COURSE CONTENT

THEORY OF ELASTICITY AND PLASTICITY								
I Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BSTD02	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Theory of Structures								

I. COURSE OVERVIEW:

This course introduces the principles of elasticity, components of stresses and strains, differential equations of equilibrium, boundary conditions, compatibility conditions and stress function. This course also covers the two-dimensional problems in rectangular coordinates and polar coordinates, Fourier series for two-dimensional problems stress distribution symmetrical about an axis, pure bending of curved bars, strain components in polar coordinates, displacements for symmetrical stress distributions, simple symmetric and asymmetric problems, analysis of stress strain in three dimensions, torsion of prismatic bars and plasticity.f

II. COURSE OBJECTIVES:

The student will try to learn:

I. The transformation of stresses and strains in two and three-Dimensional problems related to structural elements.
II. The Engineering properties of materials, force-deformation and stress-strain relationships.
III. The plastic behaviour of deformable bodies in Cartesian coordinates and polar coordinates.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Explain theory of elasticity including strain/displacement and Hooke's law relationships for analyzing the structures with in elastic range.

CO 2 Develop constitutive relationships between stress and strain in linearly elastic solid for analyzing the stresses in the field.

CO 3 Analyze the Stresses and Strains, Strain Displacement and Compatibility Relations for Boundary Value Problems in the Principal Directions.

CO 4 Explain the general theorems in three dimensions for the analysis of stresses in structures.

CO 5 Explain the stress-strain relations for linearly elastic solids, and torsion for design purpose.

CO 6 Demonstrate the ability to analyze the structure using plasticity for efficient design of structures.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION (09)
Introduction: Elasticity, notation for forces and stresses, components of stresses, components of strain, Hooks law. Plane stress and plane strain analysis, plane stress, plane strain, differential equations of equilibrium, boundary conditions, compatibility equations, stress function, boundary condition.

MODULE - II: TWO DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES (09)
Two dimensional problems in rectangular coordinates, solution by polynomials, St. Venant's principle, determination of displacements, bending of simple beams, application of Fourier series for two dimensional problems, gravity loading. Two dimensional problems in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, strain components in polar coordinates, displacements for symmetrical stress distributions, simple symmetric and asymmetric problems, general solution of two-dimensional problems in polar coordinates, application of general solution in polar coordinates.

MODULE - III: ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS (09)
Analysis of stress and strain in three dimensions, principal stresses, stress ellipsoid, director surface, determination of principal stresses, max shear stresses, homogeneous deformation, and principal axes of strain rotation.

General theorems: Differential equations of equilibrium, conditions of compatibility, determination of displacement, equations of equilibrium in terms of displacements, principle of super position, uniqueness of solution, the reciprocal theorem.

MODULE - IV: TORSION OF PRISMATICAL BARS (09)
Torsion of prismatic bars, bars with elliptical cross sections, other elementary solution, membrane analogy, torsion of rectangular bars, solution of torsion problems by energy method, use of soap films in solving torsion problems, hydro dynamical analogies, torsion of shafts, tubes, bars etc. Bending of prismatic bars: Stress function, bending of cantilever, circular cross section, elliptical cross section, rectangular cross section, bending problems by soap film method, displacements.

MODULE - V: THEORY OF PLASTICITY (09)
Theory of Plasticity: Introduction, concepts and assumptions, idealized stress train behavior, Elastic perfectly plastic material, perfectly plastic material, linearly strain hardening material, power law stress train model, strain hardening, nominal and true stress strain, yield criterions.

V. TEXT BOOKS:

1. Timoshenko, "Theory of Elasticity", McGraw-Hill Publications, 3rd edition, 1970.
2. Atkin, Raymond John, and Norman Fox. "An introduction to the theory of elasticity". Courier Corporation, 2005.
3. Chakrabarty, Jagabanduhu. Theory of plasticity. Elsevier, 2012.

VI. REFERENCE BOOKS:

1. Y. C. Fung, "Theory of Elasticity", Dover Publications, 2008.
2. Mendelson, A, "Plasticity: Theory and Applications", Mac Millan and Company, New York.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 1979.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/courses/105106049/77
2. https://lecturenotes.in/subject/162/advanced-mechanics-of-solids-amos
3. http://nptel.ac.in/courses/105106049/pdf-assignments/main.pdf

VIII. MATERIALS ONLINE:

1. Course Template
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Power point presentation