AE6001 THEORY OF ELASTICITY

DETAILED SYLLABUS

OBJECTIVES:

- To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.

UNIT I BASIC EQUATIONS OF ELASTICITY

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TEXT BOOKS:

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 1990.

2. Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003.

3. Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.

REFERENCES:

1. Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

2. Sokolnikoff, I. S., "Mathematical Theory of Elasticity", McGraw – Hill, New York, 1978.

3. Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991