Sub Code: R2322014 **R23** **Set No. 1**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURUJADA VIZINAGARAM
II B. Tech II Semester Supplementary Examinations NOV-2025
STRUCTURAL ANALYSIS
(CE)

Time: 3 hours **Max. Marks: 70**

The Question paper consists of Part A & Part B.
Part A is compulsory, Answer all questions. Part B Answers any one question from each unit.
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1		PART-A		(20M)
	a)	Explain the limitations of Castigliano's theorems when applied to non-linear structural systems.		[2]
	b)	Formulate the flexibility matrix for a statically indeterminate beam with one redundant support.		[2]
	c)	Explain the concept of compatibility matrix in the force method of structural analysis.		[2]
	d)	Derive the expression for fixed end moments in a beam with differential settlement of supports and temperature gradient.		[2]
	e)	Explain the concept of influence coefficients in the analysis of continuous beams with varying moments of inertia.		[2]
	f)	Derive the stiffness matrix for a beam element with semi-rigid connections at both ends.		[2]
	g)	How does shear deformation affect the slope-deflection equations for deep beams?		[2]
	h)	Explain the concept of modified stiffness in the moment distribution method when dealing with non-prismatic members.		[2]
	i)	Derive the sway correction factors for a multi-story frame analysed using the moment distribution method.		[2]
	j)	Derive the modified slope-deflection equations for a beam element with chord rotation.		[2]
		PART-B		(50M)
		Question from **Unit - I**		
2	a)	A three-member truss is shown in the figure. Member AB is horizontal with length 4m, member BC is vertical with length 3m, and member AC is inclined. A vertical load of 20 kN acts at joint B.Determine the horizontal and vertical deflection at joint B using the principle of virtual work. Take E= 2 × 10^5 N/mm² and cross-sectional area of all members as1500 mm².		[5]
	b)	A two-member frame consists of a horizontal member AB of length 5m and a vertical membe rBC of length 4m. Both members have the same flexural rigidity EI. A horizontal force P acts at joint B. Determine the horizontal deflection at B using the principle of virtual work, considering the effects of axial deformation in addition to bending.		[5]
		(OR)		
3	a)	A curved beam in the shape of a quarter circle of radius 3m carries a concentrated load P at the free end. Using the principle of virtual work, determine the horizontal and vertical deflection at the free end. Take E = 2 × 10^5 N/mm² and I = 1.2 × 10^8 mm⁴.Consider both bending and torsional effects.		[5]
	b)	A two-member frame consists of a horizontal member AB of length 5m and a vertical member BC of length 4m. Both members have the same flexural rigidity EI. A horizontal force P acts at joint B. Determine the horizontal deflection at B using the principle of virtual work, considering the effects of axial deformation in addition to bending.		[5]

Question from **Unit - II**

4 a) A portal frame has columns of height 4m each and a beam of span 6m. The left column is fixed at the base while the right column is hinged. Determine the degree of static and kinematic indeterminacy. Analyse the frame for a horizontal force of 20 kN acting at the top of the left column using an appropriate method. [5]

b) A truss has three redundant members. Using the flexibility method, analyse the truss when a temperature increase of 30°C occurs in one of the redundant members. The coefficient of thermal expansion is 12 × 10^-6 per °C. All members have the same cross-sectional area of 2000 mm² and E = 2 × 10^5 N/mm². [5]

(OR)

5 a) A statically indeterminate truss has two redundant members. One of the redundant members undergoes a temperature decrease of 35°C, while the other experiences a fabrication error making it 5mm shorter than required. Analyse the truss using the force method to determine the forces in all members. The coefficient of thermal expansion is 12 × 10^-6 per °C. All members have the same cross-sectional area of 2500 mm² and E = 2 × 10^5 N/mm². [5]

b) A two-bay two-story rigid frame has columns of height 3.5m each and beams of span 5m each. The bases are fixed. Determine the degree of static and kinematic indeterminacy. If one of the interior columns is replaced by a cable that can resist only tension, analyse how the indeterminacy changes and discuss the implications for structural analysis. [5]

Question from **Unit - III**

6 a) A three-span continuous beam ABCD has spans AB = 4m, BC = 6m, and CD = 5m. Support A is fixed, supports B and C are roller, and support D is hinged. Support B settles by 12mm, support C settles by 18mm, and support D rotates by 0.003 radians clockwise. Analyse beam and determine the moments at all supports. Take EI = 3 × 10^4 kN-m² throughout. [5]

b) A fixed beam of span 5m carries a moment of 30 kN-m at a distance of 2m from the left support and a moment of 25 kN-m at a distance of 3.5m from the left support, both acting clockwise .Calculate the fixed end moments and draw the bending moment diagram. Also determine the points of contraflexure and the maximum bending moment [5]

(OR)

7 a) A fixed beam of span 5m carries a moment of 30 kN-m at a distance of 2m from the left support and a moment of 25 kN-m at a distance of 3.5m from the left support, both acting clockwise. Calculate the fixed end moments and draw the bending moment diagram. Also determine the points of contraflexure and the maximum bending moment. [5]

b) A fixed beam of span 6m carries a moment of 40 kN-m at a distance of 2m from the left support .Calculate the fixed end moments and draw the bending moment diagram. Also determine the points of contraflexure [5]

Question from **Unit - IV**

8 a) non-sway portal frame has columns of height 4m each and a beam of span 6m. The bases are fixed. The left column carries a uniformly distributed load of 10 kN/m throughout its height, and the beam carries a uniformly distributed load of 15 kN/m. Analyse the frame using slope deflection method and determine the moments at all joints. [5]

b) A continuous beam ABCD has spans AB = 5m, BC = 6m, and CD = 5m. Support A is fixed, supports B and D are roller, and support C settles by 20mm. The beam carries a uniformly distributed load of 15 kN/m throughout its length. Analyse the beam using the slope deflection method. Take EI = 3 × 10^4 kN-m² throughout [5]

(OR)

9 a) A continuous beam ABCD has spans AB = 5m, BC = 6m, and CD = 5m. Support A is fixed ,supports B and D are roller, and support C settles by 20mm. The beam carries a uniformly distributed load of 15 kN/m throughout its length. Analyze the beam using the slope-deflection method. Take EI = 3 × 10^4 kN-m² throughout [5]

b) A continuous beam ABCD has spans AB = 5m, BC = 6m, and CD =5m. The beam has variable cross-section with moments of inertia in the ratio 1:1.5:1 for spans AB, BC, and CD respectively. Support A is fixed, supports B and C are roller, and support D is hinged. Support C settles by25mm. The beam carries a uniformly distributed load of 20 kN/m throughout its length. Analyze the beam using the slope-deflection method. Take EI = 2.5 × 10^4 kN-m² for span AB. [5]

Question from **Unit - V**

10 a) A three-bay two-story rigid frame has columns of height 3.5m each and beams of span 5meach. All bases are fixed. The frame carries uniformly distributed vertical loads of 18 kN/m on all beams and horizontal loads of 25 kN and 20 kN at the first and second floor levels respectively. Analyze the frame using the moment distribution method with sway correction. [5]

b) A three-bay three-story rigid frame has columns of height 3.5m each and beams of span 5meach. All bases are fixed. The frame is subjected to horizontal loads of 30 kN, 25 kN, and 20 kN atthe first, second, and third floor levels respectively. Analyze the frame for lateral loads using the moment distribution method with sway correction [5]

(OR)

11 a) A two-bay single-story portal frame has columns of height 4m each and beams of span 5meach. All bases are fixed. The frame carries a uniformly distributed vertical load of 15 kN/m oneach beam and a horizontal load of 20 kN at the top of the middle column. Analyze the frame using the moment distribution method assuming no sway. [5]

b) A two-bay two-story rigid frame has columns of height 3.5m each and beams of span 5m each.The bases are fixed. The frame is subjected to a horizontal load of 25 kN at the second floor level. [5]

Analyze the frame for lateral loads using the moment distribution method with sway correction.

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