Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII EXAMINATION – WINTER 2025

Subject Code:3171920 Date:18-11-2025

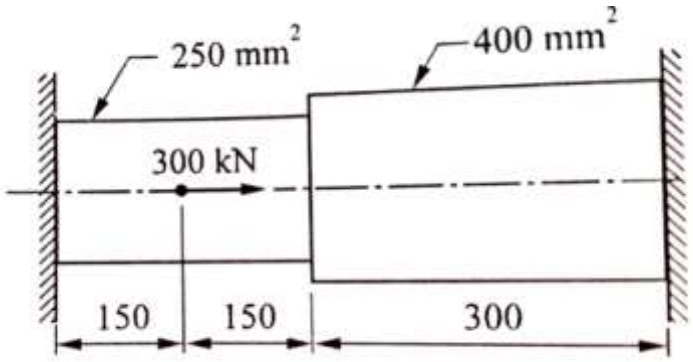
Subject Name:Finite Element Methods

Time:10:30 AM TO 01:00 PM Total Marks:70

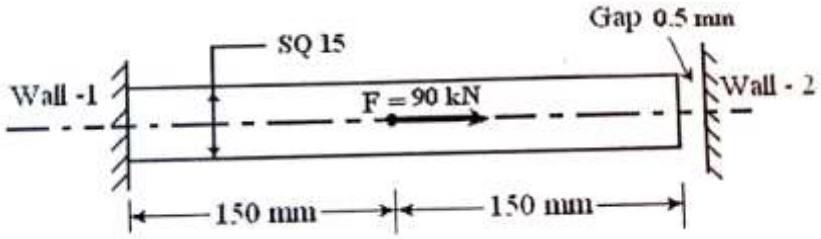
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed**.

			MARKS
Q.1	**(a)**	Why FEA is more popular method to solve complex problems in comparison with analytical method.	**03**
	(b)	Explain Domain, Node and Element with neat sketch.	**04**
	(c)	Explain step by step procedure to solve structural problem using FEM.	**07**
Q.2	**(a)**	Discuss the different types of elements used in FEA.	**03**
	(b)	Explain the Rayleigh-Ritz method.	**04**
	(c)	Derive the stiffness matrix for a bar element.	**07**
		OR	
	(c)	For the loaded bar shown in figure, determine the nodal displacement, and elements stresses. Assume E=200 * 10^9 N/m^2.	**07**



Q.3	**(a)**	Give examples of plane stress and plane strain problems.	**03**
	(b)	Enlist the properties of stiffness matrices.	**04**
	(c)	For the loading as in figure, determine displacements and stresses. Assume E= 80 *10^3 Mpa.	**07**

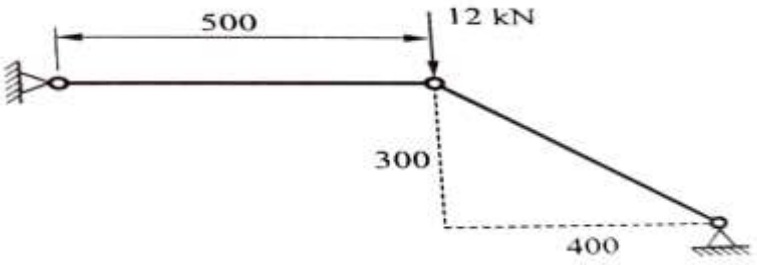


OR

Q.3 **(a)** Explain symmetric banded matrices. **03**

(b) How are thermal effects considered in a truss element? Give the necessary equation to determine stress considering thermal effects. **04**

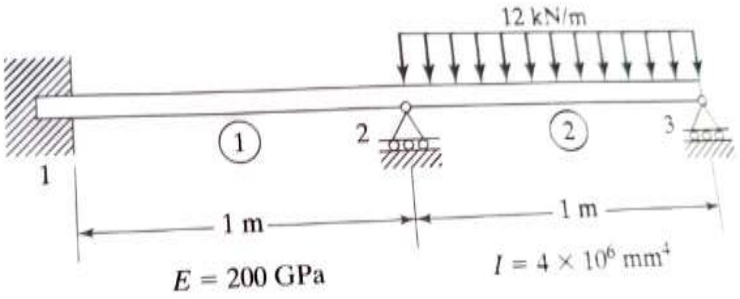
(c) For the two bar truss as shown in figure, determine the displacements in the bars. Assume E=70 GPa and A=200 mm^2 for both members. **07**



Q.4 **(a)** Explain how symmetry is used in FEA with applications. **03**

(b) Explain isoparametric element. **04**

(c) For the beam and loading shown in figure , determine the slopes at 2 and 3 (indicated in figure.) Take E = 200 GPa and I= 4 * 10^6 mm^4 **07**



OR

Q.4 **(a)** Explain LST element and give its application. **03**

(b) Explain skyline method of storing data. **04**

(c) Explain the Plane Frames element indicating its applications. Provide element stiffness matrix K and load vector. **07**

Q.5 **(a)** Explain axisymmetric element with example. **03**

(b) Explain the shape function of CST element. **04**

(c) The triangular element has nodal coordinates (10,10),(40,20) and (30,50) for nodes 1,2, and 3 respectively for a point P inside triangle, determine the x and y coordinates if shape functions N_1 and N_2 are 0.15 and 0.25 respectively. **07**

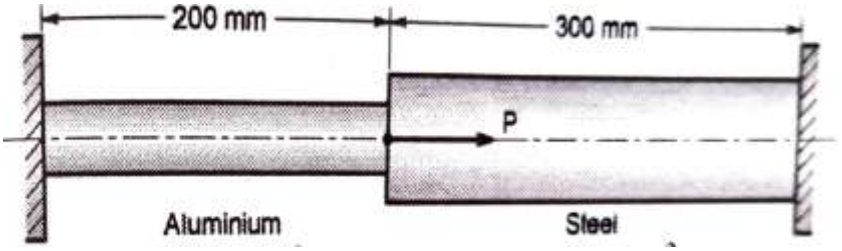
OR

Q.5 **(a)** How will you make Finite element models of pressure vessel and Belleville spring. **03**

(b) Explain the FEA procedure to model a tapered bar subjected to an axial load. **04**

(c) A stepped bimetallic bar, made of aluminium ($E= 70* 10^9$ N/m^2) **07**

and steel ($E= 200* 10^9$ N/m^2) is subjected to an axial load of 300 KN at 20°C as in figure. The temperature of bar is than raised to 60°C. The coefficient of thermal expansion for aluminum is $23 * 10^{-6}$ per °C while for steel is $11.7 * 10^{-6}$ per °C, the cross-sectional area for aluminum and steel are 900 mm^2 and 1200 mm^2 respectively. Find the nodal displacement and element stresses.



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