K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109
DEPARTMENT OF CIVIL ENGINEERING
2023-24 EVEN SEMESTER

CO-PO Mapping

Course: Analysis of Structures				
Type: Core			Course Code: BCV401	
No of Hours				
Theory (Lecture Class)	Tutorials	Practical/Field Work/Allied Activities	Total/Week	Total hours of Pedagogy
3	0	0	3	40
Marks				
CIE	SEE		Total	Credits
50	50		100	3

Aim/Objectives of the Course

1. To understand the different forms of structural systems.
2. To determine the strain energy and slope and deflection of beams, trusses and frames.
3. To analyze arches and cable structures.
4. To analyze different types of beams and frames using slope deflection method.
5. To aanalyze different types of beams and frames using moment distribution method.

Course Learning Outcomes
After completing the course, the students will be able to

CO1	**Identify** the different forms of structural systems and **analyze** the trusses.	**Applying (K3)**
CO2	**Analyze** and **determine** the stress resultants inarches and cables.	**Applying (K3)**
CO3	**Analyze** the indeterminate structures and **sketch** BMD and SFD using slope deflection method.	**Analyzing (K4)**
CO4	**Analyze** the indeterminate structures and **draw** BMD and SFD using moment distribution method.	**Analyzing (K4)**
CO5	**Evaluate** the slope and deflection in beams, frames and trusses by using moment area method and energy principles.	**Applying (K3)**

Syllabus Content

Module 1: Introduction and Analysis of Plane Trusses: Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and nonlinear analysis, Static and kinematic indeterminacies of structural systems, Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections.	CO1 8 hrs

LO: At the end of this session the student will be able to 1. **Define** equilibrium; compatibility conditions; linear and non-linear systems; geometric and material non-linearity. 2. **Explain** statically determinate and indeterminate structures with examples. 3. **Distinguish** between static and kinematic indeterminacies with examples. 4. **Determine** the static and kinematic indeterminacies for the structures shown. 5. **Explain** the salient features of stress-strain diagram for structural steel. 6. **Analyze** the trusses shown using method of joints. **Indicate** the member forces and **tabulate** the results. 7. **Determine** the member forces in the given truss using method of sections.	PO1-3 PO2-3 PO12 -1 PSO1-3 PSO2-2
Module 2: Arches and Cable Structures: Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables. **LO:** At the end of this session the student will be able to, 1. **Determine** the reaction components at supports for the given arch and **evaluate** the BM, normal thrust and radial shear at the given distance. Also **sketch** the BMD. 2. **Explain** the method of deriving equations for cable profile and tension in the cable when it is supported at the same level and subjected to horizontal UDL. 3. **Analyze** the given cable and **determine** the length of the cable, max. and min. tensions developed in the cable and the size of the cable. 4. **Analyze** the given cable and determine the forces in the tower when, (i) cable passes over smooth pulley (ii) cable passes over saddle.	**CO2** 8 hrs PO1-3 PO2-3 PO12 -1 PSO1-3 PSO2-2
Module 3: Slope Deflection Method: Introduction, sign convention, development of slope deflection equation; Analysis of continuous beams including settlement of supports; Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy up to 3. **LO:** At the end of this session the student will be able to, 1. **Analyze** a propped cantilever subjected to UDL of w kN/m and span L, using slope-deflection method. 2. **Analyze** the given beam by slope-deflection method and **draw** bending moment diagram and shear force diagram. 3. **Analyze** the given frame by slope-deflection method and **draw** bending moment diagram and shear force diagram.	**CO3** 8 hrs. PO1-3 PO2-3 PO12 -1 PSO1-3 PSO2-2
Module 4: Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy up to 3. **LO:** At the end of this session the student will be able to, 1. **Explain** fixed end moments for different loading conditions with relevant diagrams.	**CO4** 8 hrs PO1-3 PO2-3

2. **Analyze** the given beam by moment-distribution method and **draw** bending moment diagram and shear force diagram. 3. **Analyze** the given frame by slope-deflection method and **draw** bending moment diagram and shear force diagram.	PO12 -1 PSO1-3 PSO2-2
Module 5: Deflection of Beams: Moment area method: Derivation, Mohr's theorems, sign convention; Application of moment area method to determinate prismatic beams, beams of varying cross section; Use of moment diagram by parts. **Strain Energy:** Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion (No numerical). Castigliano's theorems, application of Castigliano's theorems to calculate deflection of beams, trusses and frames (No numerical on unit load method). **LO:** At the end of this session the student will be able to, 1. **State** and **explain** Mohr's theorems. 2. **State** and **explain** Castigliano's first and second theorems. 3. **Derive** expressions for strain energy due to (i) axial force (ii) bending (iii) shear (iv) torsion. 4. **State** the principles of virtual displacements and forces. 5. **Analyze** the given beam by moment-area method.	**CO5** 8 hrs PO1-3 PO2-3 PO12 -1 PSO1-3 PSO2-2

Suggested Learning Resources:

Text Books

1. Reddy, C.S., Basic Structural Analysis, 3 rd. ed., Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2011.
2. Hibbeler, R.C., Structural Analysis, 9th edition., Pearson publications., New Delhi, 2012.
3. Thandavamoorthy, T.S., Structural Analysis, 6th edition., Oxford University press., New Delhi,2015.
4. L S Negi and R S Jangid, "Structural Analysis", Tata McGraw-Hill Publishing Company Ltd.
5. D S Prakash Rao, "Structural Analysis: A Unified Approach", Universities Press.
6. K.U. Muthu and H. Narendra, "Indeterminate Structural Analysis", IK International Publishing Pvt. Ltd.
7. Gupta S P, G S Pundit and R Gupta, "Theory of Structures", Vol II, Tata McGraw Hill Publications company Ltd.
8. V N Vazirani and M M Ratwani, "Analysis of Structures", Vol. 2, Khanna Publishers.
9. Wang C K, "Intermediate Structural Analysis", McGraw Hill, International Students Edition. S. Rajashekhara and G. Sankarasubramanian, "Computational Structural Mechanics", PHI Learning Pvt. Ltd.
10. S S Bhavikatti, structural analysis, Vikas publishing house Pvt. Ltd., New Delhi.
11. S Ramamrutham and R Narayanan, Theory of Structures, Dhanpat Rai Publishing Company.

Web links and Video Lectures (e-Resources):

1. Structural Analysis I video course by IIT Kharagpur https://nptel.ac.in/courses/105105166.
2. Structural Analysis I video course by IIT Kharagpur https://nptel.ac.in/courses/105105109.

Useful Journals

- Journal of Structural Engineering.
- International Journal of Structural Engineering and Analysis.

Teaching and Learning Methods

1. Lecture class: 40 hrs

Assessment

Type of test/examination: Written examination
Continuous Internal Evaluation (CIE): 50 marks. Average of two internal assessment tests each of 25 marks. Sum of two assignments (each of 25 Marks) shall be scaled down to 25 Marks.
Semester End Exam (SEE): 100 marks (students have to answer all main questions) which will be scaled down to 50 Marks.
Test duration: 1 hrs
Examination duration: 3 hrs.

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Sustainability **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Management & Finance **PO12:**Life long Learning

PSO1: The proficiency in mathematics, physical and management sciences helps to excel in the areas of planning, analysis related to Civil Engineering systems.

PSO2: Identify sustainable materials and technologies, code of practices in construction industry and transportation systems.

CO	PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
BCV 401	K-level														
CO1	K3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO2	K3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO3	K3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO4	K4	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO5	K4	3	3	-	-	-	-	-	-	-	-	-	1	3	2

Course In charge

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