ME 223 Solid Mechanics - II (3-0-0-6)

Pre-requisite: ME 212 or equivalent.

Analysis of stresses: 3D state of stress at a point; principal stresses; invariants; 3D Mohr's circle; octahedral stresses; hydrostatic and pure shear stresses. Differential equations of equilibrium in rectangular and polar coordinates. Boundary conditions. Saint-Venant's principle, Principle of superposition. Analysis of strains: 3D strain components in rectangular and polar coordinates; state of strain at a point; principal strains; strain deviators and invariants. Compatibility conditions in rectangular and polar coordinates. Constitutive relations. Boundary value problems: Stress formulation and displacement formulation; Beltrami-Michell equations and Navier's equations. Methods of solution and uniqueness of solution. Plane problems: Plane stress and plane strain problems. Airy stress function. 2D problems in rectangular and polar coordinates and axisymmetric problems: Cantilever beam with end load; uniformly loaded beam; thick and thin walled cylinders; rotating discs and cylinders; plate with a circular hole. Curved beams. Torsion of non-circular bars: Saint-Venant's semi-inverse method; Prandtl's stress function method. Unsymmetrical bending, shear center and shear flow. Energy methods: Principle of virtual work; minimum potential energy; statically indeterminate systems. Elastic stability: Analysis of beam columns. Yield and Fracture criteria: Different failure theories; stress space and strain space; yield surfaces. Introduction to plasticity.

Texts:

[1] S. P. Timoshenko and J. N. Goodier, Theory Of Elasticity, McGraw Hill International, 2010.
[2] L. S. Srinath, Advanced Mechanics Of Solids, Tata McGraw-Hill, 2008.

References:

[1] M. H. Sadd, Elasticity: Theory, Applications And Numerics, Elsevier, 2005.
[2] S. H. Crandall, N. C. Dahl and T. J. Lardner, An Introduction To The Mechanics of Solids, 2nd Ed., Tata McGraw Hill, 2008.
[3] S. P. Timoshenko, Strength Of Materials, Vols. 1 and 2, CBS Publishers, 1986.
[4] H. Shames and J. M. Pitarresi, Introduction To Solid Mechanics, Prentice Hall of India, 2003.
[5] A. C. Ugural and S. K. Fenster, Advanced Strength And Applied Elasticity, 3rd Ed., Prentice Hall, 1994.
[6] A. P. Boresi, R. J. Schmidt and O. M. Sidebottom, Advanced Mechanics Of Materials, 5th Ed., John Wiley, 1993.
[7] Y.C. Fung, Foundations of Solid Mechanics, Prentice-Hall, 1965