Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03006011 **Date: 15-12-2025**

Subject Name: Theory of Structure

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)**	Find and draw Core or Kernel of hollow rectangular section with outer dimension 400 mm * 600 mm and internal dimensions 300 mm * 500 mm.	**03**
	(b)	A rectangular column 500 mm wide by 400 mm deep is hinged at both the ends. Take length of column is 7 m, E=1.2*10^5 N/mm^2. Find Euler's crippling load.	**04**
	(c)	A cylindrical shell 4 m long and 1 m internal diameter is subjected to an internal pressure of 1.5 N/mm^2. If the thickness of shell is 10 mm, find the circumferential & longitudinal stresses. Find also change in diameter, length and volume. Poisson's ratio = 0.3, E= 200*10^3 N/mm^2.	**07**
Q.2	**(a)**	Explain conjugate beam in brief by considering different support condition.	**03**
	(b)	An axial pull of 60 kN is suddenly applied to a steel bar of 2.5 m long and 800 mm^2 in cross section. If modulus of elasticity of steel is 200 kN/mm^2 find maximum instantaneous stress, modulus of resilience, strain energy and maximum instantaneous extension.	**04**
	(c)	Calculate deflection at point C as shown in figure 1. take EI = 40,000 kN.m^2. (Using Macaulay's method)	**07**

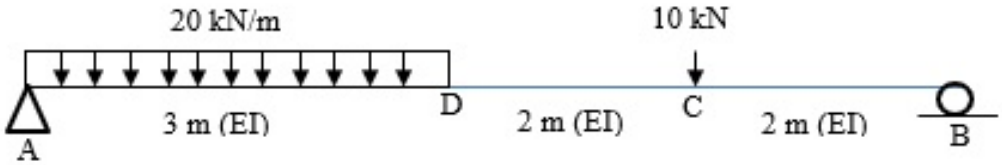

Figure -1

OR

(c) Find slope and deflection at free end of cantilever beam as shown in figure 2 by moment area method or conjugate beam method. E= $2*10^5$ N/mm^2, I=$5*10^8$ mm^4. **07**

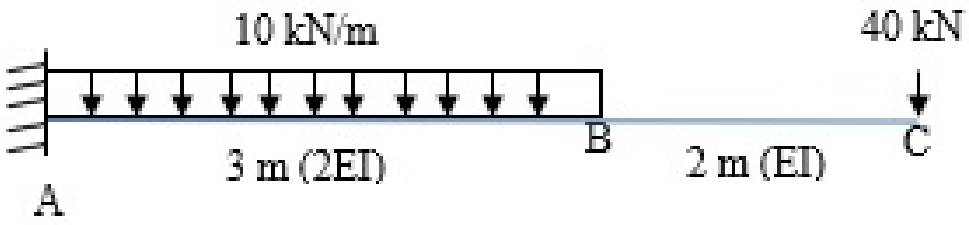

Figure -2

Q.3 **(a)** State Eddy's theorem and give the advantages of three hinged arch over beam. **03**

(b) Calculate the static and kinematic indeterminacy for structure shown in figure 3 (a,b). **04**

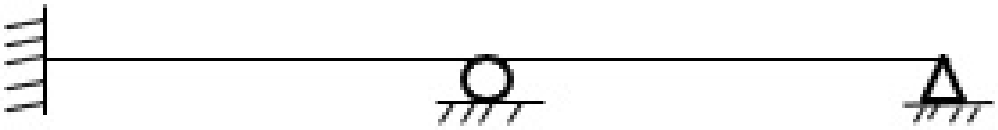

Figure (3a)

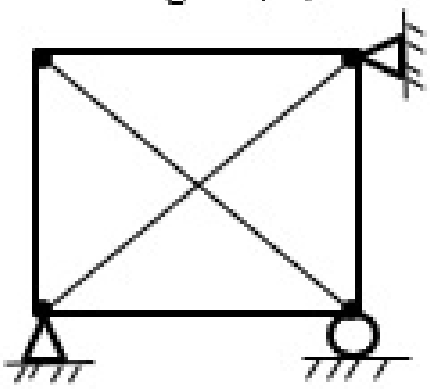

Figure (3b)

(c) Draw shear force, bending moment and axial force diagram for the rigid jointed frame as shown in figure 4. **07**

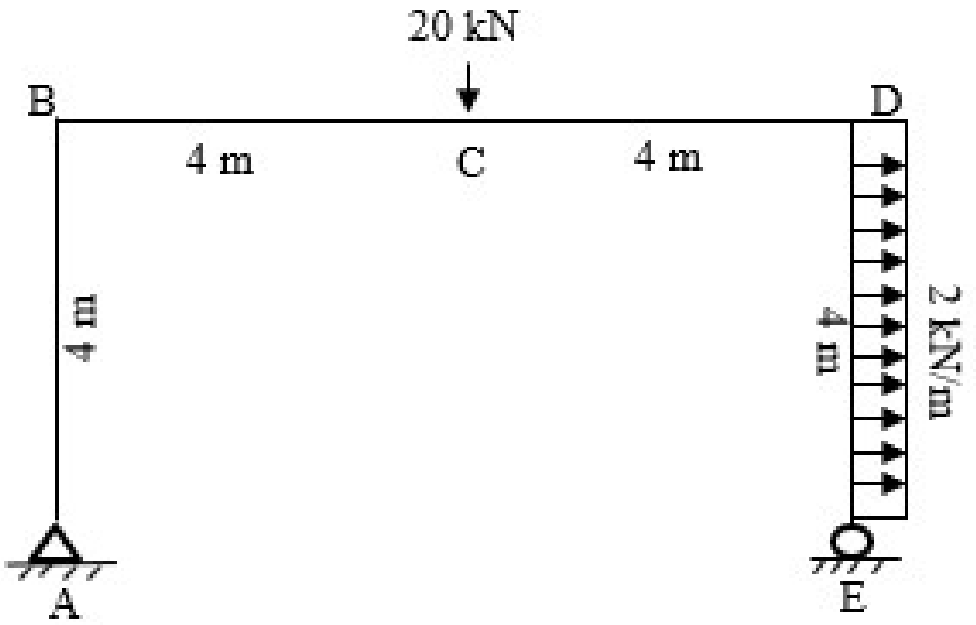

Figure 4

OR

(a) State Maxwell's reciprocal theorem by all three ways. **03**

(b) Differentiate between statically determinate structures and statically indeterminate structures. **04**

(c) A three hinged parabolic arch has a horizontal span of 10 m and central rise of 2 m. it carries UDL of 1 kN/m over the left-hand half of the span. Calculate the reactions at the end hinges. Also calculate the values of the normal thrust, shear force and bending moment at 2 m from the left hinge. **07**

Q.4 **(a)** Define axial load, eccentric load and eccentricity. **03**

(b) A rectangular column of size 500*300 mm carries an eccentric load of 800 kN on the axis bisecting the thickness at 120 mm from centroidal axis. Find maximum and minimum resultant stress and draw stress diagram. **04**

(c) Explain Mohr's circle method to find normal stress tangential stress and resultant stress on inclined plane. (for one direct stress and two direct stress) **07**

OR

(a) Write assumptions of Euler's formula. **03**

(b) A rectangular retaining wall section is 1.5 m wide. It retains water up to full height. Find minimum height required when it is just at the point of overturning. The density of wall material is 22 kN/m^3 and water 10 kN/m^3. Take co-efficient of friction as 0.5. **04**

(c) Two planes AB and BC which are at the right angles as shown in figure 5 carry shear stresses of intensity 17.5 N/mm^2 while these planes also carry a tensile stress of 70 N/mm^2 and compressive stress of 35 N/mm^2 respectively. Determine the principal stresses, positions of the principal planes and maximum shear stress. **07**

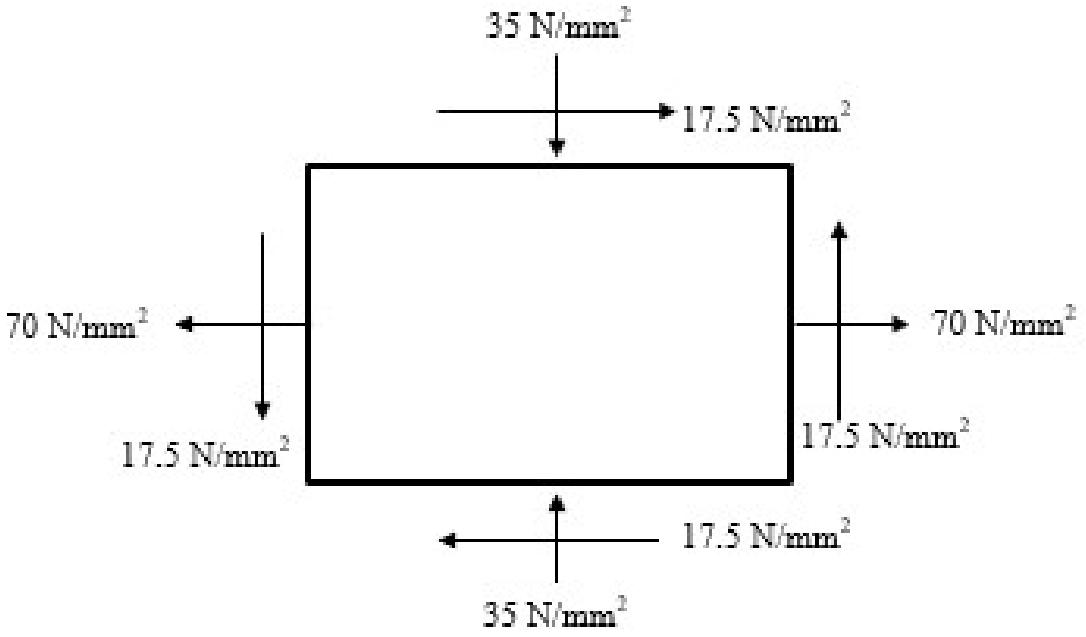

Figure 5

Q.5 **(a)** Derive the equation to calculate deflection at free end of cantilever beam of L m span and subjected to UDL of w kN/m (on entire span) using conjugate beam method. **03**

(b) Explain load position for maximum shear force at section for UDL longer than span and shorter than span. **04**

(c) An UDL of 15 kN/m and 3 m length crosses a simply supported girder of span 12 m from left to right. Draw ILD for S.F. and B.M. at section 5 m from left and find maximum S.F. and B.M. at this section. **07**

OR

(a) A steel bar 150 cm long and rectangular in section 50 mm * 90 mm is subjected to an axial load of 2 kN find maximum stress if, load is applied gradually and the load is applied suddenly. **03**

(b) Explain load position for maximum bending moment at a section for a) UDL longer than span and b) single point load. **04**

(c) A train of load shown in figure 6 crosses a simply supported girder of span 16 m from left to right. Calculate maximum shear force and bending moment at section 6 m from left. **07**

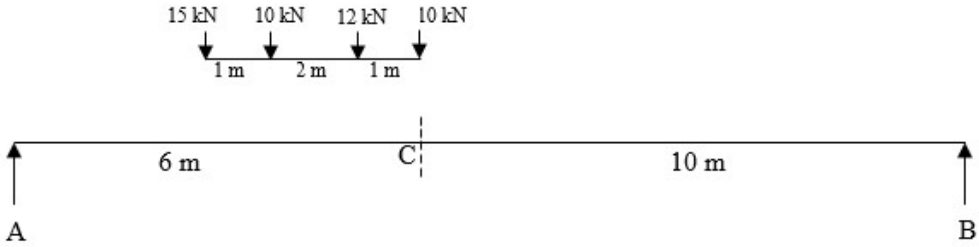

Figure 6

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