II YEAR I SEM

15AME07-MECHANICS OF SOLIDS

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Course Objectives

- To solve advanced solid mechanics problems using classical methods Outcomes:
- To understand the theory of elasticity including strain/displacement and Hooke's law relationships;
- To analyze solid mechanics problems using classical methods and energy methods;
- To solve torsion problems in bars and thin walled members;
- To solve for stresses and deflections of beams under unsymmetrical loading;
- To locate the shear center of thin wall beams;
- To obtain solutions to column buckling and plate problems;

UNIT I

Simple Stresses & Strains: Elasticity and plasticity - Types of stresses & strains - Hooke's law - stress & strain diagram for mild steel - Working stress - Factor of safety - Lateral strain, Poisson's ratio & volumetric strain - Elastic moduli & the relationship between them - Bars of varying section - composite bars - Temperature stresses. Strain energy - Resilience - Gradual, sudden, impact and shock loadings. Principle stresses and strains-computation of principle stresses and strains on inclined planes- theory of failures- minimum principle stress, strain, shear stress and strain energy theories.

UNIT II

Shear Force And Bending Moment : Definition of beam - Types of beams - Concept of shear force and bending moment - S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads and combination of these loads - Point of contra flexure - Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT III

Flexural Stresses: Theory of simple bending - Assumptions - Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis -Determination bending stresses - section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections - Design of simple beam sections.

Shear Stresses: Derivation of formula - Shear stress distribution across various beams sections like rectangular, circular, triangular, I , T angle sections.

UNIT IV

Torsion Of Circular Shafts- Theory of pure torsion- Derivation of torsion equations; $T/J=q/r=N\theta/L$ - Assumptions made in the theory of pure torsion- torsional moment of resistance- polar section modulus.

Deflection Of Beams: Bending into a circular arc - slope, deflection and radius of curvature - Differential equation for the elastic line of a beam - Double integration and Macaulay's methods - Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems - Moment area method - application to simple cases including overhanging beams.

UNIT V

Thin Cylinders: Thin seamless cylindrical shells - Derivation of formula for longitudinal and circumferential stresses - hoop, longitudinal and Volumetric strains - changes in diameter, and volume of thin cylinders - Riveted boiler shells - Thin spherical shells.

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Thick Cylinders: Lame's equation - cylinders subjected to inside & outside pressure - compound cylinders.

Text Books:

1. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2nd Edition, 2004.
2. Strength of Materials by R.K. Bansal, Laxmi Publishers, 5th Edition,2012.
3. Strength of Materials by S S Rattan, The McGraw-Hill Companies, 2 Editon,2011

Reference Books:

1. Strength of Materials by S. Ramamrutham, Dhanpat Rai Publthishers

Course outcomes

Successful completion of this course, students should be able to:

- Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tridimensional elastic solids.
- Calculate and represent the stress diagrams in bars and simple structures
- Solve problems relating to pure and non-uniform bending of beams and other simple structures.
- Solve problems relating to torsional deformation of bars and other simple tri-dimensional structures.
- Understand the concept of buckling and be able to solve the problems related to isolated bars Distinguish between isostatic and hiperstatic problems and be able to use various methods for the resolution of both.
- Be familiar with at least one software program for the evaluation of structures.