Techno India NJR Institute of Technology

Course File

Structural Analysis-I

(5CE4-02)

Basant Kumar Bansal
(Assistant Professor)
Department of CE

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. (Civil Engineering)
5CE4-02: STRUCTURE ANALYSIS-I

Credit: 2 **Max. Marks: 100(IA:30, ETE:70)**

2L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction to Indeterminate structures, Degrees of freedom per node, Static and Kinematic indeterminacy (i.e. for beams, frames & portal with & without sway etc.), Releases in structures, Maxwell's reciprocal theorem and Betti's theorem. Analysis of prop cantilever structures, Analysis of Indeterminate Structure (fixed and continues beams) using Area moment method, Conjugate beam method, Three moments Theorem.	11
3	Analysis of Statically Indeterminate Structures using Slope-deflection method and Moment-distribution method applied to continuous beams and portal frames with and without inclined members.	11
4	**Vibrations:** Elementary concepts of structural vibration, Mathematical models, basic elements of vibratory system. Degree of freedom. Equivalent Spring stiffness of springs in parallel and in series. **Simple Harmonic Motion**: vector representation, characteristic, addition of harmonic motions, Angular oscillation. **Undamped free vibration of SDOF system**: Newton's law of motion,D Almbert's principle, deriving equation of motions, solution of differential equation of motion, frequency & period of vibration, amplitude of motion; Introduction to damped and forced vibration.	5
	TOTAL	28

Course Overview:

This course covers analysis of indeterminate structures and adopts an appropriate structural analysis

Technique also behaviour of the structural elements from this 28-hour.

This course covers response of structures by classical, iterative and matrix method. Evaluation and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving load. Slope and Deflection of beam, truss

SA-I is also essential for every graduate Civil Engineer in many companies like L&T, STUP Ltd., many more. To enable the student get a feeling of how real-life structures behave, Student should learn and develop problem solving abilities. Also students can model and analyze structural systems (bridge and building) with the aid of SAP 2000 and ETABS software.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	Understand	Understand the behaviour of the structures under different loading condition
2	Apply	Derive the mathematical expression of structural vibration if the structures
3	Analyze	Analyse of indeterminate structure using area moment method, conjugate beam method and three moment's theorem.
4	Analyze	Analyze of statically indeterminate structures using slope deflection and moment distribution method.
5	Evaluate	Determine an equation of analysis of statically determinate and indeterminate structures

Prerequisites:

1. Students will able to understand the elastic structural analysis and behavior of indeterminate structures.
2. Students will be able to get knowledge about various methods involved in the analysis of indeterminatestructures.
3. Students will able to apply these methods for analyzing the indeterminate structures to evaluate theresponse of structures
4. Students will enable to get a feeling of how real-life structures behave
5. To make the students familiar with latest computational techniques and software usedfor structural analysis.

Course Outcome Mapping with Program Outcome:

V SEM															
STRUCTURAL ANALYSIS-I															
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO352.1	2	2	2	2	0	1	1	0	0	0	0	1	1	1	1
CO352.2	2	2	2	2	1	1	0	0	0	1	0	0	1	1	1
CO352.3	2	2	2	1	2	2	2	2	1	1	2	1	1	1	1
CO352.4	3	2	3	1	1	2	1	1	1	1	1	1	1	1	1
CO352.5	3	2	3	2	1	1	1	1	1	1	1	1	1	1	1
CO352(AVG)	2.4	2	2.4	1.6	1	1.4	1	0.8	0.6	0.8	0.8	0.8	1	1	1

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Academic Administration of Techno NJR Institute
Syllabus Deployment

Name of Faculty	: Mr. Nishant Sharma	Subject Code: 5CE4-02
Subject	: Structural Analysis - I	
Department	: Civil Engineering	Sem: V
Total No. of Lectures Planned: 28		

COURSE OUTCOMES HERE (3 OUTCOMES)

At the end of this course students will be able to:

CO1. Understand the behaviour of structures under different loading conditions

CO2. Develop the principles and equations for the analysis of statically determinate and indeterminate analysis in preparation for subsequent design courses

CO3. Identify indeterminacy of various structures.

Lecture No.	Unit	Topic
1	1	**INTRODUCTION**: Objective, scope and outcome of the course
2	2	**INTRODUCTION TO INDETERMINATE STRUCTURES**, Degrees of freedom per node
3	2	Static and Kinematic indeterminacy (i.e. for beams & frames)
4	2	Static and Kinematic indeterminacy (i.e. portal with & without sway etc), Releases in structures
5	2	Maxwell's reciprocal theorem
6	2	Bette's theorem
7	2	Analysis of prop cantilever structures
8	2	Analysis of Indeterminate Structure (fixed beams) using Area moment method
9	2	Analysis of Indeterminate Structure (continues beams) using Area moment method

10	2	Conjugate beam method
11	2	(Contd.) Conjugate beam method
12	2	Three moments Theorem
13	**3**	**ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES** using Slope-deflection method applied to continuous beams
14	3	(Contd.) Slope-deflection method applied to continuous beams
15	3	Slope-deflection method applied to portal frames with inclined members
16	3	(Contd.) Slope-deflection method applied to portal frames with inclined members
17	3	Slope-deflection method applied to portal frames without inclined members
18	3	(Contd.) Slope-deflection method applied to portal frames without inclined members
19	3	Moment-distribution method applied to continuous beams
20	3	(Contd.) Moment-distribution method applied to continuous beams
21	3	Moment-distribution method applied to portal frames with inclined members
22	3	(Contd.) Moment-distribution method applied to portal frames with inclined members
23	3	Moment-distribution method applied to portal frames without inclined members
24	**4**	**VIBRATIONS:** Elementary concepts of structural vibration, Mathematical models, basic elements of vibratory system
25	4	Degree of freedom. Equivalent Spring stiffness of springs in parallel and in series
26	4	Simple Harmonic Motion: vector representation, characteristic, Addition of harmonic motions, Angular oscillation
27	4	Undamped free vibration of SDOF system: Newton's law of motion, D Almbert's principle, deriving equation of motions, solution of differential equation of motion,
28	4	Frequency & period of vibration, amplitude of motion; Introduction to damped and forced vibration

TEXT/REFERENCE BOOKS

1. Strength of Materials & Mechanics of Structures: Vol. I by Dr. B.C. Punmia Laxmi Publications (p) Ltd.
2. Theory of Structure by Jangid & Negi, Tata Mc Graw Hill.
3. Structural Analysis by Hibbler R.C., Pearsons.

Course Level Problems (Test Items):

CO.NO.	Problem description
CO352.1	1) What do you understand to indeterminate structures and Degrees of freedom? 2) Write the Maxwell's reciprocal theorem and Betti's theorem
CO352.2	1) Analyze indeterminate structures by using area moment theorem. 2) Explain the principle of superposition.
CO352.3	1) What do mean by Slope deflection and Moment distribution method. 2) Enlist the advantages of double Integration and conjugate beam method.
CO352.4	1) Define the term degree of freedom? Discuss the equivalent spring stiffness in series. 2) Define the followings terms: a) Simple harmonic motion b) Angular frequency c) natural frequency d) time period
CO352.5	1) Differentiate un-damped and damped vibration of SDOF system. 2) Explain the D'Alembert's principle.

Assessment Methodology:

1. Practical exam in lab where they have to analyze problem statement. (Once in a week)

2. Assignments one from each unit.

3. Midterm subjective paper based on topics as mentioned in the modules. (Twice during the semester)

4. Final paper at the end of the semester subjective

Assignment No. 1

1 Give advantages & disadvantages of statically indeterminate structures
2 Differentiate statically determinate and indeterminate structures
3 Differentiate Plane frame and Grid
4 Give advantages of fixed beam over a simply supported beam
5 Define Static & Kinematics indeterminacy
6 Give equations of Static and Kinematics Indeterminacy for the following structures with meaning of each term used
(i) Beam
(ii) Plane truss
(iii) Plane Frame
(iv) Grid
7 State and explain principle of superposition.
8 Explain Maxwell's theorem of reciprocal deflections
9 Determine Structural indeterminacy of the structures shown in figure

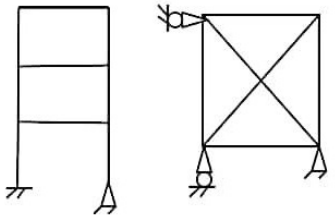


Figure 1

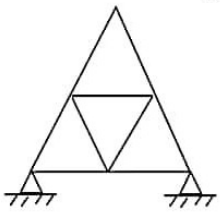


Figure 2

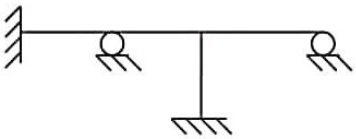


Figure 3

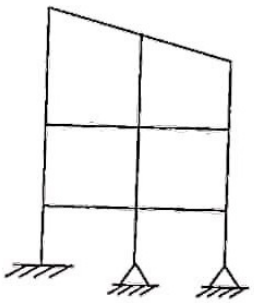


Figure 4A

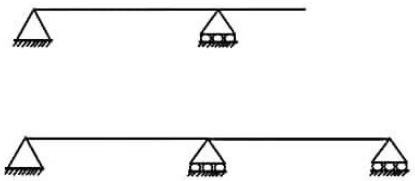


Figure 4B

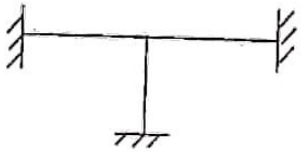


Figure 4C

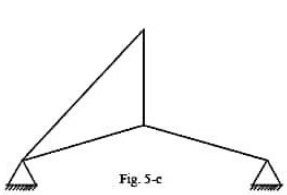


Fig. 5-c

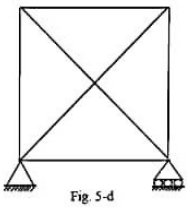


Fig. 5-d

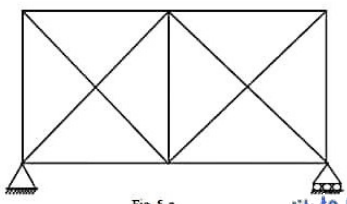
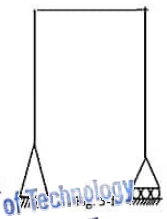


Fig. 5-e



Assignment No. 2

1 Derive relation among slope, deflection and radius of curvature
2 Derive an equation to determine deflection at center for the simply supported beam subjected to uniformly distributed load over an entire span.
3 Which points should be take care while using Macaulay's Method
4 Using Macaulay's method calculates slope at point C and deflection at point D for a simply supported beam as shown in **fig.-1**. Take EI=Constant
5 Determine deflection at B, C and D for the cantilever beam loaded as shown in **fig.-2** using Macaulay's method. Take $E=2 \times 10^5$ N/mm2 & $I = 2 \times 10^8$ mm4
6 Explain theorems of moment area method
7 Enlist advantages of double integration method and moment area method
8 Find slope & deflection for the structure shown in **fig.-3** below by Moment area method
9 Define Conjugate beam Theorems
10 Write difference between conjugate beam and real beam
11 Find deflection at C and slope at A for a simply supported beam as shown in **fig.-4** by conjugate beam method.
12 Find slope and deflection at point C for the beam shown in **fig.-5** using Conjugate beam method. Take EI = 20000 KN-m2
13 A simply supported beam is subjected to a central point load. If the slope is 0.8^0 at support due to the effect of loading, calculate deflection at center. Length of the beam is 3m

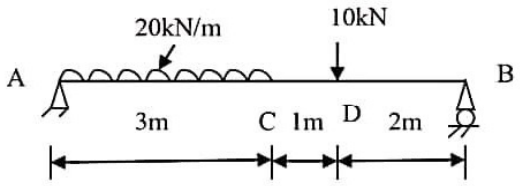


Figure 1

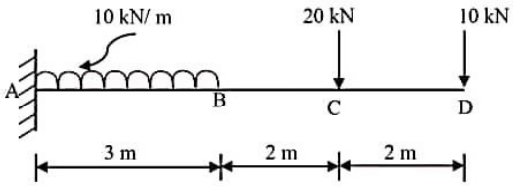


Figure 2

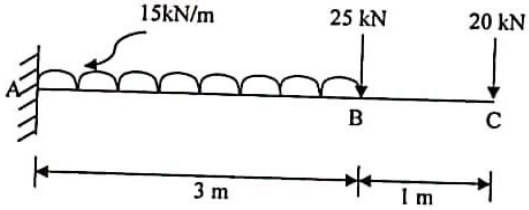


Figure 3

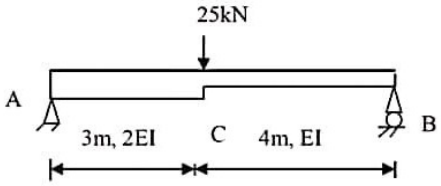


Figure 4

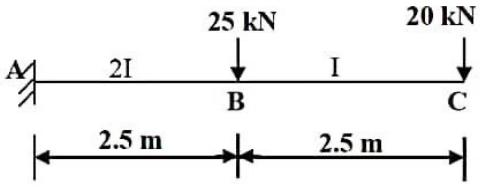


Figure 5

Techno India NJR Institute of Technology

Bhamashah (RIICO) Industrial Area, Kaladwas, Udaipur

B.Tech. V–Semester Mid Term Examination III (2019)
5CE4-02: Structural Analysis – I

Time:2 Hours **Maximum Marks: 80**

Roll No.:

Part A (*Attempt all questions. Each question carries 2 marks*)

Q1. Describe the difference between damped and un-damped vibrations?

Q2. Describe the concept of releases in structure.

Q3. What is member stiffness factor in moment distribution method?

Q4. What is natural frequency of vibration?

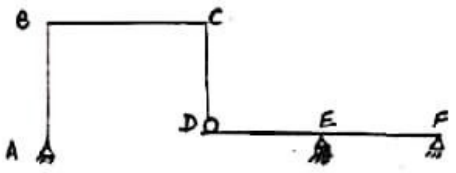
Q5. Describe logarithmic decrement.

Part B (*Attempt any **Four** questions. Each question carries 10 marks*)

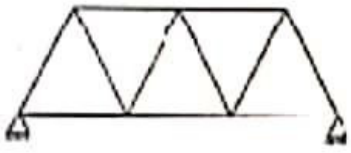
Q6. Describe the problems caused by vibration and how these problems can be minimized. Also describe D'Almbert's Principle and its applications.

Q7. Define degree of static and kinematic indeterminacy. Determined degree of kinematic and static indeterminacy of following structures.

(a)



(b)



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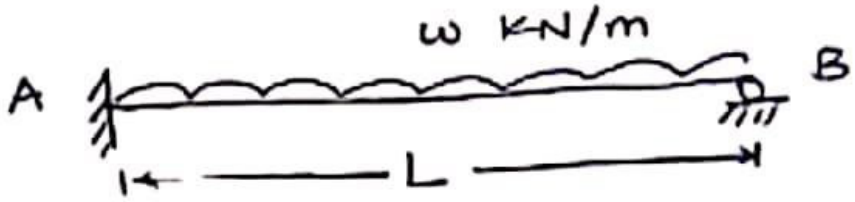
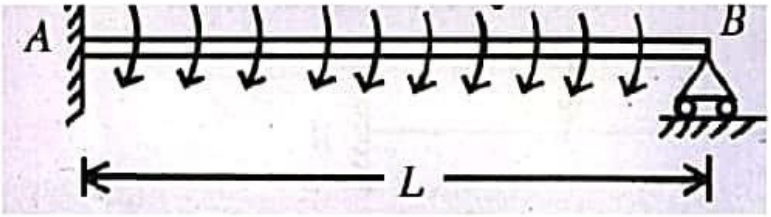
Q8. Find support reaction at B using conjugate beam method.



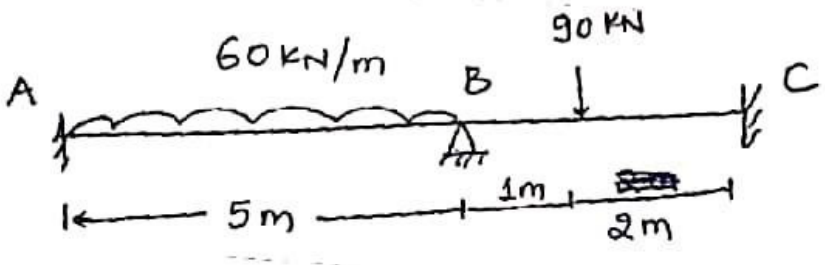
Q9. Find support reaction at B using moment area method.



Q10. A mass of 1 kg is suspended by a spring having stiffness of 600 N/m. The mass is displaced downwards from its equilibrium position by a distance of 0.01 m. Find (a) equation of motion of the system (b) natural frequency of the system (c) response of the system as a function of time (d) total energy of the system.

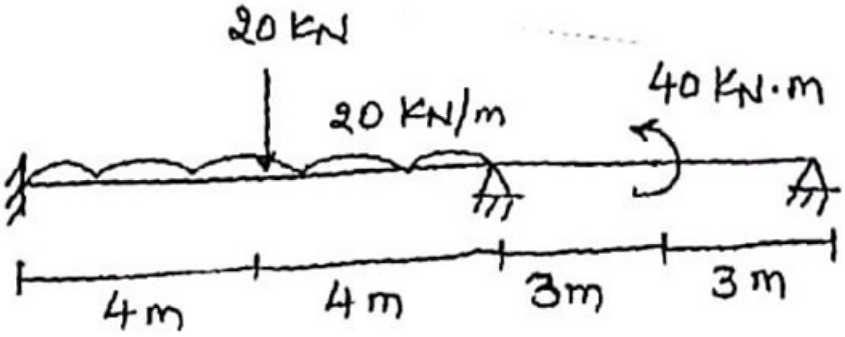
Part C (*Attempt any Two questions. Each question carries 15 marks*)

Q11. Draw SFD and BMD using slope deflection equation.

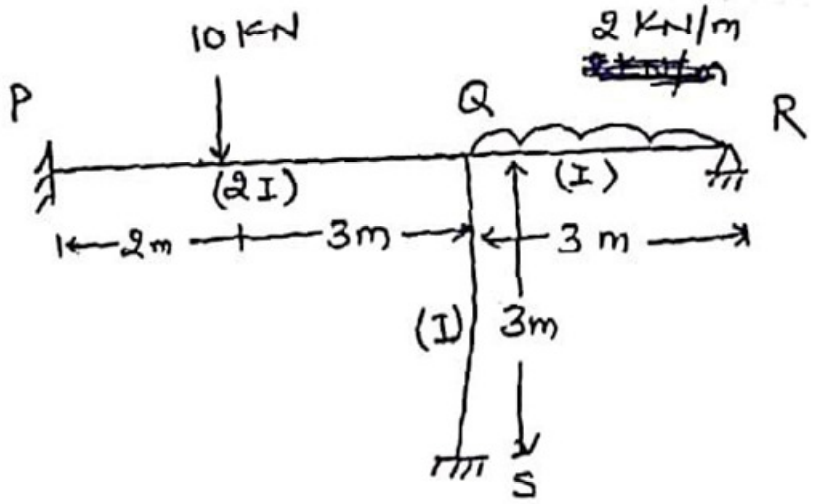


P.T.O.

Q12. Draw SFD and BMD using theorem of three moments.



Q13. **(a)** Find end moments using moment distribution method **(8 Marks)**



P.T.O.