COURSE CONTENT

MECHANICS OF SOLIDS								
III Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2530317	**Foundation**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisites: Engineering Mechanics								

Course Overview:

This course explores the fundamental concepts of stress and strain in materials, including axial, shear, and thermal stresses. It examines shear force and bending moment relationships in beams, bending stress, and deflection analysis. The syllabus covers the theory of torsion for circular shafts and helical springs, stresses in thin-walled cylinders, and principal stresses using analytical and graphical methods. Practical applications in structural analysis and material strength are emphasized throughout.

Course Objective:

1. To Understand the concepts of internal forces, moments, stress, strain, and deformation of solids with applications to bars, beams, and columns.
2. To Learn the fundamentals of applying equilibrium, compatibility, and force – deformation relationships to structural elements.
3. To Study twisting of circular bars and hollow shafts acted on by torsional moments.
4. To Define the state of stress at a point on a body and to develop stress transformations.
5. To Introduce the concept of theories of elastic failure and their significance in the design.

Course Outcomes: After successful completion of the course, students should be able to

1. Evaluate the internal forces, moments, stresses, strains, and deformations in structures made of various materials acted on by a variety of loads.
2. Draw axial force, shear force and bending moment diagrams for beams and frames.
3. Develop the Bending and Torsion formula and apply to the design of beams and shafts.
4. Use the stress transformation equations to find the state of stress at a point for various rotated positions of the stress element and display the same in graphical form as Mohr's circle.
5. Understand the different criteria for the safety of the component by applying the theories of elastic failure.

UNIT - I [09]

Stress and Strain: Elasticity and plasticity, Types of stresses and strains, Hooke'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 sections, Composite bars, Temperature stresses. Strain energy and Resilience: Gradual, sudden, impact and shock loadings.

UNIT -II: [10]

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 and Uniformly Distribute 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.

UNIT -III: [10]

Flexural Stresses: Theory of simple bending, Assumptions, Derivation of pure bending equation, Determination of bending stresses. Section modulus for rectangular and circular sections of 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: Rectangular, Circular, Triangular, I, T and Angle sections.

UNIT -IV: [10]

Principal Stresses and Strains: Introduction, Stresses on inclined sections 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.

Torsion of Circular Shafts: Theory of pure torsion, Derivation of Torsion equations, Assumptions made in the theory of pure torsion, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion and end thrust.

UNIT –V: [9]

Columns and Struts: Euler's Theory, Limitations of Euler's theory, Equivalent Length, Rankine's Formula, Secant Formula.

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

TEXT BOOKS:

1. Strength of Materials, S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing, 20th Edition, 2020.
2. Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, CBS Publishers, 5th Edition, Reprint 2020.

REFERENCE BOOKS:

1. Strength of Materials, S. S. Rattan, Tata McGraw Hill, 2nd Edition,2011.
2. Engineering Mechanics of Solids, Egor P. Popov and Toader A. Balan, PHI Learning, 2nd Edition, 2010.
3. Strength of Materials, Bansal, Lakshmi Publications, 6th Edition.2012.

ELECTRONIC RESOURCES:

1. http://www.efunda.com/sm_home/sm.cfm
2. https://nptel.ac.in/courses/112105171/1
3. https://nptel.ac.in/courses/112107146
4. https://onlinecourses.nptel.ac.in/noc23_me140/preview

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper – I
6. Model question paper – II
7. Lecture notes
8. E-Learning Readiness Videos (ELRV)