Lok Jagruti Kendra University
University with a Difference

Diploma
in
Civil Engineering

Course Code:025050305

Structural Mechanics

Programme / Branch Name	Diploma in Civil Engineering					
Course Name	Structural Mechanics				**Course Code**	025050305
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				**Evaluation Scheme**			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOTAL**
4	0	2	5	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisites

- ✓ Engineering Physics
- ✓ Applied Mechanics

3. Rationale

Structural Mechanics is a field of Applied Mechanics in which students study the computation of deformations, stresses and strains in solid materials, the loads and their effects on structural elements. The design of any structure can be possible only after the analysis of all loads and their effects. The engineering properties and behaviour of construction materials obtained through the study help in the selection of material, size and shape of any structural member for any construction work as well as in the design load calculation. This syllabus helps students to develop the ability for both model and analysis of statically determinate and indeterminate structures and to provide realistic applications encountered in professional practices. After completion of this syllabus, students will be able to analyse structural elements used in the construction.

4. Objectives

- ✓ To calculate the stress and strain produced in structural members.
- ✓ To analyze the determinate and indeterminate beam and draw shear force and bending moment diagram.
- ✓ To calculate the permissible stress limits in beam and column.
- ✓ To understand the theory of slope and deflection developed in any beam.
- ✓ To learn the concepts of the short column and long column.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcomes	% Weightage	Hours
1.	**Simple Stress and Simple Strain**	1.1. Simple Stress 1.1.1. Loading a Bar 1.1.2. Principle of Superposition 1.1.3. Classification of Loaded Bar 1.1.4. Gradual, Sudden, Impact and Shock Loading 1.1.5. Tension and Compression 1.1.6. Resistance of an Axially Loaded Bar 1.1.7. Concept of a Stress 1.1.8. Normal Stresses 1.1.9. Non-Prismatic Bars 1.1.10. Axial Force Diagram 1.1.11. Numericals	• Calculation of Various Mechanical Properties of the Structural Elements. • Analyze Prismatic and Non-Prismatic Bars.	20	12
		1.2. Simple Strain 1.2.1. Linear Strain 1.2.2. Shear Strain 1.2.3. Elasticity 1.2.4. Hooke's Law 1.2.5. Axial and Shear Deformations 1.2.6. Bars of Varying Section 1.2.7. Lateral Strain: Poisson's Ratio 1.2.8. Biaxial and Triaxial Deformations 1.2.9. Numericals	• Computation of Various Mechanical Properties of the Structural Elements. • Computation of Change in Dimension of Body Under Load.		
2.	**Shear Forces and Bending Moments**	2.1. Types of Beams 2.2. Actions on the Cross-Section of a Beam 2.3. Sign Conventions 2.4. Shear Force (S.F.) and Bending Moment (B.M.) Diagrams 2.5. Cantilevers 2.6. Simply Supported	• Understanding the Concept of Statically Determinate Beams. • DrawShear Force and Bending Moment Diagram.	25	14

		Beams 2.7. Relation Between the S.F. and the B.M. at a Cross-Section of a Beam 2.8. Overhanging Beams 2.9. Numericals			
3.	**Continuous Beam and Fixed Beam**	3.1. Continuous Beam 3.1.1. Introduction 3.1.2. The Three Moment Theorem 3.1.3. Numericals	• To Analyze the Continous Beam. • Draw Shear Force and Bending Moment Diagram.	20	12
		3.2. Fixed Beam 3.2.1. Indeterminate Structures 3.2.2. Use of Indeterminate Structures 3.2.3. Methods of Analysis 3.2.4. Solution by Moment Area Method 3.2.5. Numericals	• Understand the Difference Between Determinate and Indeterminate Beam. • Draw Shear Force and Bending Moment Diagram.		
4.	**Deflections,Direct and Bending Stresses**	4.1. Deflections 4.1.1. Use of Deflection Computations 4.1.2. Limitations of the Equation of Elastic Line 4.1.3. Cantilevers 4.1.4. Simply Supported Beams 4.1.5. Numericals	• Find Slope and Deflection of Determinate Beam. • Draw Deflection Curve of Beam Under Different Load Conditions.	20	10
		4.2. Direct and Bending Stresses 4.2.1. Introduction 4.2.2. Combined Axial and Flexural Load 4.2.3. Eccentric Loading 4.2.4. Limit of Eccentricity 4.2.5. Numericals	• Computation of Direct and Bending Stresses.		
5.	**Column & Struts**	5.1. Axial Loading 5.2. Very Long Columns – Euler's Formula 5.3. Limitations of Euler's Formula 5.4. Rankine's	• Analysisof Column and Strut.	15	8

		Formula 5.5. Numericals			
				Total Hours	**56**

6. List of Practicals / Exercises

The practicals/exercises have been properly designed and implemented in an attempt to develop different types of skills so that students can acquire the competencies/programme outcomes. Following is the list of practicals/exercises.

Sr. No.	Practical / Exercises	Key Competency	Hours
1.	Determine the tensile strength of the mild steel bar.	Stress-Strain Diagram for Mild Steel.	4
2.	Calculate impact value of mild steel using Izod impact test apparatus.	Calculation of Impact Value of Mild Steel.	2
3.	Calculate impact value of mild steel using Charpy impact test apparatus.	Calculation of Impact Value of Mild Steel.	2
4.	Solve six numerical based on shear force and bending moment of the beam.	Draw Shear Force and Bending Moment Diagram.	2
5.	Solve six numerical based on continuous beam and fixed beam.	Draw Shear Force and Bending Moment Diagram.	2
6.	Solve fivenumerical based on slope and deflection of beams.	Computation of Slope and Deflection of Determinate Beam.	2
7.	Solve five numerical ofdirect and bending stresses.	Computation of Direct and Bending Stresses.	2
8.	Solve five numerical based on column and strut.	Find Load Capacity of Column and Strut.	2
9.	Survey different structural steel products available in the market and prepare a report on them.	Knowledge of Steel Sections used in the Construction Industry.	4
10.	Visit a structure having more than 20 years lifespan and prepare a report with photographs of cracks and make comments on the pattern of cracks.	Knowledge of Crack Pattern in Member of Structure.	4
11.	Model making of different types of beam, supports and loads.	Model Making.	2
		Total Hours	**28**

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	App %	C %	E %	An %
1.	Simple Stress and Simple Strain	20	40	0	0	0	40
2.	Shear Forces and Bending Moments	20	30	10	0	0	40
3.	Continuous Beam and Fixed Beam	35	15	15	0	0	35
4.	Deflections, Direct and Bending Stresses	20	20	10	0	0	50
5.	Column & Struts	15	30	25	0	0	30

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

8. Textbooks

1) Mechanics of StructuresVolume-Iby H.J. Shah & S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.

9. Reference Books

1) Strength of Materials by R. S. Khurmi, N. Khurmi, S.Chand & Company Limited.
2) Strength of Materialsby Dr. B. C. Punmia, Er. Ashokkumar Jain, Dr. Arunkumar Jain, Laxmi Publications.
3) Strength of Materials by S. Ramamrutham& R. Narayanan,Dhanpat Rai Publishing Company Limited.

10. Open Sources (Website, Video, Movie)

1) www.nptel.ac.in
2) LJP-Civil-Structural Mechanics-I & II(YouTube)