

**MECHANICS OF MATERIALS**  
**B.E, III Semester, Mechanical Engineering**  
**[As per Choice Based Credit System (CBCS) scheme]**

Course Code	17ME34	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

Credits – 04

**Course Objectives:**

- Classify the stresses into various categories and define elastic properties of materials and compute stress and strain intensities caused by applied loads in simple and compound sections and temperature changes.
- Derive the equations for principal stress and maximum in-plane shear stress and calculate their magnitude and direction. Draw Mohr circle for plane stress system and interpret this circle.
- Determine the shear force, bending moment and draw shear force and bending moment diagrams, describe behavior of beams under lateral loads.
- Explain the structural behavior of members subjected to torque, Calculate twist and stress induced in shafts subjected to bending and torsion.
- Understand the concept of stability and derive crippling loads for columns.
- Understand the concept of strain energy and compute strain energy for applied loads.

**Module - 1**

**Stress and Strain:** Introduction, Hooke's law, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Generalized Hooke's law, Bulk modulus, Relationship between elastic constants.

**Module - 2**

**Analysis of Stress and Strain:** Plane stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear stress, Mohr circle for plane stress conditions.

**Cylinders:** Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lame's equations.

**Module - 3**

**Shear Forces and Bending Moments:** Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads and uniformly distributed constant / varying loads.

**Stress in Beams:** Pure bending, Curvature of a beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses.

#### Module - 4

**Torsion:** Circular solid and hollow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections

**Columns:** Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

#### Module - 5

**Strain Energy:** Castigliano's theorem I and II, Load deformation diagram, Strain energy due to normal stresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion.

**Theories of Failure:** Maximum Principal stress theory, Maximum shear stress theory.

#### Course outcomes:

- Understand simple, compound, thermal stresses and strains their relations, Poisson's ratio, Hooke's law, mechanical properties including elastic constants and their relations.
- Determine stresses, strains and deformations in bars with varying circular and rectangular cross-sections subjected to normal and temperature loads
- Determine plane stress, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle
- Determine the dimensions of structural members including beams, bars and rods using Energy methods and also stress distribution in thick and thin cylinders
- Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples
- Determine dimensions, bending stress, shear stress and its distribution in beams of circular, rectangular, symmetrical I and T sections subjected to point loads and UDL
- Determine the dimensions of shafts based on torsional strength, rigidity and flexibility and also elastic stability of columns using Rankin's and Euler's theory

#### TEXT BOOKS:

1. James M Gere, Barry J Goodno, Strength of Materials, Indian Edition, Cengage Learning, 2009.
2. R Subramanian, Strength of Materials, Oxford, 2005.

#### REFERENCE BOOKS

1. S S Rattan, Strength of Materials, Second Edition, McGraw Hill, 2011.
2. Ferdinand Beer and Russell Johnston, Mechanics of materials, Tata McGraw Hill, 2003.

  
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