

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – WINTER 2023****Subject Code:2140603****Date:24-01-2024****Subject Name: Structural Analysis-I****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.
5. Take $E = 2 \times 10^5 \text{ N/mm}^2$ if required in the data.

		Marks
Q.1	(a) Explain with neat sketches, Maxwell's Reciprocal Theorem	03
	(b) Differentiate between Statically determinate and Statically indeterminate structures giving suitable examples.	04
	(c) Calculate SI, KI and draw the bending moment diagram for the portal frame shown in Fig: 1 .	07
Q.2	(a) Explain about the relation between a Real Beam and a Conjugate Beam	03
	(b) Derive the relation between Moment, slope and curvature for an elastic beam.	04
	(c) Find slope at left support and deflection at mid span for the beam in given in Fig: 2 . Take $E = 200 \text{ GPa}$ and $I = 21875 \times 10^3 \text{ mm}^4$.	07
	OR	
	(c) A cantilever with a span of 4m carries a point load at its free end. If the slope at free end in 1.5° , calculate its deflection at free end.	07
Q.3	(a) Define Kernel of a section. Determine the kernel for a circular cross section.	03
	(b) Explain the condition for zero tensile forces in section due to eccentric loading in a column	04
	(c) A masonry pier of 3m x 4m, supports a load as shown in Fig: 3 . Determine stresses at each corner of the pier.	07
	OR	
Q.3	(a) Write the assumptions for Euler's long column theory	03
	(b) A solid round bar 60mm in diameter and 2.5m long is used as a strut. If one end of the bar is fixed while the other is considered as hinge, determine the Euler's load for the strut. Take $E = 2 \times 10^5 \text{ N/mm}^2$.	04
	(c) A 1.5m long cast iron column has a circular cross section of 50mm diameter. One end of the column is fixed and the other is free. Taking the factor of safety as 3, calculate the safe load using Rankine's formula and Euler's Formula. Take Yield stress as 560 N/mm^2 , $\alpha = 1/1600$, and $E = 1.2 \times 10^5 \text{ N/mm}^2$.	07
Q.4	(a) Explain about the benefits of an Arch as compared to a Beam	03
	(b) Evaluate the slope and deflection at free end for a cantilever beam subjected to uniformly distributed load throughout its span.	04
	(c) A three hinged parabolic arch has a span of 30m and rise of 10m. The arch carries a uniformly distributed load of 60kN/m on the left half of its span. It also carries two concentrated loads of 160 kN and 100 kN at 5m and 10m from right end.	07

Determine the horizontal and vertical thrust at each support.

OR

- Q.4** (a) Derive the expression for circumferential stress and longitudinal stress for a thin cylindrical shell. **03**
 (b) Calculate the bursting pressure for a cold drawn seamless steel tubing of 60mm inside diameter and 2mm wall thickness. The ultimate strength of the steel is 380 N/mm². **04**
 (c) A fixed beam having a span of 6m is subjected to a central point load of 45 kN and uniformly distributed load of 20 kN/m throughout its span. Calculate the fixed end moment and draw the SF and BM diagrams. **07**

- Q.5** (a) Define: Proof Resilience, Modulus of Resilience and Strain Energy **03**
 (b) Evaluate the fixed moment and support reaction for a propped cantilever beam subjected to a central point load. Use method of consistent deformation. **04**
 (c) Using Conjugate beam method, determine the deflection at free end for a cantilever beam 2m long that carries a load of 15 kN at a distance of 1m from the free end and 10 kN at the free end. Take $E = 2 \times 10^5$ N/mm² and $I = 15 \times 10^{-6}$ m⁴. **07**

OR

- Q.5** (a) Derive the expression for strain energy store in a bar subjected to sudden loading. **03**
 (b) An object of 100 N weight falls by gravity from a vertical distance of 5m, where it is stopped by a collar at the free end of a vertical rod having length of 10m and diameter of 20mm. The top of the bar is rigidly fixed. Calculate the maximum stress and strain energy stored in the bar due to this impact. Take $E = 200$ kN/mm². **04**
 (c) Using Moment Area method, determine the deflection at free end for a cantilever beam 2m long that carries a load of 15 kN at a distance of 1m from the free end and 10 kN at the free end. Take $E = 2 \times 10^5$ N/mm² and $I = 15 \times 10^{-6}$ m⁴. **07**

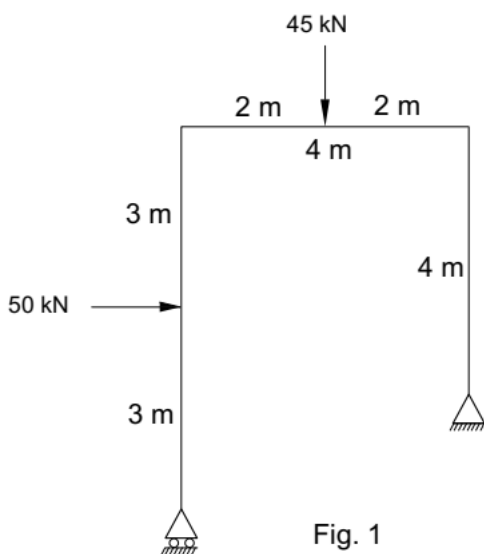


Fig. 1

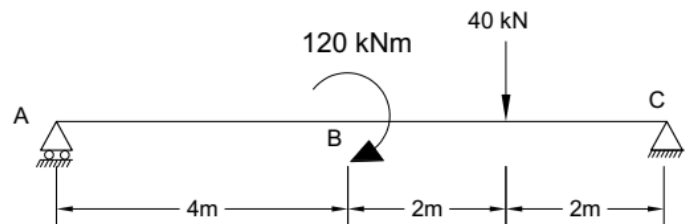


Fig. 2

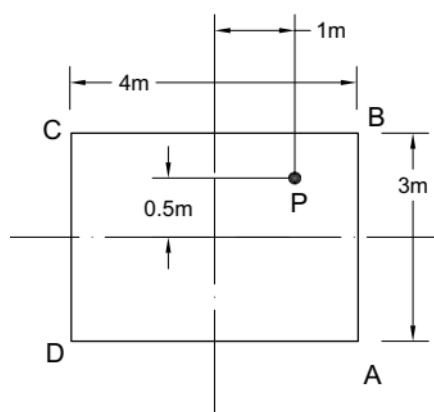


Fig. 3
