31031 - ENGINEERING MECHANICS

DETAILED SYLLABUS

Unit I SIMPLE STRESSES AND STRAINS

1.1 INTRODUCTION TO STRESSES AND STRAINS Definitions of: Force, Moment of force, Actions and reactions, Statics, Static equilibrium of bodies, Mechanics, Engineering Mechanics - Conditions of static equilibrium - Types of forces on structural members - Study of strength of material - Mechanical properties of materials – Rigidity, Elasticity, Plasticity, Compressibility, Hardness, Toughness, Stiffness, Brittleness, Ductility, Malleability, Creep, Fatigue, Tenacity, Durability - Definitions of stress and strain - Types of stresses -Tensile, Compressive and Shear stresses - Types of strains - Tensile, Compressive and Shear strains - Elongation and Contraction - Longitudinal and Lateral strains - Poisson's Ratio - Volumetric strain - Simple problems in computation of stress, strain, Poisson's ratio, change in dimensions and volume etc- Hooke's law - Elastic Constants - Definitions of: Young's Modulus of Elasticity – Shear modulus (or) Modulus of Rigidity - Bulk Modulus - Relationship between elastic constants (Derivations not necessary)- Simple problems - Young's modulus values of few important engineering materials.

1.2 APPLICATION OF STRESS AND STRAIN IN ENGINEERING FIELD

Behaviour of ductile and brittle materials under direct loads - Load Extension curve (or) Stress Strain curve of a ductile material - Limit of proportionality, Elastic limit, Yield stress, Ultimate stress, Breaking stress, Actual / Nominal stresses - Working stress - Factor of safety - Percentage elongation - Percentage reduction in area - Significance of percentage elongation and reduction in area of cross section - Deformation of prismatic and stepped bars due to uniaxial load - Deformation of prismatic bars due to its self weight - Numerical problems. Composite Sections – Examples of composite sections in Engineering field- Advantages - Assumptions made – Principles of analysis of Composite sections - Modular ratio - Equivalent area (No problems)

Unit II SHEAR FORCE AND BENDING MOMENT

2.1 TYPES OF LOADS AND BEAMS Definitions of: Axial load, Transverse load, Concentrated (or) Point load, Uniformly Distributed load (UDL), Varying load – Types of Supports and Reactions: Simple support, Roller support, Hinged support, Fixed support; Vertical reaction, Horizontal reaction, Moment reaction- Types of Beams based on support conditions- Diagrammatic representation of beams, loads and supports– Static equilibrium equations – Determinate and indeterminate beams.

2.2 SHEAR FORCE AND BENDING MOMENT IN BEAMS Definitions of Shear Force and Bending Moment – Conventional signs used for S.F. and B.M – S.F and B.M of general cases of determinate beams – S.F and B.M diagrams for Cantilevers, Simply supported beams and Over hanging beams – Position of maximum BM - Point of contra flexure – Derivation of Relation between intensity of load, S.F and B.M. – Numerical problems on S.F and B.M.(Determinate beams with concentrated loads and udl only)

UNIT III GEOMETRICAL PROPERTIES OF SECTIONS

3.1 CENTROID Geometrical properties – Definitions and examples of Symmetrical, Anti Symmetrical, Asymmetrical shapes - Definitions of centre of gravity and centroid - Centroid of Symmetrical shapes (solid / hollow square, rectangular, circular, I Sections) - Centroid of Asymmetrical shapes (triangular, semi circular, quadrant, trapezoidal, parabolic sections) - Centroid of Anti Symmetric shapes (S , Z sections) – Built up structural sections - Problems

3.2 MOMENT OF INERTI: A Definitions of: Inertia, Moment of Inertia, Polar moment of inertia, Radius of gyration, Section Modulus, Polar modulus - Parallel and perpendicular axes theorems - Derivation of expressions for M.I / Polar M I, Section modulus and Radius of gyration of regular geometrical plane sections (rectangle, circle, triangle) – M.I about centroid axis / base, Section modulus, Radius of gyration of symmetric, asymmetric, anti-symmetric and built up sections – Numerical problems.

Unit IV STRESSES IN BEAMS AND SHAFTS

4.1 STRESSES IN BEAMS DUE TO BENDING: Types of Bending stresses – Neutral axis – Theory of simple bending – Assumptions – Moment of resistance –

Derivation of flexure/bending equation M / I = E / R = σ/y – Bending stress distribution – Curvature of beam – Position of N.A and centroid axis – Stiffness equation – Flexural rigidity – Strength equation – Significance of Section modulus – Numerical problems. 4.2 STRESS IN SHAFTS DUE TO TORSION Definitions of: Shaft, Couple, Torque (or) Twisting moment - Types of Shafts (one end fixed and the other rotating, both ends rotating at different speeds) - Theory of Pure Torsion – Assumptions -Derivation of Torsion equation, T / Ip = λmax/ R = GΘ / I - Shear stress distribution in circular section due to torsion - Strength and Stiffness of shafts – Torsional rigidity - Torsional modulus - Comparative analysis of hollow and solid shafts - Power transmitted by a shaft - Numerical problems.

UNIT V PIN JOINTED FRAMES

5.1 ANALYSIS BY ANALYTICAL METHOD (METHOD OF JOINTS) Definitions of: Frame / Truss, Pin Joint, Nodes, Rafters, Ties, Struts, Slings - Determinate and indeterminate frames - Classification of frames - Perfect and imperfect frames – Deficient / Instable and redundant frames - Formulation of a perfect frame - Common types of trusses – Support conditions - Resolution of a force - Designation of a force - Nature of forces in the frame members - Analysis of Frames – Assumptions - Methods of analysis - Analytical methods - Method of Joints and Method of Sections - Problems on Analysis of cantilever and simply supported perfect frames (with not more than ten members) with vertical nodal loads by method of joints only. Identification of members with nil force in a determinate truss. 5.2 ANALYSIS BY GRAPHICAL METHOD Graphic statics - Advantages - Space diagram - Bow's notation Resultant force (or) Equivalent force -Equilibrant force - Vector diagram - Determination of magnitude and nature of forces in the members of a cantilever / simply supported determinate trusses (with not more than ten members) with vertical nodal loads only.

Reference Book : 1) R.S.Khurmi "Strength of Materials", S.Chand & Company Ltd, New Delhi 2) S.Ramamirtham, "Strength of Materials", Dhanpat Rai (2003)