

STRENGTH OF MATERIALS AND THEORY OF STRUCTURES

ENCE 257

Lecture : 3
Tutorial : 2
Practical : 1

Year : II
Part : II

Course Objectives:

To provide fundamental knowledge, concept and methods of analysis for solving problems related to different load conditions, stress and strains on structures and components. The students will be able to analyze, calculate and design basic components of structure and other engineering components on the basis of strength, stiffness and stability of the material

- 1 Introduction (3 hours)**
 - 1.1 Types of structure based on material used
 - 1.2 Statically determinate and indeterminate structures

- 2 Stresses and Strains (4 hours)**
 - 2.1 Definition of stresses and strains
 - 2.2 Relationship between stresses and strains
 - 2.3 Elastic and elastoplastic behavior under various stress loads

- 3 Types and Characteristics of Stresses (3 hours)**
 - 3.1 Tensile test of different material
 - 3.2 Ultimate stresses
 - 3.3 Allowable stresses and factor of safety
 - 3.4 Stress concentrations
 - 3.5 Elastic constants

- 4 Stress and Strain Analysis (4 hours)**
 - 4.1 Hooke's law, modulus of elasticity, Poisson's ratio and modulus of rigidity
 - 4.2 Deformation of axially loaded bar, generalized Hooke's law
 - 4.3 Stresses due to change in temperature

- 5 Theory of Flexure and Torsion (5 hours)**
 - 5.1 Coplanar and pure bending
 - 5.2 Radius of curvature, flexural stiffness

- 5.3 Elastic and plastic bending
- 5.4 Beam deflection

6 Buckling (2 hours)

- 6.1 Definition of buckling
- 6.2 Euler's formula for column with different end restraints
- 6.3 Concept of effective length and slenderness ratio

7 Deflection of Beam (6 hours)

- 7.1 Double integration method
- 7.2 Deflection by strain energy
- 7.3 Curvature, slope and deflection
- 7.4 Deflection by moment area method
- 7.5 Deflection by conjugate beam method

8 Influence Lines for Simple Structures (8 hours)

- 8.1 Concept of Influence line
- 8.2 Influence line diagram for reaction at supports, bending moments and shear force
- 8.3 Determination of reactions, bending moments and shear forces using influence line diagram

9 Statically Determinate Arches and Frames (4 hours)

- 9.1 Types of arches and frames
- 9.2 Three hinged arches with the support at the same level
- 9.3 Determination of support reactions, shearing forces, axial forces, bending moments in arches and frames

10 Statically Indeterminate Structures (6 hours)

- 10.1 Types of indeterminate structures, static and kinematic indeterminacy
- 10.2 Slope deflection method
- 10.3 Moment distribution method

Tutorial (30 hours)

- 1. Stress and Strain Analysis
- 2. Theory of Flexure and Torsion
- 3. Buckling of Column
- 4. Deflection of Beam
- 5. Statically Determinate Arches and Frames
- 6. Statically Indeterminate Structures

Practical**(15 hours)**

1. Uniaxial tension test
2. Torsion test
3. Bending test
4. Column behavior
5. Deflection of beams
6. Measurement of reactions in three hinged arches under different loading arrangements
7. Influence lines for beams

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 2	7	5
3 and 4	7	7
5 and 6	7	12
7	6	8
8	8	6
9	4	6
10	6	16
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Gere, J. M., Timoshenko, S. P. (2002). Mechanics of Materials. United Kingdom: Stanley Thornes.
2. Wilbur, J. B., Norris, C. H. (2012). Elementary Structural Analysis. United States: Literary Licensing, LLC.
3. Popov, E.P. (2015). Mechanics of Materials (2nd Ed.). New Delhi: Prentice hall of India.
4. Wang, C.K. (1989). Intermediate Structural Analysis. McGraw Hill International.