

# GUJARAT TECHNOLOGICAL UNIVERSITY

## CIVIL (STRUCTURAL ENGINEERING)

### ADVANCED SOLID MECHANICS

**SUBJECT CODE:** 2712010

**SEMESTER:** I

**Type of course:** Elective

**Prerequisite:** Mechanics of Solids and Structural Analysis

**Rationale:** The Theory of Elasticity and Stability plays an important role in the design of conventional to advanced civil engineering structures. Using Elasticity in the design process enables to attain more efficient structure as it can provide accurate values for the stress, strains and displacements even for structures of complicated geometries and loadings. Further, the modern use of steel and high strength alloys in structures has made elastic instability a problem of great importance. It has been observed that the structures embodying slender compression members, thin plates and thin shells may fail in some cases not due to over stressing, but due to insufficient elastic stability of slender or thin walled member. The present course on *Advanced Solid Mechanics* provides the student with the mathematical and physical principles of Theory of Elasticity and Stability with various solution strategies and their practical applications.

#### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2	2	5	70	30	20	10	20	0	150

#### Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: State of stress and strain at a point in two and three dimensions, stress and strain invariants, Hooke's law, plane stress and plane strain.	10	20
2	Two dimensional problems in Cartesian and polar co-ordinates, solution by Airy's stress function, stress concentration, problems of torsion, curved elements, membrane analogy method, stress function of circular plates.	16	40
3	Concept of stability, static dynamic and energy criterion of stability, flexibility and stiffness criteria, buckling, post buckling stages, stability of columns, beams, inelastic bending, Beams – Column, Stability of frames, methods applied to stability problems.	16	40

#### Reference Books:

1. Theory of elasticity N. Filonenko - Borodich
2. Theory of elasticity - S. P. Timoshenko and J.N. Goodier
3. Buckling of bars, plates and shells - Don O. Brush and B. O. Almorh
4. Theory of elastic stability - S. P. Timoshenko and J.M. Gere
5. Principles of structural stability theory - Chajes
6. Structural stability of plates and shells - N.G.R. Iyengar
7. An introduction to elastic stability to structure - G.J. Siitses

**Course Outcome:**

After learning the course the students should be able to:

1. Understand the mathematical and physical foundations of the continuum mechanics of solids, including deformation and stress measures and constitutive relations.
2. Apply the basic principles of solid mechanics to solve engineering problems and design systems or components to meet the desired needs.
3. Understand basic concepts of structural stability, various approaches to stability analysis and their practical applications.

**List of Experiments/Tutorials:**

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics.

**Open Ended Problems:**

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:

1. Finding engineering application of elasticity and analysis.
2. Finding engineering application of stability and analysis.

**Major Equipments:** --

**List of Open Source Software/learning website:**

<http://nptel.ac.in/>

<http://ocw.mit.edu/courses/civil-and-environmental-engineering/>