

Devi Ahilya University, Indore, India Institute of Engineering & Technology				I Year ME (Design & Thermal Engg.) Full Time			
Subject Code & Name	Instructions Hours per Week			Credits			
<b>DTR1E1</b> <b>Advanced Mechanics of Solids</b>	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: <b>3 Hours</b>							

Course Objectives:

- To develop the analytical methods for solving problems in mechanics of solid those are generally considered beyond the scope of basic course in the discipline. As such, the developments tend to evolve from fundamentals principles such as equilibrium and conservation of energy.
- To understand fundamentals of linear elasticity and energy methods for solving torsion, bending problems.
- To gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures using Finite Element Analysis

Prerequisites: Mechanics of Solids

### COURSE OF CONTENTS

#### Unit-1

##### 3D Analysis of Stresses and strains

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, strains. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions, Relations between Elastic Constants.

#### Unit-2

##### Unsymmetrical Bending

Stresses and deflections in beams subjected to unsymmetrical loading-Kern of section, Deflection of Beams, Shear Center.

#### Unit-3

##### Bending of Curved Beams

Bending Stresses and Deflections of Curved Beams.

#### Unit-4

##### Introduction to the Finite Element Method

Introduction, Node and Element Notations, The Truss Element, Beam and Frame Elements, Two Dimensional Elastic Elements, Higher Order and Three Dimensional Elastic Elements.

#### Unit-5

##### Finite Element Modeling Techniques

Planing and Creating the Finite Element Model (Preprocessing), Element Selection and Mesh Strategy, Load Application, Constraints, Preprocessing Checks, Processing the Model and Postprocessing.

#### Text Books

- [1] Richard G. Budynas, Advanced Strength and Applied Stress Analysis, Mc Graw Hill Education (India), Second Edition, 2014  
 [2] L. S. Shreenath, Advanced Mechanics of Solids, Tata McGraw Hill Publication, 2014

#### Reference Books

- [1] G H Ryder, Strength of Materials, McMillan India Ltd., Third Edition, 1969.  
 [2] Timoshenko, *Elements of Strength of Materials*, 5/e, Wadsworth Publishing, 1968  
 [3] Kamal Kumar and R. C. Ghai, Advanced Mechanics of Materials, Khanna Publishers, 2010.

## List of Experiments

1. To measure the Elastic Modulus of Steel rod and Stainless Steel Wire.
2. To experimentally study the linear elastic behavior of beams under multi point loading.
3. To compare the stiffness of beams of the same length and cross-sectional area but having different profiles.
4. To measure the extensional strain in the top and bottom fibers of the beam specimens and compare with the prediction of engineering beam theory.
5. Introduction to Finite Element Analysis software.
6. To Solve 1D – Structural, thermal and fluid problems using FEA software.
7. To Solve Beam problems with different boundary and loading conditions using FEA software.
8. To Solve 2D problems using different element types in a FEA software. Also analyse effect of element formulation and number of elements.
9. To Solve 3D problems using FEA software.
10. To Solve Dynamic problems using FEA software.