Marwadi University

Bachelor of Technology

Civil Engineering

Structural Analysis-I

01CI1402

Objective of the Course:

- To understand the concept of determinate and indeterminate structures and impart the principles of elastic structural analysis to identify the behaviour of determinate structures.
- To know and apply the different techniques available for the analysis of structures to identify internal forces and displacement in different structures.
- To calculate the stresses and strain energy stored in the bar due to the application of various loading like axial, shear, bending, and torsion.

Credit Earned: 04

Prerequisite: Mechanics of Solids

Students learning outcomes:

After successful completion of the course, it is expected that students will be able to,

1. Classify structures and apply principles of statics to analyze statically determinate structures
2. Analyze the determinate structures i.e., beam, frame, truss, arches, and cable, and draw its internal force diagram.
3. Evaluate displacement and slope in determinate beams by different methods.
4. Compute buckling load for long columns with different end conditions using Rankine's and Euler's theory.
5. Compute strain energy stored in a body due to the application of axial, shear, bending, and torsional forces.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Term Work (TW)	
03	01	00	04	50	30	20	25	25	150

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Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Analysis of Determinate Structures**	**17**
	Introduction: Indeterminacy - Static and Kinematic, statically determinate & indeterminate structures, its merits and de-merits, stability of structures based on static indeterminacy, Calculation of static and kinematic indeterminacy of beams, plane frames, plane trusses, Grid, Space truss, and space frames **Beams:** Definition of shear force and bending moment. Correlation between loading, shear force & bending moment in beams. Shear force and Bending moment diagrams for statically determinate beams subjected to different loading and boundary conditions. Point of Contra flexure and maximum bending moment in a beam. **Plane Frames:** Computation of internal forces and diagrams in statically determinate plane frames **Plane Truss:** Computation of internal forces of Truss using method of joint and method of section. **Arches and Cables:** Calculation of internal forces in three hinge arches with circular and parabolic shapes subjected to various types of loading. Forces and end actions in cables due to various types of loading	
2	**Displacement of Determinate Beams**	**17**
	Slope & Deflection equation of the beam subjected to uniform bending Double Integration Method, Macaulay's Method Moment Area Method, Conjugate Beam Method, Castigliano's 1st Theorem Unit Load Method	
3	**Column and Strut**	**04**
	Definition of the Long column, Short Column, **Euler's theory**–its assumptions and Euler's Buckling load for various end conditions, the effective length of a long column, and radius of gyration. **Rankine's theory**–its assumption and its comparison with Euler's theory. Analysis of columns with Rankine's and Euler's load	
4	**Strain Energy**	**04**
	Strain Energy, Resilience, proof resilience and modulus of resilience, Strain Energy stored in the body subjected to Axially gradual, sudden and impact loading, Strain Energy stored in the members subjected to torsional and shear forces. Strain Energy stored in the members subjected to bending	
	Total	**42**

List of Tutorials

1) Classify the structures and Calculations of S.I and K.I.
2) Analyze the determinate beams and draw its Shear Force and Bending Moment diagrams.
3) To study the behavior of a portal frame under different end conditions experimentally and draw Axial Force, Shear Force and Bending Moment diagram of determinate Frames analytically.
4) Analysis of Truss by Method of Joint and section
5) To find the value of flexural rigidity (EI) and determine deflection for a given beam and compare it with the theoretical value.
6) To determine displacement by various methods Double Integration Method, Macaulay's Method, Moment Area Method, Conjugate Beam Method, Castigliano's First Theorem, and Unit Load Method.
7) To calculate Strain energy due to different loading
8) To study the behavior of different types of columns and find Euler's buckling load for each case. To calculate the critical load on column and Strut by Euler's and Rankine's Theory

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve an effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	10%	35%	30%	10%	10%

Instructional Method and Pedagogy:

1. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
2. Lectures will be taken in class room with the use of multi-media presentations, white board– mix of both.

3. Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation.
4. Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation
5. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.
6. Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation.
7. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. Minimum 8 experiments are planned based on the course content.

Recommended Study Material

1. Ramamrutham, S; Theory of Structures; Dhanpat Rai Publication
2. Junarkar S.B. & Shah H.J.; Mechanics of Structures Vol-I; Charotar publishing house, Anand
3. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
4. Popov E.P.; Engineering Mechanics of Solids; Prentice Hall of India, New Delhi
5. Ryder G.H.; Strength of Materials; McMillan
6. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
7. Hibbler R C; Structural Analysis; Pearson Education
8. Laursen Harold; Structural Analysis; McGraw Hill Education
9. Das, Madan Mohan; Das, Bhargav Mohan, Structural Analysis, PHI learning