Marwadi University

Master of Technology
Structural Engineering

Advanced Solid Mechanics

01ST1110 (PEC)

Objective of the Course: Objectives of introducing this subject at first year level in Masters of civil engineering are:

- To understand the basic concept of stress and elasticity
- To apply simple and advanced practical problems of elasticity.
- To understand materials for structural elements.
- To solve the problems on torsion for different shaped bars.

Credit Earned: 3

Students learning outcomes:

After successful completion of the course, it is expected that student will be able to

1. Apply principles of theory of elasticity to estimate stresses and strains in solids.
2. Establish stress strain compatibility relations.
3. To solve two- and three-dimensional problems in cartesian coordinates
4. Solve general bending and torsional problems using principles of theory of elasticity.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE (I)	IA (M)	Viva (V)	Term Work (TW)	
03	00	00	03	50	20	30	25	25	150

Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Introduction**	**04**
	Introduction to the general theory of elasticity, Assumptions and Applications of General Elasticity, Introduction to Stress and Strains, Hook's Law, Stress and Strain Fields, Body Force, Surface Force and Stress Vector, Constitutive Relations.	
2	**Stress Analysis**	**12**
	Stress Tensor, State of Stress at a point in two and three dimensions,	

	Principal Stresses in two and three dimensions, Stress and Strain Invariants, Rectangular Stress Components, Cauchy's Stress Principle, Differential Equations of Equilibrium, Boundary and Compatibility Conditions, Plane Stress Problem, Airy's Stress Function, Two-Dimensional Problem in Cartesian and Polar Coordinates.	
3	**Strain Analysis**	**12**
	Change in Length of Linear Elements and Components, Types of Strain, Strain Tensor, Strain Transformation, Strain Invariants, Rectangular Strain Components, State of Strain at a Point, Principal Strain, Plane Strain Problem, Mohr's circle for Strain, Compatibility Condition	
4	**Stress-Strain Relations and Equation of Elasticity**	**08**
	Generalized Hook's Law, Transformation of Compatibility Conditions from Strain Components to Stress Components, Relationship between Stress and Strain, Equations of Equilibrium, Strain Displacement and Compatibility Relations	
5	**Torsion of Prismatic Bars**	**06**
	General Solution of Torsion Problem, Stress Function, Stress Concentration and Saint Venant's Principle, Prandtl's Membrane Analogy, Torsion for Non-Circular Sections and Rectangular Sections, Torsion of Thin Walled and tubes	

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	5%	20%	25%	25%	20%

Instructional Method and Pedagogy:

1. Use of Learning Management system like canvas
2. Demonstration through presentations and videos and lectures
3. Brainstorming and group discussion sessions
4. Collaborative learning

Recommended Study Material:

Reference Book:

1. Timoshenko S. and Goodier J. N., Theory of Elasticity, McGraw Hill, 1961
2. Saddm. H., Elasticity, Elsevier, 2005.
3. Ragab A. R., Bayoumis E., Engineering Solid Mechanics, CRC Press,1999.

4. Ameenm., Computational Elasticity, Narosa,2005.
5. Kazimis. M. A., Solid Mechanics, Tata McGraw Hill,1994.
6. Srinath L. S., Advanced Mechanics of Solids, Tata McGraw Hill, 2007.

Web Resources

Theory of Elasticity NPTEL Course (Video)

https://nptel.ac.in/courses/105/105/105105177/

Applied Elasticity For Engineers NPTEL course (Web):

https://nptel.ac.in/courses/105108070.

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