

16CE203 SOLID MECHANICS

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	15	-	20	46	6	12	3	5

Course Description and Objectives:

The course deals with various engineering properties of solid materials and calculation of internal stresses and strains produced in the material. The objective of this course is to determine shear force and bending moment in beams and columns and also to impart students the knowledge to understand the behavior of metal rods, cables and thin cylinders under the action of applied loads.

Course Outcomes:

The student will be able to:

- calculate internal stresses and strains to know mechanical behavior of solid material under the externally applied loads and forces.
- find out of shear forces and bending moments of structural components like beams, columns, and slabs, for different load cases.
- calculate the developed internal stresses in beams under flexural actions.
- calculate torsional forces developed in components with circular cross sections.
- analyse thin cylinders filled with fluid at an internal pressure.

SKILLS:

- ✓ Determine shear force and bending moment at a given section of a beam.
- ✓ Determine principal stresses and principal strains.
- ✓ Determine shearstress and bending stresse in all types of beams.
- ✓ Calculate biaxial stresses on an inclined plane.
- ✓ Analyse stability of columns by applying Euler's and Rankine's formula.

UNIT – 1**L-9, T-3**

SIMPLE STRESSES AND STRAINS: Elasticity and plasticity, Types of stresses and strains, Hook's law, Stress, Strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them, Bars of varying section, Composite bars, Temperature stresses.

UNIT – 2**L-9, T-3**

PRINCIPAL STRESSES AND STRAINS: Introduction, Stresses on an inclined section of a bar under axial loading, Compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses, Two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses, Principal stresses and strains, Analytical and graphical solutions. Introduction to Failure Theories.

THIN CYLINDRICAL SHELLS: Introduction, Hoop and Longitudinal stresses and strains, Thin spherical shell stresses.

UNIT – 3**L-9, T-3**

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, Uniformly distributed load, 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.

SHEAR STRESSES: Derivation of formula, Shear stress distribution across various beam sections like rectangular, Circular, triangular, I, T, angle sections.

UNIT – 4**L-9, T-3**

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.

TORSION: Introduction, Torsion equation, Shear stress distribution for circular solid and hollow shafts, Stepped shafts, Shafts fixed at both the ends.

UNIT – 5**L-9, T-3**

DIRECT AND BENDING STRESSES: Stresses under the combined action of direct loading and B.M, core of a section, Determination of stresses in the case of dams, Conditions for stability.

COLUMNS AND STRUTS: Introduction-types of columns, Euler's formula, Equivalent length-end conditions, Rankine's formula, Slenderness ratio.

TEXT BOOKS:

1. S. S. Bhavikatti, "Strength of Materials", 3rd edition, Vikas Publishing House, 2008.
2. S. Ramamrutham, "Strength of Materials", 7th edition, Dhanpat Rai Publishing House, 2011.

REFERENCE BOOKS:

1. L. N. Srinath, "Advanced Mechanics of Solids", 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
2. S. Timshenko, "Strength of Materials", 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
3. Vazirani and Ratwani, "Analysis of Structures", 17th edition, Khanna Publishers, 2007.
4. Sadhu Singh, "Strength of Materials", 8th edition, Khanna Publishers, 2003.

ACTIVITIES:

- Analyze stress strain variation in MS bar under tension, draw stress strain curve and find out Young's modulus for the tested specimen.
- Draw Mohr's circles for all possible combinations of biaxial stresses on an inclined plane and find out principal stresses .
- Calculate all possible forces acting on an simply supported beam in U-Block and draw bending moment and shear force diagrams along the span.
- Find out torsional rigidity of circular shaft by conducting laboratory test.
- Find out slenderness ratio for all columns in the class room and analyze them using Rankine's formula.