCES
2. Bathe K.J. “Finite Element Procedures in Engineering Analysis”,

<table>
<thead>
<tr>
<th>ME2113</th>
<th>ADVANCED STRENGTH OF MATERIALS</th>
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PURPOSE
To familiarize the students in the area of stress, strain and deformation for a
3D problems.

INSTRUCTIONAL OBJECTIVES
Upon successful completion of the course the students will be able to solve
practical problems involving Unsymmetrical bending, stress in flat plates,
Torsion of noncircular sections and contact stresses.

UNIT I-INTRODUCTION  (9 hours)
Stress-strain relations and general equations of elasticity in Cartesian, polar
and spherical co-ordinates equations of equilibrium - compatibility -
boundary conditions - representation of 3-dimentional stress of tensor -
generalized Hooke’s law - St.Venant’s principle - plane strain - plane stress -
Airy’s stress function - SHEAR CENTRE - Location of shear center for various sections - shear flow.

UNIT II- UN-SYMMETRICAL BENDING (9 hours)
Stress and deflections in beams subjected to unsymmetrical loading - kern of a section - CURVED FLEXURAL MEMBERS - circumferential and radial stresses - deflections - curved beam with restrained ends - closed ring subjected to concentrated loading and uniform load - chain links and crane hooks.

UNIT III-STRESS IN FLAT PLATES (9 hours)
Stresses in circular and rectangular plates due to various types of loading and end conditions - buckling of plates.

UNIT IV-TORSION OF NON-CIRCULAR SECTIONS (9 hours)
Torsion of rectangular cross section - St. Venant’s theory - elastic membrane analogy - Prandtl’s stress function - torsional stress in hollow thin-walled tubes - STRESSES DUE TO ROTATION - Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness - allowable speeds.

UNIT V-THEORY OF CONTACT STRESSES (9 hours)
Methods of computing contact stresses - deflection of bodies in points and line contact - applications.

REFERENCES
ME2114  TRIBOLOGY IN DESIGN  

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Total Contact Hours-45

Prerequisites
Nil

PURPOSE
To study the surface properties, wear and lubrication in Mechanical Engineering.

INSTRUCTIONAL OBJECTIVES
After successful completion of this course the students are

1. To identify the tribological problems.
2. To know the how to rectify these problems

UNIT I-BASIC PRINCIPLES OF TRIBOLOGY  

9 hours

Introduction to the concept of tribodesign, specific principles of tribodesign, tribological problems in machine design, Basic principles in tribology. Nature of engineering surface, surface topography, Measurement of surface topography.

UNIT II-CONTACT BETWEEN SURFACES  

9 hours

Contact between surfaces, Elastic and plastic deformation, surface and subsurface stresses, surface tension, surface energy, Friction theory, Junction growth, Friction due to plugging, adhesion, deformation, Friction under complex, motion conditions. Friction characteristics of metal and non-metals, rolling friction, Friction measurements.

UNIT III-TYPES OF WEAR AND THEIR MECHANISMS  

9 hours

Adhesive wear, Material selection for Adhesive wear situation, Abrasive wear, Materials for adhesive wear situation, wear due to surface fatigue, wear due to chemical reaction, wear measurements, wear of non-metals.

UNIT IV-LUBRICATION THEORY  

12 hours

Composition and properties of oil and Grease lubricants, Gas lubricants, Viscosity measurements, ASTM standards Lubrication regimes, externally pressurized lubrication, Hydrodynamic lubrication, Elasto hydrodynamic, Boundary and solid lubrication. Performance analysis of thrust bearings and journal bearing. Selection and Design considerations, Design procedure Reynolds Equation with pressure and viscosity effects, Film thickness equation.
UNIT V-SURFACE ENGINEERING IN TRIBOLOGY (6 hours)
Introduction, Surface modifications, Thermo–Chemical processes, Surface coatings.

REFERENCES

<table>
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<th>ME2115 ADVANCED MECHANISMS DESIGN</th>
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Prerequisites
Nil

PURPOSE
To study how various mechanisms can be designed

INSTRUCTIONAL OBJECTIVES

1. Study of Kinematics of various mechanisms and Kinematics synthesis of linkages.
2. Study of various graphical constructions of acceleration analysis.
3. Static and dynamic force analysis of linkages.
4. Kinematics analysis and kinematics synthesis of spatial mechanisms.

UNIT I-KINEMATICS ANALYSIS OF MECHANISMS (9 hours)
and acceleration Analysis - Four bar linkage jerk analysis. Plane complex mechanisms.

UNIT II-KINEMATICS SYNTHESIS OF LINKAGES (9 hours)

UNIT III-PATH CURVATURE THEORY (9 hours)
Fixed and moving Centreodes, Hartmann’s Construction, Inflection Points, The Inflection Circle, The Euler - Savary Equation, The collination axis and Bobiller’s theorem, Conjugate points and inverse motion, the cubic Stationary curvature, Ball’s Point.

UNIT IV-DYNAMICS OF MECHANISMS (9 hours)
Static force analysis - inertia force analysis - Combined static and inertia force Analysis, Shaking force, Kinematic analysis, Introduction to force and moment balancing of linkages.

UNIT V-SPATIAL MECHANISMS & ROBOTICS (9 hours)
Introduction Mobility of mechanisms, Describing spatial motions, Kinematic analysis of spatial mechanism, Kinematic synthesis of spatial mechanisms, position, Velocity and acceleration analysis, Eulerian Angles - Introduction to Robotic Manipulators - topological arrangements of Robotic arms, Kinematic analysis of spatial Mechanism - Devavit - Hartenberg Parameters, Forward and inverse Kinematics of Robotic Manipulators.

REFERENCES
ME2116 COMPOSITE MATERIALS AND MECHANICS

Prerequisites
Nil

Total Contact Hours-45

PURPOSE
To study the principles, properties and analysis of composite materials.

INSTRUCTIONAL OBJECTIVES
1. Upon successful completion of this course the students will be able to analyze the characteristics of fiber-reinforced plastics.
2. Understand the various moulding process of composite materials, stress analysis of composite beams, plates and shells.

UNIT I-INTRODUCTION (9 hours)

UNIT II-MECHANICS AND PERFORMANCE (9 hours)
Characteristics of fiber-reinforced Lamina-Laminates-Interlaminar stresses-Static Mechanical Properties - fatigue and Impact properties - Environmental effects - Fracture Behavior and Damage Tolerance.

UNIT III-MANUFACTURING (9 hours)
Bag Moulding - Compression moulding - Pultrusion-Filament winding - other Manufacturing Processes - Quality Inspection method.

UNIT IV-ANALYSIS (9 hours)
Stress analysis of laminated composite Beams, Plates, Shells - Vibration and Stability Analysis - Reliability of Composites - Finite Element Methods of Analysis - Analysis of Sandwich structures.

UNIT V-DESIGN (9 hours)
Failure predictions - Laminated Design Consideration - Bolted and Bonded Joints. Design examples.
REFERENCES

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Prerequisites
Nil

PURPOSE
To study about various, sensors, transducers, microprocessors and PLC

INSTRUCTIONAL OBJECTIVES
1. To study the sensors and transducers, used in mechanical engineering
2. To study how microprocessors can be used to do simple applications in mechanical engineering
3. To study about PLC and its applications

UNIT I-INTRODUCTION (9 hours)

UNIT II-SENSORS AND TRANSDUCERS (9 hours)

UNIT III-MICROPROCESSORS IN MECHATRONICS (9 hours)
UNIT IV-PROGRAMMABLE LOGIC CONTROLLERS  (9 hours)
Introduction - basic structure - input and output processing - programming -
Mnemonics timers, internal relays and counters - data handling - analog input
and output - selection of PLC.

UNIT V-DESIGN AND MECHATRONICS  (9 hours)
Designing - Possible design solution - case studies of Mechatronics systems.

REFERENCES
1. Michael B. Histan and David G. Alciatore, “Introduction and
Mechatronics and Measurement systems”, McGraw Hill International
3. Ramesh S. Gaonkar, ‘Microprocessors Architecture, Programming and
4. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering,
5. Ghosh.P.K and Srithar, P.R.8000 to 8085 “Introduction to
Microprocessors for Engineers and Scientists” Second Edition Prentice
Hall, 1995

WEB REFERENCE
ME2118  NEURAL NETWORKS, GAs AND ITS APPLICATIONS  3 0 0 3
Total Contact Hours-45

Prerequisites
Nil

PURPOSE
To study about the modern tools Neural Networks and Genetic algorithms and its applications to Mechanical Engineering.

INSTRUCTIONAL OBJECTIVES
1. Basic concepts of Genetic Algorithms
2. Application of GAs to Mechanical Engineering
3. Advances in Genetic Algorithms
4. Basic concepts of Neural Networks and applications of GAs to Neural networks
5. Applications of GAs and Neural networks to Mechanical Engineering

UNIT I-INTRODUCTION AND CONCEPT OF GENETIC ALGORITHMS  (9 hours)
GAs - Robustness of Traditional Optimization Techniques - Distinctiveness of GAs from Traditional Optimization producers - Mathematical foundation of GAs Similarity Templates - Working of Schema Process - Minimal Deceptive Problem - Similarity Templates as Hyper planes.

UNIT II-IMPLEMENTATION OF GAs AND ADVANCED TECHNIQUES IN GENETIC SEARCH  (9 hours)
Data Structures - Reproduction , Crossover and Mutation - Mapping objective functions to Fitness From - Fitness Scaling - Multiparameter , Mapped , Fixed Point Coding - Computer Implementation - Evolution of Dominance , Diploidy and Abeyance - Inversion and other reordering operators - Multi objective optimization -Knowledge based Techniques - GAs and Parallel Processors.

UNIT III-GENETIC BASED MACHINE LEARNING  (9 hours)
UNIT IV-NEURAL NETWORKS AND APPLICATION OF GAs TO NEURAL NETWORKS  (9 hours)
Fundamentals of Neural Networks - Biological Basis - Features of Artificial Neural Networks - Back Propagation Training - Modular Neural Networks - Fitness Function - Application of GAs to Neural Networks - Use of Genetic Algorithms to Neural Networks - Use of Genetic Algorithms in the Design of Neural Networks.

UNIT V-APPLICATIONS  (9 hours)
GAs applications in Pattern Recognition - Function Optimization - Improvements in Basic Technique - Optimization of Pipeline System - Multi model and Multi objective Optimization - Nonlinear Optimization.

REFERENCES

<table>
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<tr>
<th>ME2119</th>
<th>CONCURRENT ENGINEERING</th>
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Prerequisites
Nil

PURPOSE
To study the principles of concurrent engineering and its implementation

INSTRUCTIONAL OBJECTIVES
1. To familiarize with the basics of concurrent engineering
2. The tools and methodologies available in CE
3. Various approaches to CE
4. The other related aspects of CE

UNIT I- INTRODUCTION  (9 hours)
UNIT II- CONCURRENT ENGINEERING TOOLS (9 hours)

UNIT III IMPLEMENTATION OF CONCURRENT ENGINEERING (9 hours)
Implementing CE in an organization – concurrent Engineering Teams – their roles and responsibilities Organizational functions to support CE team environment. Setting Team goals, measuring performance of team & managing a CE Team, Limitations of team.

UNIT IV CONCURRENT APPROACHES TO DESIGN AND MANUFACTURE (9 hours)

UNIT V CONCURRENT APPROACHES TO OTHER ASPECTS OF ENGINEERING (9 hours)

REFERENCES
ME2120 INTEGRATED PRODUCT DESIGN AND DEVELOPMENT

Prerequisites
Nil

PURPOSE
To study the various tools and approaches available for product design and development.

INSTRUCTIONAL OBJECTIVES
To give clear insight about various aspects of product design and development. The procedural approach for the product design and development are discussed. The knowledge gained by the students after completing this course will be useful for the better product development.

UNIT I - INTRODUCTION (5 hours)

UNIT II - CONCEPT GENERATION AND SELECTION (5 hours)

UNIT III - PRODUCT ARCHITECTURE (10 hours)

UNIT IV - INDUSTRIAL DESIGN (10 hours)
Integrate process design-managing costs –Robust design, QFD-Integrating CAD, CAM, CAE, PDM, MPM tools-FMEA/FMECA and SPC Techniques for process yield enhancement -simulating product performance and manufacturing processes electronically – need for industrial design-impact-

UNIT V-DESIGN FOR MANUFACTURING AND VIRTUAL PRODUCT DEVELOPMENT

(15 hours)

Definition-Estimation of manufacturing cost –reducing the component costs and assembly costs –minimize system –complexity-prototype basics – principles of prototyping –planning for prototypes –economic analysis – understanding and representing tasks-baseline project planning-accelerating the project-project execution –Collaborative CAD, Virtual Reality Goals, Augmented Reality, Animation and Simulation.

REFERENCES


WEB REFERENCE

1. www.me.mit/2.7444
ME2121 | INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS | L | T | P | C
---|---|---|---|---|---
 | | 3 | 0 | 0 | 3
Total Contact Hours-45

Prerequisites
Nil

PURPOSE
To study the components of Industrial robotics and Expert systems.

INSTRUCTIONAL OBJECTIVES
After completion of this subject, students are expected to be familiar with

2. The controlling of Robots and devices system.
3. Sensor technology
4. Robot programming and Expert system.

UNIT I-INTRODUCTION AND ROBOTIC KINEMATICS (10 hours)

UNIT II-ROBOT DRIVES AND CONTROL (9 hours)
Controlling the robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – designing of end effectors – Vacuum, magnetic and air operated grippers

UNIT III-ROBOT SENSORS (9 hours)

UNIT IV-ROBOT CELL DESIGN AND APPLICATION (9 hours)
Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple robots and machine interference – Robot cycle time analysis – Industrial applications of robots
UNIT V-ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS  
(8 hours)

REFERENCES

<table>
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<tr>
<th>ME2122</th>
<th>RAPID PROTOTYPING AND TOOLING</th>
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Prerequisites
Nil

PURPOSE
To study the modern prototyping tool Rapid prototyping, its types and applications.

INSTRUCTIONAL OBJECTIVES
1. To familiarize the basics of RPT
2. The various process in RP
3. The principles of Rapid tooling and reverse Engineering

UNIT I-INTRODUCTION  
(9 hours)
Definitions, evolution, CAD for RPT. Product design and rapid product development. The cost and effects of design changes during conceptual modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and
its role in modern manufacturing mechanical design. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

UNIT II-LIQUID AND POWDER BASED RP PROCESSES  (9 hours)
Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT III-SOLID BASED RP PROCESSES  (9 hours)
Principles and typical processes such as fused deposition modeling laminated object modeling and others.

UNIT IV-RAPID TOOLING  (9 hours)
Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.

UNIT V-REVERSE ENGINEERING  (9 hours)
3D scanning, 3D digitizing and Data fitting,. High speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies.

REFERENCES
SUPPORTIVE COURSES

<table>
<thead>
<tr>
<th>MA2006</th>
<th>COMPUTATIONAL METHODS IN ENGINEERING</th>
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Prerequisite
Nil

PURPOSE
To develop analytical capability and to impart knowledge in Mathematical and Statistical methods and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

INSTRUCTIONAL OBJECTIVES
At the end of the course, Students should be able to understand Mathematical and Statistical concepts and apply the concepts in solving the engineering problems.

UNIT I INITIAL AND BOUNDARY VALUE PROBLEMS (9 hours)
Classification of Linear differential equation - solution of initial and boundary value problems. Laplace transform methods for one-dimensional wave equation - Displacements in a string. Fourier series methods for one-dimensional wave equation and one-dimensional heat conduction problems.

UNIT II PROBABILITY (9 hours)
basic definition, conditional, Probability, Baye's theorem - Binomial, Poisson, Normal, Exponential, Rectangular, Gamma Distributions. Moment generating function, random variables, two dimensional random variables.

UNIT III PRINCIPLE OF LEAST SQUARES (9 hours)
Fitting of Straight line and parabola - Correlation - Linear multiple and partial correlation - Linear regression - Multiple regression.

UNIT IV SAMPLING DISTRIBUTIONS (9 hours)
Tests based on t-distribution, chi-square and F-distributions - Analysis of variance - One-way and two-way classifications.
UNIT V TIME SERIES ANALYSIS                     (9 hours)
Significance of time series analysis - Components of Time series - Secular
trend - Graphical method - Semi-average method - Method of Moving
Averages - Method of Least squares - Seasonal variations - Method of Simple
Averages - Ratio to trend method - Ratio to moving average method.

REFERENCES
   Delhi, 2003
   Sultan Chand and Sons, New Delhi, 1999
3. Kapoor V.K., Statistics (Problems and Solutions), Sultan Chand and
   Sons, New Delhi 1994
4. Montgomery D.C. and Johnson L.A., Forecasting and Time Series,
   McGraw Hill
5. Anderson O.D., Time Series Analysis: Theory and Practice, I. North-
   Holland, Amsterdam, 1982.

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<tr>
<th>MA2007</th>
<th>APPLIED MATHEMATICS FOR MECHANICAL ENGINEERS</th>
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Total contact hours - 45

Prerequisite
Nil

PURPOSE
To develop analytical capability and to impart knowledge in Mathematical
and Statistical methods and their applications in Engineering and Technology
and to apply these concepts in engineering problems they would come across.

INSTRUCTIONAL OBJECTIVES
At the end of the course, Students should be able to understand Mathematical
and Statistical concepts and apply the concepts in solving the engineering
problems.

UNIT I TRANSFORM METHODS                     (9 hours)
Laplace transform methods for one-dimensional wave equation -
Displacements in a string - Longitudinal vibrations of an elastic bar - Fourier
transform methods for one-dimensional heat conduction problems in infinite
and semi-infinite rod.
UNIT II ELLIPTIC EQUATIONS  
Laplace equation - Fourier transform methods for Laplace equation - Solution of Poisson equation by Fourier transform method.

UNIT III CALCULUS OF VARIATIONS  
Variation and its properties - Euler's equation - Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods - Ritz methods.

UNIT IV NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS  
Numerical Solution of Partial Differential Equations - Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method - Diffusion equation by the explicit and Crank Nicholson implicit methods - Solution of wave equation by explicit scheme.

UNIT V REGRESSION METHODS  
Principle of least squares - Correlation - Multiple and Partial correlation - Linear and non-linear regression - Multiple linear regression.

REFERENCES

1. Sankara Rao K., Introduction to Partial Differential Equations, 4th printing, PHI, New Delhi, April 2003
ME2191 VISUAL PROGRAMMING AND ITS APPLICATIONS

Prerequisite
Nil

Total Contact Hours-45

PURPOSE
To study the general purpose programming tools Visual Basic and Visual C++.

INSTRUCTIONAL OBJECTIVES
1. Various programming methodologies
2. Microsoft Windows and its programming methods
3. Writing and debugging programs using Visual Basic
4. Writing and debugging programs using Visual C++
5. Solving programs applied to Mechanical Engineering

UNIT I-HISTORICAL DEVELOPMENT OF PROGRAMMING
(9 hours)
Procedural programming – Structural programming – object oriented programming – windows programming- event driven programming – conceptual comparison.

UNIT II-WINDOWS PROGRAMMING
(9 hours)
Overview of windows programming – data types – resources – controls – interfaces – dynamic link libraries – SDK (Software development kit tools) – Context help

UNIT III-VISUAL BASIC PROGRAMMING
(9 hours)

UNIT IV-VISUAL C++ PROGRAMMING
(9 hours)
UNIT V-CASE STUDIES (9 hours)
Application to Mechanical Engineering problems - Mini Project

REFERENCES
5. Plewolds, “Windows Programming”

<table>
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<tr>
<th>ME2192</th>
<th>OBJECT ORIENTED SOFTWARE TECHNOLOGY</th>
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Prerequisite
Nil

PURPOSE
To learn the advanced software engineering principles and methodologies for effective Software development.

INSTRUCTIONAL OBJECTIVES
1. To learn about software prototyping, analysis and design
2. To learn UML and its usage
3. Case studies to apply the principles

UNIT I-INTRODUCTION (8 hours)

UNIT II-PLANNING AND SCHEDULING (9 hours)

UNIT III-ANALYSIS AND DESIGN (12 hours)

UNIT IV-IMPLEMENTATION AND TESTING (8 hours)
Top-Down, Bottom-Up, object oriented product Implementation& Integration. Software Testing Methods-White Box, Basis Path-Control Structure –Black Box-Unit Testing- Integration testing-Validation & System testing. Testing OOA & OOD models-Object oriented testing strategies.

UNIT V-MAINTENANCE (8 hours)
Maintenance process-System documentation-program evolution dynamics-Maintenance costs-Maintainability measurement – Case Studies

REFERENCES
OTHER COURSES

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<th>ME2196</th>
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<th>C</th>
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<tbody>
<tr>
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<td>Prerequisite</td>
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Students have to present a minimum of three seminar papers on the topics of current interest. The evaluation will be based on the knowledge of the student on the subject of presentation, their communication abilities, the method of presentation, the way questions were answered and his attention to the other students' seminars.

<table>
<thead>
<tr>
<th>ME2197</th>
<th>PROJECT WORK – PHASE I</th>
<th>L</th>
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Students can register for this course only after earning at least 12 credits in the core courses of their study.

<table>
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<th>ME2198</th>
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Students can register for this course only after earning at least 16 credits in the core courses of their study.

Students can enroll for this course only after completing Project Work-Phase I.