CE1012E MECHANICS OF SOLIDS

Pre-requisites: Engineering Mechanics or equivalent

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Total lecture sessions: 39

Course Outcomes:

Students will be able to:

CO1: Evaluate the stress-strain behavior of linear elastic solids

CO2: Assess bending and shear stresses in beams of different cross-sections

CO3: Analyze stresses at inclined planes and calculate principal stresses and strain

CO4: Apply the appropriate method for finding the deflections of beams under different loading

CO5: Determine the buckling load of columns subjected to different end conditions

Tension, compression and shear: Types of external loads - self weight - internal stresses - normal and shear stresses - strain - Hooke's law - Poisson's ratio - relationship between elastic constants - stress strain diagrams - working stress - elongation of bars of constant and varying sections - statically indeterminate problems in tension and compression - thermal stresses - strain energy in tension, compression and shear.

Theory of simple bending: limitations - bending stresses in beams of different cross sections - moment of resistance - beams of two materials - shear stresses in bending - principal stresses in bending - strain energy in bending.

Torsion: Torsion of circular solid and hollow shafts - strain energy in shear and torsion - helical springs. Concept of shear flow and shear center.

Analysis of stress and strain: Stress on inclined planes for axial and biaxial stress fields - principal stresses - concept of Mohr's circle - principal stress problem as an eigenvalue problem - principal strains - strain rosette.

Deflection of beams: Differential equation of elastic curve - slope and deflection of beams by successive integration - Macaulay's method - moment area method - conjugate beam method.

Theory of columns: Axial loading of short strut - long columns - differential equation of elastic curve – Euler's formula - eccentric loading - direct and bending stresses – buckling load as an eigenvalue problem.

References:

1.Gere, J.M., Mechanics of Materials, Thomson, Singapore, 2001.

2.Timoshenko, S.P., Young, D.H., Elements of Strength of Materials, East West Press, New Delhi, 2003.

3.Popov, E.P., Mechanics of Materials, Prentice Hall India, New Delhi, 2002.

4.Beer, F. P. and Johnston, E. R., Mechanics of Materials, Tata McGraw Hill, New Delhi, 2005

5.Nash, W.A., Strength of Materials, Schaum's Outline Series, McGraw Hill, New York, 1988.