CORE SUBJECTS
(CE501) THEORY OF ELASTICITY

Objective of the Course:

The course will provide a basic treatment of the formulation of linear elasticity theory and its application to problems of stress and displacement analysis. The fundamental field equations will be developed including strain energy concepts. Applications will involve the solution to problems of engineering interest including two-dimensional problems of plane strain and plane stress, fracture mechanics, torsion, bending and stress concentration, and an introduction to three-dimensional solutions.

UNIT-I:

Plane stress and plane strain

Components of stress, strain, Hooks law, Stress and Strain at a point, Plane stress, Plane strain, Equations of equilibrium, Boundary conditions, compatibility equations, stress foundation.

UNIT-II:

Two Dimensional Problems in Rectangular Coordinates

Solution by polynomials, Saint Venant's principle determination of displacements, bending of cantilever loaded at the end, bending of a beam subjected to uniform load.

UNIT-III:

Two Dimensional Problems in Polar Coordinates

General equations of equilibrium, stress function and equation of compatibility with zero body forces. Analysis of thick cylindrical shells with symmetrical loading about the axis, pure bending of curved bars, Strain components in polar coordinates, rotating disks.

UNIT-IV:

Three Dimensional State of Stress

Differential equations of equilibrium – Boundary conditions of compatibility–displacements – Equations of equilibrium in terms of displacements – Principle of superposition – Uniqueness of solution. Analysis of Stress and Strain in Three Dimensions. Introduction - Principal stresses - Determination of principal stress – Stress invariants–Maximum shearing stress & strain at a point.

UNIT-V:

Torsion

Torsion of straight bars – St.Venant solution; Stress function; Warp function – Elliptic cross section –Membrane analogy torsion of bar of narrow rectangular cross section.

TEXT BOOKS:

1"Theory of Elasticity" by Timoshenko & Goodier, McGraw Hill Company. 3rd edition, 1970.

2. "Advanced Strength of Materials" by Denhorteg, Dover Publishing, 1987

REFERENCE BOOKS:

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.

2. Hearn , E.J. "Mechanics of Materials", Vol.2, Pergamon Press, Oxford, 1985.