

Approval: 16th Senate Meeting

Course Number: CE 557

Course Name : Solid Mechanics in Structural Engineering

Credits: 3-0-0-3

Prerequisites: Strength of Material and Structures (CE 301) or Mechanics of Solids (ME206) or Equivalent

Intended for: UG (Civil)/ M.S./ M.Tech./ Ph.D.

Distribution: Specialization Core (M.Tech. in Structural Engineering)/Elective (UG, MS, PhD, M.Tech)

Semester: Odd/Even

1. Preamble: This course highlights the limitations of Strength of material approach, which usually taught at undergraduate level. The course starts with the introduction to the elasticity, assumptions and applications of linear elasticity. Later, the concept of the analysis of stresses and strains will be developed and applied to the various practical problems. This course also discusses about advanced topics in structural mechanics like torsion of non-circular members, non-symmetric bending of beams, beams on elastic foundation, different failure theories and introduction to theory of Plasticity.

2. Course Modules with Quantitative Lecture Hours:

Module 1: Theories of Stress and Strain (8 hours)

Stress at a point, Equilibrium equations, Deformation of a Deformable Body, Strain tensor, Transformation of Stress/Strain, Principal Stress/Strains, Strain Compatibility, Strain – Displacement relations in Cylindrical coordinates, Equilibrium equations in Cylindrical Coordinates, Strain measurement and Strain Rosettes, Hooke's Law: Isotropic Elasticity, Elastic constants and their relations, Displacement Equations of Equilibrium.

Module 2: Plane Strain and Plane Stress (5 hours)

Plane Stress, Plane Strain, Airy's Stress function, Differential equation for the stress function, Polar coordinates in the plane, Bending of Cantilever beam, Thick – walled Cylinder subjected to Internal and External Pressures - Lamé's Problem.

Module 3: Bending of Beams (7 hours)

Nonsymmetrical bending, deflections of beams subjected to Nonsymmetrical bending, Shear flow in thin – Wall beam cross section, Bending of Curved Beams (Winkler – Bach Formula).

Module 4: Torsion**(6 hours)**

Torsion of Prismatic Bars, Torsion of Circular, Elliptical, Equilateral Triangular and Rectangular bars, Membrane Analogy, Torsion of Thin – walled tubes.

Module 5: Beams on Elastic Foundations**(5 hours)**

Infinite beam subjected to a Concentrated/ Distributed Load, Semi - infinite Beam subjected to end loads, short beams.

Module 6: Failure Theories and Introduction to Ideally Plastic solid**(6 hours)**

Theories of failure, Factor of Safety in Design, Mohr’s Theory of failure, Ideally Plastic solid, Yield Surfaces of Tresca and Von Mises, Stress-Strain Relations (Plastic Flow), Prandtl-Reuss Equation.

Module 7: Three-Dimensional elastic half-space**(5 hours)**

Elastic half-space subjected to surface point, and distributed loads (Boussinesq problem), Propagation of waves in elastic half-space (dilatation, distortion and surface waves), Introduction to earthquake induced ground vibration.

3. Text books:

- (i) Srinath L.S (2008), “Advanced Mechanics of Solids”, 3rd Edition, Tata McGraw-Hill.
- (ii) Timoshenko, S.P. and Goodier, J.N (2010), Theory of Elasticity, 3rd Edition, McGraw-Hill.

4. References:

- (i) K. F. Graff (1991), “Wave Motion in Elastic Solids”, Dover Publications, Inc.
- (ii) M. H. Sadd (2014), ‘Elasticity: Theory, application and numerics’, 3rd edition, Elsevier India.

5. Similarity content declaration with existing courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	ME 632	Hooke’s Law, Stress Components	< 5%
2	ME 606	Nonsymmetrical bending, Curved beams, Beams on elastic foundation	< 20%

6. Justification for new course proposal if cumulative similarity content is > 30%:

Not applicable

7. Approvals:

Other, Faculty interested in teaching this course: Dr. Sandip Shah

Proposed by: Dr. Mahesh Reddy Gade and Dr. Rajneesh Sharma

School: School of Engineering

Signature:

Date:

Recommended/Not Recommended, with Comments:

Date: _____

Chairman, CPC

Approved / Not Approved

Date: _____

Chairman, Senate