Mechanics of Structure
EG 2203 CE

Year: II **Total: 6 Hrs. /week**
Semester: II **Lecture: 4 Hrs./week**
Tutorial: 1 Hrs./week
Practical: Hrs./week
Lab: 2/2 Hrs./week

Course Description:
This course is about structural analysis of statically determinate structures and properties of some materials used in structure. It is requisite for design of simple structures.

Course Objectives:
After the completion of this course, students will be able to:
1. Identify stable and unstable and statically determinate and indeterminate structures;
2. Determine degree of static indeterminacy of statically indeterminate structures
3. Understand constitutive relation of some materials to be used in structures;
4. Analyze the simple determinate structures like truss, beam and frame, and
5. Analyze shaft and strut for torsion and axial load.

Course Contents:

Theory

Unit 1: Introduction: **[4 Hrs.]**
- 1.1 Definition of mechanics of structure.
- 1.2 Review on types of loads, types of supports and reaction. Their symbolic representation.
- 1.3 Stability, determinacy, indeterminacy and degree of freedom of structure (beam, frame and truss)
- 1.4 Introduction to statically determinate and indeterminate structures
- 1.5 Determination of degrees of static indeterminacies.

Unit 2: Simple Stress and Strain: **[14 Hrs.]**
- 2.1 Concepts of stress and strain
- 2.2 Linear stress and strain and their relation, Hooke's law and Young's modulus of elasticity.
- 2.3 Deformation of uniform bar due to axial load
- 2.4 Stress strain curves for different materials.
- 2.5 Ultimate strength and working stress of materials and factor of safety.
- 2.6 Factors affecting factor of safety.
- 2.7 Thermal stress.
- 2.8 Stress and strains in plain and composite bars.
- 2.9 Poisson's ratio, Shear stress, shear strain and modulus of rigidity.
- 2.10 Volumetric strain and Bulk modulus.
- 2.11 Relation between Young's modulus, Bulk modulus and modulus of rigidity.
- 2.12 Concept of Principle stresses, principle planes and shear stress

Unit 3: Axial force, Shearing force and Bending moment: **[12 Hrs.]**
- 3.1 Review of Axial force, shear force and bending moment
- 3.2 Axial force, shear force and bending moment diagrams for statically determinate Beam under various types of loading.

3.3 Axial force, shear force and bending moment diagrams for statically determinate Plane frame under various types of loading.
3.4 Point of contra flexure.
3.5 Axial force analysis for statically determinate truss

Unit 4: Theory of Simple Bending: [10 Hrs.]

4.1 Concept of bending and pure bending.
4.2 Assumptions in theory of simple bending.
4.3 Radius of curvature, neutral layer and neutral axis.
4.4 Stress due to bending.
4.5 Moment of resistance.
4.6 Derivation of flexural formula (Relation between bending stress, Radius of curvature and moment of resistance)
4.7 Shearing stress in beams.
4.8 Distribution of shear stress in rectangular cross section of beam.
4.9 Determination of bending stress for simple beams
4.10 Section modulus.

Unit 5: Deflection of beams [6 Hrs.]

5.1 Definition of elastic curve, slope and deflection of beam.
5.2 Differential equation of elastic curve.
5.3 Deflection of simply supported and cantilever beams.

Unit 6: Torsion: [6 Hrs.]

6.1 Introduction.
6.2 Definition of torque and angle of twist.
6.3 Stress due to torsion.
6.4 Derivation of torsional equation.
6.5 Strength of solid and hollow circular shaft.
6.6 Power transmitted by shaft.

Unit 7: Simple Strut Theory: [8 Hrs.]

7.1 Definition of column and strut.
7.2 Stability of columns
7.3 End conditions and their effects.
7.4 Derivation of Euler's formula for columns for different types of end conditions
7.5 Effective height and Slenderness ratio.
7.6 Introduction to eccentrically loaded column.

Tutorial

Unit 1: Introduction: [1 Hr.]

1.1 Differentiate statically determinate and indeterminate structures
1.2 Determine of degrees of static indeterminacies.

Unit 2: Simple Stress and Strain: [4 Hrs.]

2.1 Calculate deformation of uniform bar due to axial load
2.2 Draw stress strain curves for different materials and find out ultimate strength, yield strength and working stress.
2.3 Calculate stress and strains in plain and composite bars due to external and thermal loading.
2.4 Calculate poisson's ratio, Shear stress, shear strain and modulus of rigidity.

2.5 Calculate volumetric strain and Bulk modulus.

Unit 3: Axial force, Shearing force and Bending moment: [4 Hrs.]

3.1 Draw axial force, shear force and bending moment diagrams for Beam and Frame.
3.2 Determine location of point of contra flexure.

Unit 4: Theory of Simple Bending: [2 Hrs.]

4.1 Evaluate radius of curvature, neutral, bending stress and draw stress diagram.
4.2 Calculate moment of resistance and section modulus.

Unit 5: Deflection of beams: [1 Hr.]

5.1 Determine deflection of simply supported and cantilever beams.

Unit 6: Torsion: [1 Hr.]

6.1 Determine stress in solid and hollow circular shaft.
6.2 Determine strength of solid and hollow circular shaft.
6.3 Evaluate power transmitted by shaft.

Unit 7: Simple Strut Theory: [2 Hrs.]

7.1 Determine critical load for different types of columns and strut.

Practical (Laboratory)

1 Determine Young's modulus, yield stress and ultimate strength of mild steel specimen (Stress-strain curve)
2 Measure strain and determine force in members of a plane truss
3 Measure deflection of simple beams
4 Determine buckling load of different types of columns

Textbooks:

1. G B Motra, "A text book of strength of materials", Publisher .....
2. R.K. Rajput "Strength of Materials", ...

References:

1. Surendra Singh "Strength of materials" S. K. Kkataria and sons.
2. Ferdinand P. Beer E Russell Johnston "Mechanics of Materials", Mcgrow hill Book Company.

Evaluation Scheme

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

Chapter	Title	Hrs.	Mark distribution*
1	Introduction	04	04
2	Simple Stress and Strain	14	20
3	Axial force, Shearing force and Bending moment	12	16
4	Theory of Simple Bending	10	14
5	Deflection of beams	06	08
6	Torsion	06	08
7	Simple Strut Theory	08	10
Total		60	80

* There may be minor deviation in marks distribution.