MME40: Theory of Elasticity

Programme: B.Tech. (MME) Year: 2018 Semester: VIII

Course : Program Elective Credits : 3 Hours : 40

Course Context and Overview (100 words):

The objective of this course is to enable the student to, solve the advanced practical problems related to the theory of elasticity. Upon completion of this course, student should be able to propose materials and structural elements to the analysis of complex structures.

The further detailed objectives are as following:

1. To analyze the transformation of stresses and strains in 3D.
2. To study engineering properties of materials, force-deformation, and stress-strain relationship.
3. To understand the plastic behavior of deformable bodies

Prerequisites Courses: Mechanics of Solids

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 Understand the concepts of stress- strain.
C02 Understand the concepts of strain energy and failure criteria.
C03 To solve the advanced practical problems related to the theory of elasticity.
C04. To propose materials and structural elements to the analysis of complex structures.

Course Topics:

Topics	Lecture Hours	
UNIT - I **1. Topic: Theory of 3D Stresses**		8
1.1 Introduction to stress tensor components	2	
1.2 Equilibrium equations	2	
1.3 Stress transformation	2	
1.4 Principal stresses	1	
1.5 Boundary conditions	1	
Unit – II **2. Topic: Theory of 3D Strains**		7
2.1 Introduction to strain tensor components	1	
2.2 Strain transformation	2	
2.3 Principal Strains	2	
2.4 Compatibility	2	
Unit - III **3. Topic: Stress-Strain Relations**		5
3.1 Introduction	1	
3.2 Generalized Hooke's law	1	
3.3 St. Venant's principle	1	
3.4 Strain-energy	2	
Unit - IV **4. Topic: Theories of Failure**		7
4.1 Introduction	1	
4.2 Theories of Failure	2	
4.3 A Note on the use of Factor of Safety	1	
4.4 Ideally Plastic Solid	1	
4.5 Stress Space and Strain Space	1	
4.6 Stress–Strain Relations (Plastic Flow)	1	
UNIT – V **5. Topic: Unsymmetrical Bending and Torsion**		7
5.1 Introduction	1	
5.2 Bending of Curved Beams (Winkler-Bach Formula)	2	
5.3 Deflections of Thick Curved Bars	1	
5.3 Torsion of Equilateral Triangular Bar	1	
5.4 Torsion of Rectangular Bars	1	
5.5 Torsion of Thin-Walled Tubes	1	
UNIT – V I **6. Topic: Axisymmetric Problems**		6
6.1 Introduction	1	
6.2 Thick-Walled Cylinder-Lame's Problem	2	
6.3 Stresses in Composite Tubes—Shrink Fits	1	
6.4 Sphere with Purely Radial Displacements	1	
6.5 Rotating Disks of Uniform and Variable Thickness	1	

Textbook references (IEEE format):

Text Book:

1. L. S. Srinath, “Advanced Mechanics of Solids“, 3rd ed., McGraw-Hill Education, 2009.

Reference Books:

1. M. Filonenko-Borodich, 'Theory of Elasticity“, University Press of the Pacific, 2003
2. S.P. Timoshenko and J. N. Goodier, 'Theory of Elasticity', 3rd ed., McGraw-Hill Education, 2010

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Item	Weightage
Quiz 1: 10	30
Quiz 2: 10	
Assignments: 5 Attendance: 5	
Midterm	30
Final Examination	40

Prepared By: Dr Ashok Kumar Dargar