# M.E. STRUCTURAL ENGINEERING

## SEMESTER I

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TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 70

### UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY CHENNAI : : CHENNAI 600 025

REGULATIONS - 2009

CURRICULUM I TO VI SEMESTERS (PART TIME)

M.E.STRUCTURAL ENGINEERING

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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 70**

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OBJECTIVE:

- To familiarize the students in the field of differential and elliptic equations to solve boundary value problems associated with engineering applications.

- To expose the students to variational formulation and numerical integration techniques and their applications to obtain solutions for buckling, dynamic response, heat and flow problems of one and two dimensional conditions.

UNIT I ONE DIMENSIONAL WAVE AND HEAT EQUATIONS 10+3


UNIT II ELLIPTIC EQUATION 9+3

Laplace equation – Properties of harmonic functions – Solution of Laplace’s equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip – Solution of Poisson equation by Fourier transform method.

UNIT III CALCULUS OF VARIATIONS 9+3

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

UNIT IV EIGEN VALUE PROBLEMS 9+3


UNIT V NUMERICAL INTEGRATION 8+3

Gaussian Quadrature – One and Two Dimensions – Gauss Hermite Quadrature – Monte Carlo Method – Multiple Integration by using mapping function

TOTAL (L:30+T:15) : 45 PERIODS

REFERENCES:

# OBJECTIVE:

- To study the behaviour, analysis and design of R.C. structures.

## UNIT I  OVERALL REVIEW  9

Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS and ACI Codes.

## UNIT II  DESIGN OF SPECIAL RC ELEMENTS  10


## UNIT III  FLAT SLABS AND FLAT PLATES  10

Design of flat slabs and flat plates according to IS and ACI methods - Design of shear reinforcement - Design of spandrel beams - Yield line theory and Hillerborgs strip method of design of slabs.

## UNIT IV  INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES  9


## UNIT V  DETAILING AND FIELD PRACTICE  7

Detailing for ductility - Fire resistance of structural members – Quality of control of concrete

TOTAL: 45 PERIODS

## REFERENCES:

OBJECTIVE:

- To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.

UNIT I  PRINCIPLES OF VIBRATION ANALYSIS  9+3
Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems, Effect of damping, Transmissibility.

UNIT II  TWO DEGREE OF FREEDOM SYSTEMS  9+3
Equations of Motion of Two degree of freedom systems, normal modes of vibration, applications.

UNIT III  DYNAMIC ANALYSIS OF MDOF  9+3
Multidegree of freedom systems, orthogonality of normal modes, approximate methods. Mode superposition technique, numerical integration procedure.

UNIT IV  DYNAMIC ANALYSIS CONTINUOUS SYSTEMS  9+3

UNIT V  PRACTICAL APPLICATIONS  9+3
Idealisation and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics, gust phenomenon, principles of analysis.

TOTAL (L:45+T:15) : 60 PERIODS

REFERENCES:

OBJECTIVE:

- To understand the concept of 3D stress, strain analysis and its applications to simple problems.

UNIT I ELASTICITY 9+3

UNIT II ELASTICITY SOLUTION 9+3
Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar co-ordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION 9+3
Saint-venant’s approach - Prandtl’s approach – Membrane analogy - Torsion of thin walled open and closed sections.

UNIT IV ENERGY METHODS 9+3

UNIT V PLASTICITY 9+3

TOTAL (L:45+T:15) : 60 PERIODS

REFERENCES:

OBJECTIVE

- To study the energy principles, finite element concept, stress analysis, meshing, nonlinear problems and applications.

UNIT I INTRODUCTION 9+3


UNIT II STRESS ANALYSIS 9+3

Two Dimensional problems – Plane Stress, Plane Strain and Axisymmetric Problems – Triangular and Quadrilateral Elements – Natural Coordinates - Isoparametric Formulation - Numerical Integration – Plate Bending and Shell Elements — Brick Elements – Elements for Fracture Analysis

UNIT III MESHING AND SOLUTION PROBLEMS 9+3


UNIT IV NONLINEAR, VIBRATION AND THERMAL PROBLEMS 9+3

Material and Geometric Nonlinearity – Methods of Treatment – Consistent System Matrices – Dynamic Condensation – Eigen Value Extraction - thermal analysis.

UNIT V APPLICATIONS 9+3

Modeling and analysis using recent softwares.

TOTAL (L:45+T:15) : 60 PERIODS

REFERENCES:

OBJECTIVE:

- To learn the principles of measurements of static and dynamic response of Structures and carryout the analysis of results.

UNIT I FORCES AND STRAIN MEASUREMENT 6+6

UNIT II VIBRATION MEASUREMENTS 6+6

UNIT III ACOUSTICS AND WIND FLOW MEASURES 6+6

UNIT IV DISTRESS MEASUREMENTS AND CONTROL 6+6

UNIT V NON DESTRUCTIVE TESTING METHODS 6+6

TOTAL (L:30 + P:30) : 60 PERIODS
REFERENCES:

OBJECTIVE:

- To study the behaviour of members and connections, analysis and design of steel towers, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

UNIT I  GENERAL  9
Design of members subjected to lateral loads and axial loads, Analysis and design of Industrial Buildings and bents, Sway and non-sway frames, Design of Purlins, Louver rails, Gable column and Gable wind girder - Design of Moment Resisting Base Plates – Analysis of Gable Frames.

UNIT II  DESIGN OF CONNECTIONS  9

UNIT III  ANALYSIS AND DESIGN OF STEEL TOWERS  9

UNIT IV  PLASTIC ANALYSIS OF STRUCTURES  9

UNIT V  DESIGN OF LIGHT GAUGE STEEL STRUCTURES  9

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the effect of earthquakes, analysis and design of earthquake resistant Structures.

UNIT I EARTHQUAKES AND GROUND MOTION 9
Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation.

UNIT II EFFECTS OF EARTHQUAKE ON STRUCTURES 9
Dynamics of Structures (SDOFS/ MDOFS), Response Spectra - Average Response Spectra - Design Response Spectra, Evaluation of Earthquake Forces as per codal provisions, Effect of Earthquake on Different Types of Structures, Lessons Learnt From Past Earthquakes

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

UNIT V SPECIAL TOPICS 9

TOTAL: 45 PERIODS

REFERENCES:

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
   a. To determine the damping coefficients from free vibrations.
   b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
   a. Drift of the frame.
   b. Stiffness of the frame.
   c. Energy dissipation capacity of the frame.
6. Determination of in-situ strength and quality of concrete using i) rebound hammer and ii) Ultrasonic Pulse Velocity Tester

LABORATORY EQUIPMENTS REQUIREMENTS

1. Strong Floor
2. Loading Frame
3. Hydraulic Jack
4. Load Cell
5. Proving Ring
6. Demec Gauge
7. Electrical Strain Gauge with indicator
8. Rebound Hammer
9. Ultrasonic Pulse Velocity Tester
10. Dial Gauges
11. Clinometer
12. Vibration Exciter
13. Vibration Meter
14. FFT Analyser

REFERENCES:

OBJECTIVE:

- To study the properties of materials, tests and mix design for concrete.

UNIT I  CONCRETE MAKING MATERIALS  9


UNIT II  CONCRETE  9


UNIT III  MIX DESIGN  9

Principles of concrete mix design, Methods of concrete mix design, Testing of Concrete. Statistical quality control- sampling and acceptance criteria.

UNIT IV  SPECIAL CONCRETE  9


UNIT V  CONCRETING METHODS  9


TOTAL : 45 PERIODS

REFERENCES:

OBJECTIVE:

- To learn the principles of Computer graphics, Structural analysis, Finite element analysis and Application packages, Optimization and Artificial intelligence.

UNIT I  COMPUTER GRAPHICS  6+6


UNIT II  STRUCTURAL ANALYSIS  6+6

Computer methods of structural analysis –Analysis through software packages.

UNIT III  STRUCTURAL DESIGN  6+6

Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials

UNIT IV  OPTIMIZATION  6+6

Application of linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications -

UNIT V  ARTIFICIAL INTELLIGENCE  6+6


TOTAL (L:30 + P:30) : 60 PERIODS

REFERENCES:

OBJECTIVE:

- To study the loads, forces on bridges and design of several types of bridges.

UNIT II INTRODUCTION 6
Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT II SHORT SPAN BRIDGES 9
Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.

UNIT III LONG SPAN GIRDER BRIDGES 12
Design principles of continuous bridges, box girder bridges, balanced cantilever bridges.

UNIT IV DESIGN OF PRESTRESSED BRIDGES 9

UNIT V DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES 9

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNIT I  CLASSIFICATION OF SHELLS  6+6

UNIT II  FOLDED PLATES  6+6
Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof.

UNIT III  INTRODUCTION TO SPACE FRAME  6+6
Space frames - configuration - types of nodes - general principles of design Philosophy - Behaviour.

UNIT IV  ANALYSIS AND DESIGN  6+6
Analysis of space frames – detailed design of Space frames – Introduction to Computer Aided Design and Software Packages.

UNIT V  SPECIAL METHODS  6+6
Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL (L:30 + P:30) : 60 PERIODS

REFERENCES:

OBJECTIVE:

- To develop an understanding of the behaviour and design study of Steel concrete composite elements and structures.

UNIT I  INTRODUCTION  9
Introduction to steel - concrete composite construction - theory of composite structures - construction.

UNIT II  DESIGN OF COMPOSITE MEMBERS.  9
Design of composite beams, slabs, columns, beam – columns - design of composite trusses.

UNIT III  DESIGN OF CONNECTIONS  9
Types of connections, Design of connections in the composite structures - shear connections. Degree of shear connection – Partial shear interaction

UNIT IV  COMPOSITE BOX GIRDER BRIDGES  9
Introduction - behaviour of box girder bridges - design concepts.

UNIT V  GENERAL  9
Case studies on steel - concrete composite construction in buildings - seismic behaviour of composite structures.

TOTAL: 45 PERIODS

REFERENCES:

ST 9155       DESIGN OF TALL BUILDINGS                L  T  P  C
3   0   0   3

OBJECTIVE:

- To study the behaviour, analysis and design of tall structures.

UNIT I       DESIGN PRINCIPLES AND LOADING  9
Design philosophy, Loading, sequential loading, materials - high performance, concrete - Fibre reinforced Concrete - Light weight concrete - design mixes. Gravity loading Wind loading Earthquake loading

UNIT II      BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS  9
Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems.

UNIT III     ANALYSIS AND DESIGN  9
Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis.

UNIT IV      STRUCTURAL ELEMENTS  9
Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V       STABILITY OF TALL BUILDINGS  9
Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the requirements, planning and design of Industrial structures.

UNIT I  PLANNING AND FUNCTIONAL REQUIREMENTS  9

UNIT II  INDUSTRIAL BUILDINGS  9

UNIT III  POWER PLANT STRUCTURES  9
Types of power plants – Design of Turbo generator foundation – containment structures.

UNIT IV  POWER TRANSMISSION STRUCTURES  9

UNIT V  AUXILLIARY STRUCTURES  9
Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the damages, repair, rehabilitation of structures.

UNIT I MAINTENANCE AND REPAIR STRATEGIES 8
Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 8
Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking

UNIT III MATERIALS AND TECHNIQUES FOR REPAIR 15
Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection.

UNIT IV REPAIRS TO STRUCTURES 10
Repair of structures distressed due to earthquake – Strengthening using FRP - Strengthening and stabilization techniques for repair.

UNIT V DEMOLITION OF STRUCTURES 4
Engineered demolition techniques for structures - case studies

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

UNIT I  INTRODUCTION  9
Introduction to Composites, Classifying composite materials, Commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites,

UNIT II  STRESS STRAIN RELATIONS  9
Concepts in solid mechanics, Hooke’s law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III  ANALYSIS OF LAMINATED COMPOSITES  9

UNIT IV  FAILURE AND FRACTURE OF COMPOSITES  9
Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V  APPLICATIONS AND DESIGN  9
Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the concept of nonlinear behaviour and analysis of elements and simple structures.

UNIT I ELASTIC ANALYSIS OF FLEXURAL MEMBERS 9
Introduction to nonlinear mechanics; statically determinate and statically indeterminate flexible bars of uniform and variable thickness.

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9
Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints.

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9
Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading.

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9
Elastic and inelastic analysis of uniform and variable thickness plates.

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9
Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

REFERENCES:

OBJEKTIVE:

- To study the concept of wave theories, forces and design of jacket towers, pipes and cables.

UNIT I WAVE THEORIES 8
Wave generation process, small and finite amplitude wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 8
Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9
Different types of offshore structures, foundation modeling, structural modeling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 10
Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT V DESIGN OF OFFSHORE STRUCTURES 10
Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the optimization methodologies applied to structural engineering

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9


UNIT II LINEAR AND NON-LINEAR PROGRAMMING 10


UNIT III GEOMETRIC PROGRAMMING 8

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty.

UNIT IV DYNAMIC PROGRAMMING 9

Bellman’s principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods.

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multistorey buildings, water tanks and bridges.

REFERENCES:


TOTAL: 45 PERIODS
OBJECTIVE:
- To Study the design principles, analysis and design of elements.

UNIT I DESIGN PRINCIPLES
General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II REINFORCED CONCRETE
Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, - Connections – Beam to column and column to column.

UNIT III FLOORS, STAIRS AND ROOFS
Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV WALLS
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS

TOTAL: 45 PERIODS

REFERENCES:
OBJECTIVE:

- Principle of prestressing, analysis and design of prestressed concrete structures.

UNIT I PRINCIPLES OF PRESTRESSING 9
Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts.

UNIT II DESIGN OF FLEXURAL MEMBERS 9
Behaviour of flexural members, determination of ultimate flexural strength – Codal provisions -Design of flexural members, Design for shear, bond and torsion. Design of end blocks.

UNIT III DESIGN OF CONTINUOUS BEAMS 9
Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and gap cables

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9
Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flagmasts and similar structures.

UNIT V DESIGN OF COMPOSITE MEMBERS 9
Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the concept of buckling and analysis of structural elements.

UNIT I  BUCKLING OF COLUMNS  12

UNIT II  BUCKLING OF BEAM-COLUMNS AND FRAMES  9
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method.

UNIT III  TORSIONAL AND LATERAL BUCKLING  9
Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever,

UNIT IV  BUCKLING OF PLATES  9
Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques

UNIT V  INELASTIC BUCKLING  6
Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates

REFERENCES:


TOTAL: 45 PERIODS
OBJECTIVE:

- To study the behaviour and analysis of thin plates and the behaviour of anisotropic and thick plates.

UNIT I  INTRODUCTION TO PLATES THEORY  10
Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT II  RECTANGULAR PLATES  12
Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions, plates on elastic foundation.

UNIT III CIRCULAR PLATES  8
Symmetrical bending of circular plates.

UNIT IV SPECIAL AND APPROXIMATE METHODS.  8
Energy methods, Finite difference and Finite element methods.

UNIT V ANISOTROPIC PLATES AND THICK PLATES  7
Orthotropic plates and grids, moderately thick plates.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVE:

- To study the concept of wind effects, analysis and design of structures.

UNIT I INTRODUCTION
Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects.

UNIT II WIND TUNNEL STUDIES
Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

UNIT III EFFECT OF WIND ON STRUCTURES
Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, chimneys.

UNIT IV IS CODES AND SPECIAL STRUCTURES
Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters

UNIT V CYCLONE EFFECTS
Cyclone effect on structures, cladding design, window glass design.

TOTAL: 45 PERIODS

REFERENCES: