### I Year I Semester

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## II YEAR II - SEMESTER

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**Total** 0 0 40 20

*For Dissertation Work Review - I, Please refer 7.8 in R19 Academic Regulations.*

**Audit Course I & II:**
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills
Prerequisite: Applied Mechanics, Mechanics of solids

Course Objectives: This course is concerned with the development of analytical methods for solving problems in mechanics of materials that are generally considered beyond the scope of basic course in the discipline.

Course outcomes: After completing this course, the student should be able to
- Determine the point of location of applied load to avoid twisting in thin sections used in aerospace applications.
- Understand the concept of distinguish between neutral and centroidal axes in curved beams.
- Understanding the analogy models developed for analyzing the non-circular bars subjected to torsion, and also analyzing the stresses developed between rolling bodies and stress in three dimensional bodies.

UNIT–I:
Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending, Deflection of straight beams due to nonsymmetrical bending.

UNIT–II:

UNIT–III:
Torsion: Linear elastic solution Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section, Hollow thin wall torsion members, Multiply connected Cross Section.

UNIT–IV:
Contact stresses: Introduction, problem of determining contact stresses, Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses, Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact) Loads normal to area, Stresses for two bodies in line contact, loads normal and Tangent to contact area.

UNIT–V:
Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatic bar by its own weight twist of circular shafts of constant cross section, pure bending of plates.

TEXT BOOKS:

REFERENCE BOOKS:
1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates by Timoshenko.
3. Strength of materials & Theory of structures by B.C Punmia (Vol I & II)
4. Strength of materials by Sadhu singh
Prerequisite: Kinematics of machinery

Course Objectives: The overall objective of this course is to learn how to analyze the motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines. To find radius of curvature of polodes.

Course outcomes: After completing this course, the student should be able to
- Understand the kinematic analysis of rolling bodies based on graphical, geometrical and analytical methods.
- Design of mechanisms by using graphically and analytically by involving function generator, rigid body guidance and path generation(Coupler curve) methods

UNIT–I:
Advanced Kinematics of plane motion- I: Introduction to plane motion. Euler – Savary Equation, the Inflection circle, Analytical and graphical determination of d, Bobillier’s Construction, Collineation axis, Hartmann’s Construction, Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT–II:
Advanced Kinematics of plane motion - II: Polode curvature, Hall’s Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Freudenstein’s collineation – axis theorem, Carter –Hall circle.

UNIT–III:
Introduction to Synthesis-Graphical Methods - I: The Four bar linkage, Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle, Guiding a body through Four distinct positions: Burmester’s curve.

UNIT–IV:

UNIT–V:

TEXT BOOKS:

REFERENCE BOOKS:
Prerequisite: Basic concepts of Physics

Course Objectives:
- To understand the fundamentals of Vibration Theory
- To be able to mathematically model real-world mechanical vibration problems

Course Outcomes: At the end of the course the students will be able to
- To study the vibrations in machine elements and how to control them.
- Ability to analyze the mathematical model of linear vibratory system to determine its response
- Obtain linear mathematical models of real life engineering systems
- Determine vibratory responses of single and multi degree of freedom systems to harmonic, periodic and non-periodic excitation

UNIT-I:

UNIT-II:

UNIT- III:

UNIT-IV:

UNIT-V:
TEXT BOOKS:
2. Elements of Vibration Analysis by Meirovitch.

REFERENCE BOOKS:
1. Mechanical Vibrations by G.K. Groover.
2. Vibrations by W.T. Thomson
MECHANICAL BEHAVIOUR OF MATERIALS (Professional Elective - I)

Prerequisite: Physical Metallurgy

Course Objectives: The main objectives are to provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear.

Course outcomes: After completing this course, the student should be able to understand the different modes of failures like fracture, fatigue and creep of ductile and brittle materials

UNIT-I:
Fracture Mechanics: Strain Energy Release rate, Fracture Toughness and Design, Crack Opening Displacement, J-Integral, R Curve,

UNIT-II:
Theory of Elasticity and Plasticity:
Plasticity: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, true stress and true strain, flow rules, strain hardening, Ramberg Osgood equation, stress-strain relation in plasticity, plastic deformation of metals and polymers

UNIT-III:
Fatigue-I: Introduction, Stress Cycles, S-N Curve, Effect of Mean Stress on Fatigue, Cyclic Stress strain curve, Low Cycle Fatigue, Strain Life Equation, Structural Features of Fatigue, Fatigue Crack Propagation, Effect of Metallurgical Variables on Fatigue.

UNIT-IV:
Fatigue-II: Effect of stress concentration on Fatigue, Size Effect, Surface effects on Fatigue, Fatigue under Combined stresses, Design for Fatigue, Machine Design approach-Infinite life design, Local strain approach, Corrosion Fatigue, Effect of Temperature on fatigue.

UNIT-V:

TEXT BOOKS:
REFERENCE BOOKS:
FRACTURE MECHANICS (Professional Elective - I)

Prerequisite: Strength of Materials, Theory of Elasticity desirable.

Course Objectives:
- Acquire fundamental understanding of the fracture of solid materials.
- Develop detailed understanding of fracture mechanics, creep, and fatigue.
- Obtain fundamental knowledge of corrosion and environmentally-assisted cracking.
- Acquire basic understanding of the techniques used to perform failure analysis.

Course Outcomes: At the end of the course the students will be able to
- Predict material failure for any combination of applied stresses.
- Estimate failure conditions of a structure
- Determine the stress intensity factor for simple components of simple geometry
- Predict the likelihood of failure of a structure containing a defect

UNIT-I:

UNIT-II:

UNIT-III:
PHYSICAL ASPECTS OF FATIGUE: Phase in fatigue life - Crack initiation – Crack growth - Final fracture - Dislocation – Fatigue fracture surfaces. Safe Life and Fail safe design philosophies Importance of Fracture Mechanics in Aerospace structure – Applications to composite materials and structures.

UNIT-IV:
STATICAL ASPECTS OF FATIGUE BEHAVIOUR: Low cycle and high cycle fatigue - Coffin-Manson’s Relation –Transition Life – Cyclic strain hardening and softening – Analysis of load histories – Cycle counting techniques – Cumulative damage – Miner’s theory, other theories.

UNIT-V:

TEXT BOOKS:
1. Introduction to Fracture Mechanics by Hellan K, McGraw Hill
2. Fracture Vol II by Liebowitz, H.Editor, Academic Press
REFERENCE BOOKS:

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives: The objective of course is identify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.

Course Outcomes: At the end of the course, the student will be able to:
- Understand the quality aspects of design for manufacture and assembly
- Apply Boothroyd method of DFM for product design and assembly
- Apply the concept of DFM for casting, welding, forming and assembly
- Identify the design factors and processes as per customer specifications
- Apply the DFM method for a given product

UNIT - I:
Introduction: Design philosophy steps in design process - General design rules for manufacturability - basic principles of design 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 Process: 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 tolerances - use of solidification simulation in casting design - product design rules for sand casting.

UNIT - III:

UNIT-IV
Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.
Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-V:
Design of Manual Assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and
fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

TEXT BOOKS:

REFERENCES:
1. Computer Aided Assembly London/ A Delbainbre/.
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MACHINE DESIGN)

OPTIMIZATION TECHNIQUES & APPLICATIONS (Professional Elective - II)

Pre-requisites: Operations Research

Course Objectives: The main objectives of the course are: Learn
- Numerical optimization techniques for single variable and multi variable non-linear optimization problems.
- Sensitivity analysis on LPP queuing
- Simulation of annexing problem & inventory problem.
- Geometry cutting plane method & branch bound method for linear IPP.
- Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm.
- Formulation of GP model and solving it using arithmetic geometric inequality theorem.
- State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes: At the end of the course, the student is able to apply appropriate optimization techniques and solve.
- Based on the type of optimization problem like single variable or multivariable,
- Make sensitivity analysis to study effect of changes in parameters of LPP on the optimal solution without reworking.
- Simulate the system to estimate specified performance measures.
- Solve integer programming problem by either geometry cutting plane algorithm or branch band method.
- Apply chance constrained algorithm and solve stochastic linear programme.
- Formulate GP model and solve it.
- Solve given optimization problem by genetic algorithm or simulated annealing or PSO.

UNIT-I:

UNIT-II:

UNIT-III:

UNIT-IV:
Integer Programming: Introduction – formulation – Geometry cutting plane algorithm – Zero or one algorithm, branch and bound method

UNIT-V:
Geometric Programming: Posynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P (≤ type only)

TEXT BOOKS:
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

REFERENCE BOOKS:
1. Operations Research by S. D. Sharma
2. Operation Research by H. A. Taha, TMH
3. Optimization in operations research by R. L Rardin
Prerequisite: Structure and properties of composite materials and design procedures for composite structures

Course objectives:
To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching and to predict the elastic properties of both long and short fiber and understand the stress-strain relations and establish the failure criteria for laminated structures.

Course Outcomes: At the end of the course the students will be able to
- Understanding of types, manufacturing processes, and applications of composite materials.
- Basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- Ability to analyze problems on macro and micro mechanical behavior of lamina
- Ability to analyze problems on macro mechanical behavior of laminate
- An ability to predict the loads and moments that cause an individual composite layer and a composite laminate to fail and to compute hygro thermal loads in composites.
- An ability to compute the properties of a composite laminate with any stacking sequence.

UNIT-I:
Introduction to Composite Materials: Introduction , Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications.

UNIT-II:
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT-III:

UNIT-IV:

UNIT-V:
TEXT BOOKS:
1. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw, Publisher: CRC.

REFERENCE BOOK:
RESEARCH METHODOLOGY AND IPR

Prerequisite: None

Course Objectives:
- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to
- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:
Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:

UNIT-V:
TEXT BOOKS:
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

REFERENCES:
List of Experiments:
1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Direct Kinematic analysis of a robot.
8. Inverse Kinematic analysis of a robot.
9. Trajectory planning of a robot in joint space scheme.
11. To determine the characteristic curves of the Watt and Porter Governors.
12. To determine the characteristic curves of the Proell and Spring-loaded Governors.
13. To determine the characteristics of Journal Bearings.
List of Experiments:
1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.
5. Preparation of metallic specimens by electro polishing.
6. Study of work hardening characteristics of a pure metal.
7. Determination of carbon percentage in the given ferrous specimen.
8. To determine the deflection of a Structural Member using Pin-jointed setup
9. Calculation of Shear Centre of a different cross-sections using Shear Centre setup
10. To determine the deflection of a Frame using Portal Frame Setup
11. Analyse the Stress Distribution of a Structural Member using Curved Beam apparatus.
12. Determination of natural frequency of given structure using FFT analyzer.

Note: Any 10 experiments may be performed from the above listed experiments.
Prerequisites: CAD/CAM

Course Objectives:
- Learn modeling curves (B-splines and Bezier)
- Learn modeling Bezier and B-spline surfaces
- Familiarity with NURBS
- Familiarity with advanced techniques such as subdivision and reconstruction
- Mastery of object construction and manipulation methods including lofting, surface of revolution, and tubularization.
- Mastery of Reconstruction from PCD and Mesh generation

Course Outcomes: After doing this course, the student should be able to do
- 2D & 3D transformations
- Develop cubic splines, Bezier curves and B-spline curves
- Write equations of surfaces, quadratic surfaces and analyze mathematically

UNIT–I:
Geometrical Modeling: Introduction, History, Geometrical representation, Linear Algebra Boolean Algebra, Vectors, Matrices, Equations for curves- Intrinsic and Explicit, parametric equations of curves, conic curves and points on curves, Problems

UNIT–II:
Transformations: 2-D and 3D Transformations, translation, Rotation, Homogeneous space, Scaling, stretching, Mirror reflection, Composite Transformations and problems

UNIT–III:
Cubic Splines: Algebraic and geometric force of cubic spline, parametric space of a curve, blending functions, Problems
Bezier Curves: Berusstein’s polynomials, equations, control points, convex hull property, truncating and subdividing composite and Rational Bezier curves, Problems
B-Spline Curves: Uniform and non-uniform B-Spline basis functions, quadratic and cubic B-spline basis functions, NURBS, Problems

UNIT–IV:
Surfaces: Explicit and Implicit equations of surfaces, quadratic surfaces, parametric equation of surfaces, Curve Nets and Embedded Curves, Generation, Mathematical Analysis, Applications of Bezier and B-Spline Surfaces, Surface patches. Problems

UNIT–V:

TEXT BOOKS:
2. CAD/CAM concepts and Applications by Alavala, PHI
REFERENCE BOOKS:
1. Curves and surfaces for CAGD, Fifth Edition by Gerald Farin, Elsevier, India
2. Computer Graphics by Alavala, PHI, New Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
ADVANCED FINITE ELEMENT AND BOUNDARY ELEMENT METHODS
(Professional Core - IV)

Prerequisite: Strength of Materials, Mathematics, Heat Transfer and Vibrations.

Course Objectives:
- To introduce the basic concepts of the finite element method, the boundary element method
- To discuss the advantages and limitations of each method
- To demonstrate the capabilities of each method on a variety of problems

Course outcomes: After completing this course, the student should be able to
- Understand the background of mathematical equations used for development of modeling software modules to develop the various structural related applications
- Identify mathematical model for solution of common engineering problems.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.

UNIT–I:
One Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions.
Analysis of Trusses: Derivation of Stiffness Matrix for Trusses, Stress and strain Calculations, Calculation of reaction forces and displacements.
Analysis of Beams: Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

UNIT–II:

UNIT–III:
Steady state heat transfer analysis: One Dimensional Finite Element analysis of fin and composite slabs. Two-dimensional steady state heat transfer problems: Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST, Derivation of thermal force vector for 2D heat transfer problems.
Dynamic Analysis: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

UNIT–IV:
Plate Bending: Introduction – Plate behavior – C¹ (Kirchoff) Plate elements – C⁰ (Mindlin) Plate elements – Mindlin beam – More devices for C⁰ Plate elements – Boundary conditions - Analytical problems.
Nonlinear finite element of solids: Material Nonlinearities, objective rates, nonlinear elasticity, Plasticity, viscoplasticity, viscoelasticity

UNIT–V:
Boundary Element Formulation for Electrostatic Problems: Introduction, Basic Relation- Boundary condition, other relations. Discretization and Matrix Formulation – Determination of term C(p)m.

Text Books:

Reference Books:
1. Finite Element Methods by Alavala, PHI.
2. Introduction to Finite Elements in Engineering by Tirupathi K. Chandrupatla and Ashok D. Belagundu.
3. An Introduction to Finite Element Methods by J. N. Reddy, Mc Grawhill
5. Concepts and Applications of Finite Element Analysis by Robert Cook, Wiley
ADVANCED MACHINE DESIGN (Professional Elective - III)

Prerequisite: Design of Machine Elements

Course Objectives:
- To study design concepts in order to enhance the basic design.
- To study behaviour of mechanical components under fatigue and creep.
- To study statistical techniques and its applications in mechanical design.

Course outcomes: After completing this course, the student should be able to
- Ability to analyze behaviour of mechanical elements under different loads
- Understand the design of different transmission elements of automobile
- Ability to analyze mechanical elements critically.

UNIT-I:

UNIT-II:
Rope drive: Fibre ropes, rope drives for power transmission, fibrous Ropes used in Hoisting Tackle, Wire Ropes, Materials, Wire Rope Construction, Applications of Ropes, properties of various types of Ropes, Approximate wire Diameters and Effective Cross-section of Ropes: Fiber cores for steel wire ropes, Working loads, Friction and Efficiency wire rope, sheaves and Drum, rope fasteners, Selection of wire rope, design procedure.

UNIT-III:
Chain drives: Types of Chain drives, construction of Chains, Roller Chains, Silent Chains, selection of a chain, Design of the chain Drive, Good design practice.

UNIT-IV:
Gear drives: Design calculations for helical gears, Definitions, double helical, Gear tooth proportions, Design calculations, forces acting in a Bevel gear, Worm gear drives, worm wheel, designation of a worm gear drive, Materials, efficiency of Drive, Heat Dissipation, Design of worm Gearing, Forces on worm gears, advantages and disadvantages of worm gear drives.

UNIT-V:
Power screws: Friction, Types of Power screws, Multiple threads, Comparison of square and trapezoidal threads, Power screw drive, Efficiency of screws, square threads, Trapezoidal Threads, stresses in screws design calculations, design procedure, other types of screws, differential and compounds screws, ball baring screws.

TEXT BOOKS:

REFERENCE BOOKS:
1. Machine Design by Schaum series
2. Mechanical Engineering design by J.E. Shigley
MECHANICS OF COMPOSITE MATERIALS (Professional Elective - III)

Prerequisite: Structure and properties of composite materials and design procedures for composite structures

Course objectives: To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching and to predict the elastic properties of both long and short fiber and understand the stress-strain relations and establish the failure criteria for laminated structures.

Course Outcomes: At the end of the course the students will be able to
- Understanding of types, manufacturing processes, and applications of composite materials.
- Basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- Ability to analyze problems on macro and micro mechanical behavior of lamina
- Ability to analyze problems on macro mechanical behavior of laminate
- An ability to predict the loads and moments that cause an individual composite layer and a composite laminate to fail and to compute hygro thermal loads in composites.
- An ability to compute the properties of a composite laminate with any stacking sequence.

UNIT – I:

UNIT – II:
Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT – III:
Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship 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. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.
UNIT – V:
Analysis of Laminated Composite Plates: Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

TEXT BOOKS:

REFERENCES BOOKS:
CONTROL SYSTEMS (Professional Elective - III)

UNIT-I:
Industrial Automatic Controls - Classification – Proportional derivative and integral control actions – Liquid level control systems with proportional and integral control – Pneumatic, hydraulic and electronic controllers

UNIT-II:

UNIT-III:

UNIT-IV:

UNIT-V:
State Variable Model and Analysis - Concepts of state & state variables – Derivation of state models from Block diagrams - State space representation of systems – Transfer matrix - Solution of state equation – State transition matrix – Concepts of controllability and observability.

TEXT BOOKS:
1. Control systems, Principles and Design / M Gopal / TMH
2. Modern Control Engineering/ K.Ogata / Prentice Hall
3. Control Systems /Anand Kumar / Prentice Hall

REFERENCE BOOKS:
1. Control Systems Engineering /Nagrath & M. Gopal/ Wiley Eastern
2. Automatic control systems/ B.C.Kuo/John Wiley & Sons\ Modern Control Systems/ Richard C.Dorf and Robert H. Bishop
MACHINE TOOL DESIGN (Professional Elective - IV)

UNIT – I

UNIT – II

UNIT – III

UNIT – IV
Computer-Aided Programming: General information, APT programming, Examples apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors introduction to CAD/CAM software, automatic Tool Path generation.

UNIT - V
Tooling for CNC Machines: Interchangeable tooling system, present and qualifies tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control; Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

TEXT BOOKS:

REFERENCES BOOKS:
Prerequisite: Design of machine members, Fluid Mechanics

Course Objectives:
- To Explain the processes of lubrication in all regimes
- To Explain the friction phenomena
- To Select a suitable lubricant for a specific application
- To Select a suitable material combination for tribological contacts
- To Determine the risk of wear by using simple analyses
- To Suggest an explanation to the cause of a tribological failure

Course outcomes: After completing this course, the student should be able to
- Understand the different types of lubrications and relevant theories used in supporting elements.
- Understand the failure mechanisms in different types of supporting elements.

UNIT–I:
Selection of rolling element bearings: Nominal life, static and dynamic capacity - Equivalent load, probabilities of survival - cubic mean load - bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT–II:

UNIT–III:

UNIT–IV:
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.
Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants - additives - lubrication systems and their selection – selection of pump, filters, piping design - oil changing and oil conservation.

UNIT–V:
Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferro graphy. Factors to be considered for life enhancement

TEXT BOOKS:
1977.

REFERENCES BOOKS:
Prerequisites: Kinematics of machinery

Course Objectives:
- To demonstrate knowledge of different types of actuators used in robotic systems.
- To analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To analyze the dynamics of a robot arm, implement in 2D.
- To analyze sensor signals to implement real-time control algorithms.
- To demonstrate knowledge of error propagation in electrical, mechanical, and computational systems.
- To construct, program, and test the operation of a robotic system to perform a specified task.

Course Outcomes: After doing this course, the student should be able to:
- Understand the evolution, classification, structures, and drives for robots.
- Teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- Expose the students to build a robot for any type of application.


UNIT-II: Motion Analysis and Control: Manipulator kinematics, position representation, homogeneous transformation, D-H notation, D-H transformation matrix, forward & inverse transformations, problems on planar & spatial manipulators, differential kinematics, Jacobian formulation, problems, manipulator path control: slew, joint interpolated & straight line motions, trajectory planning: joint space scheme, Cartesian space scheme, cubic polynomial fit without and with via point, blending.


UNIT-IV: Robot Programming: Lead through programming, Robot programming as a path in space, motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.
UNIT-V:
Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

TEXT BOOKS:
1. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
2. Industrial robotics by Mikell P.Groover, McGraw Hill.

REFERENCE BOOKS:
1. Industrial robotics by Mikell P.Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
Prerequisite: CAD, FEM

Course Outcomes: At the end of the course the students will be able to
- Students should be able to use CATIA and Pro-E and software for modeling, tolerance & GD&T analysis of a product.
- Students should be able to use CATIA software to model a consumer product and industrial robot.

DRAFTING:
1. Development of part drawings for various components in the form of orthographic and isometric.

PART MODELING:
1. Generation of various 3D Models through pad, shaft, shell sweep.
2. Feature based and Boolean based modeling surface and Assembly Modeling. Design simple components.
3. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
4. To make an isometric dimensional drawing of a connecting rod.
5. Draw Different type’s bolts and nuts with internal and external threading in Acme and Square threading standards. Save the bolts and nut as blocks suitable for insertion.
6. To model and assemble the flange coupling as per the dimensions given and also convert the 3D model into different views.
7. To model and assemble the Screw jack as per the dimensions given and also convert the 3D model into different views.
8. To model and assemble the strap joint of Gib & cotter as per the dimensions given and also convert the 3D model into different view.
9. Various Dimensioning and tolerancing techniques on typical products using CAD software.
10. Simulation of Kinematic Mechanism using MS Adams Package
Prerequisite: CAD, FEM

Course Outcomes: At the end of the course the students will be able to
- Students should be able to carry out structural, Harmonic and fracture analysis using FEA software for real time applications.

Note: Conduct any Ten exercises from the list given below:
1. Analysis of Framed structures using FEA software.
2. Perform Fracture analysis for simple problem using FEA software.
3. Analysis of laminated composite structures using FEA software.
4. Perform a simple modal analysis for a cantilever beam using FEA software.
5. Perform Harmonic analysis for a given cantilever beam using FEA.
6. Perform a simple transient analysis for different beams.
7. Non Linear Analysis: Find the geometric non linearity behavior for a cantilever beam subjected to a large moment.
8. Buckling analysis: Solve simple buckling problems using Eigen value and non linear methods
10. Thermal Analysis of 1D & 2D problem with conduction and convection boundary conditions. (Minimum 4 exercises)
11. Design optimization of unknown parameters for a given beam.
12. Use of contact elements to simulate two given beams when they are in contact with each other.
13. Flow Over a Flat Plate: Solve a classical flat plate 2-D air flow problem
15. Sub-structuring: Solve a simple problems using Sub-structuring method in ANSYS.
Prerequisites: None

Course Outcomes:
- After doing this course, the student should be able to understand the need of Industrial Product & Development, customer needs & Design aspects of new products.
- Able to involve customer into the development of new products and managing requirements
- Able to understand the design of experiments and technical analysis
- Know product architecture
- Investigate the customer requirement and survey of problems
- Design for manufacture and do prototyping

UNIT – I:
**Introduction:** Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behavior analysis

UNIT – II:

UNIT – III:
**Product architecture:** Implications – Product change – variety – component standardization
- Product performance – manufacturability
**Industrial design:** Assessing the need for industrial design, impact – design process
Integrate design process – assessing the quality of industrial design.
**ROBUST DESIGN:** introduction, various steps in robust design.

UNIT – IV:

UNIT – V:
**Design for manufacturing:** Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –cost of supporting production. Minimizing System complexity.
**Prototyping:** Prototype basics – Principles of prototyping – planning for prototypes – Economic analysis. Understanding and representing tasks – baseline project planning – accelerating the project execution.

REFERENCE BOOKS:
CONDITION MONITORING (Professional Elective - V)

Pre-requisites: Dynamics of Machinery

Course Outcomes: At the end of this course the student shall be able to:
- Understand the types of maintenance used and its significance, role of condition based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries.
- Implement the basic signal processing techniques.
- Understand the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines.
- Understand the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance.
- Study condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining.

UNIT – I:
Introduction to maintenance and condition based maintenance Definition, system approach, objectives, responsibilities of maintenance department, maintenance strategies, principles of maintenance, concepts of maintainability, availability and reliability, implementation of CBM, comparison of CBM with other maintenance techniques and case studies (overview). Introduction to condition monitoring Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.

UNIT – II:
Basic signal processing techniques Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrum analysis, Digital filtering, Deterministic/random signal separation, Time-frequency analysis. Wavelet Transform Introduction to Wavelets, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Wavelet Packet Transform (WPT), types of wavelets – Haarwavelets, Shannon wavelets, Meyer wavelets, Daubechies wavelets, Coifmann wavelets and applications of wavelets.

UNIT – III:
Vibration Monitoring Introduction, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis. Rotating and reciprocating machines Vibration signals from rotating and reciprocating machines – signal classification, signals generated by rotating machines, signals generated by reciprocating machines.

UNIT – IV:
Mechanical fault diagnosis Wear monitoring and lubricant analysis - sources of contamination, techniques, Spectrometric Oil Analysis Procedure (SOAP) and ferrography. Nondestructive testing techniques Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection.

UNIT – V:
Condition monitoring of rolling element bearings and gear Introduction, construction, types of faults, rolling element bearing diagnostics and gear diagnostics. Tool wear monitoring Introduction, techniques and case studies. 2 hours
TEXT BOOKS:
1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications, John Wiley & Sons Ltd., 2011
3. ISTE Course material on Condition Monitoring.

REFERENCE BOOKS:
VEHICLE DYNAMICS (Professional Elective - V)

Prerequisite: Automobile Engineering

Course Objectives:
- The students should be able to understand multi-body system approach to vehicle dynamics.
- The student should be able to use 2-D computational software to solve vehicle dynamics problems

Course Outcomes: At the end of the course the students will be able to
- The focus of Automotive System Dynamics is to introduce the fundamentals of vehicle dynamics and the performance indices and evaluation criteria of vehicles, to analyze the influence of vehicle configuration and design parameters on vehicle performance.

UNIT-I:

UNIT-II:
Three dimensional Mechanisms, Multi-Body Systems Design, Introduction to 3D vehicle design.

UNIT-III:
Suspension Design: Computer models using Bond Graph Technology, Drive train dynamics, vehicle performance

UNIT-IV:

UNIT-V:
Wheeled Vehicle Handling – Handling control loop, vehicle transfer function, Kinematic behavior of vehicles with rigid wheels and with compliant tyres: Neutral steer point, static margin, over and under-steer. Solution with two degree of freedom in the steady state: Stability factor, characteristic and critical speeds. Tracked Vehicle Handling – Analysis of sprocket torques and speeds, required to skid steer a tracked vehicle. Extension of theory to include three degrees of freedom.

TEXT BOOKS:

REFERENCE BOOKS:
1. Vehicle stability by Dean Karnopp, Dekker Mechanical Engineering
4. Fundamental of Vehicle Dynamics by Gillespie T.D, SAE USA.
Prerequisite: None

Course objectives: Students will be able to:
- Understand how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title. Ensure the good quality of paper at very first-time submission

UNIT-I:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI:
useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

TEXT BOOKS/ REFERENCES:
Prerequisite: None

Course Objectives: Students will be able to
- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches.
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:
Introduction:
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II:
Repercussions Of Disasters And Hazards:
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Spills And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III:
Disaster Prone Areas In India:
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT-IV:
Disaster Preparedness And Management:
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V:
Risk Assessment Disaster Risk:

UNIT-VI:
Disaster Mitigation:
Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.
TEXT BOOKS/ REFERENCES:
2. Sahni, Pardeep Et.Al. (Eds.)" Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to
- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to
- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

UNIT-II:

UNIT-III:
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

UNIT-V:

TEXT BOOKS/ REFERENCES:
Prerequisite: None

Course Objectives: Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT-II:
Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT-III:

UNIT-IV:
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:
UNIT-VI:
**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

**TEXT BOOKS/ REFERENCES:**
1. The Constitution of India, 1950 (Bare Act), Government Publication.
PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:
- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

UNIT-II:
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:
Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT-IV:
Professional development: alignment with classroom practices and follow-up support. Peer support, Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.

UNIT-V:
Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

TEXT BOOKS/ REFERENCES:
STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:
Definitions of Eight parts of Yog. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do’s and Don’t’s in life.
i) Ahinsa, satya, astheya, brahmacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/REFERENCES:
1. “Yogic Asanas for Group Tarining-Part-I”: Janardan Swami Yogabhysani Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama
   (Publication Department), Kolkata
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

Prerequisite: None

Course Objectives:
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:
Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:
Neetisatakam-Holistic development of personality
- Verses- 52,53,59 (dont’s)
- Verses- 71,73,75,78 (do’s)

UNIT-III:
Approach to day to day work and duties.
- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:
Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12-Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:
1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.