Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER– IV EXAMINATION – SUMMER 2026

Subject Code:3140603 Date:21-05-2026

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.**

			Marks
Q.1	**(a)**	Define statically determinate and indeterminate structures. Also give examples with neat sketch.	**03**
	(b)	State and prove Maxwell's reciprocal theorem.	**04**
	(c)	Analyze the truss given in Fig:(1) by Method of Joint.	**07**
Q.2	**(a)**	Distinguish between Truss and Frame.	**03**
	(b)	Derive the expressions for Hoop and longitudinal stresses in a thin cylinder.	**04**
	(c)	Calculate horizontal thrust at support of three hinged parabolic arch with 'L' span, certral rise 'R' and two hinges at same level. It is subjected to UDL of w/L kN/m over entire span. Also calculate bending moment at L/3 meter from the support.	**07**
		OR	
	(c)	A cylindrical shell 1 meter long, 180 mm internal diameter, thickness of metal 8 mm is filled with a fluid at atmospheric pressure. If an additional 20000 mm^3 of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall of the cylinder. Find also the hoop stress induced. Take E= 2 x 10^5 N/mm^2 and Poisson's ratio as 0.3.	**07**
Q.3	**(a)**	Define: 1)Resilience, 2) Proof Resilience and 3) Modulus of Resilience.	**03**
	(b)	Derive the Relationship between slope, deflection and radius of curvature.	**04**
	(c)	A uniform metal bar has a cross sectional area of 700 mm^2 and a length of 1.5 meter with an elastic limit of 160 N/mm^2. Find its proof resilience. Find also the maximum value of an applied load which may be suddenly applied without exceeding the elastic limit. Calculate the value of the gradually applied load which will produce the same extension as that produced by the above suddenly applied load. E = 200 GPa.	**07**
		OR	
Q.3	**(a)**	Differentiate between real beam and conjugate beam. Justify the support conditions in conjugate beam.	**03**
	(b)	Define slenderness ratio. With the help of sketches, explain effective length of column for different end conditions.	**04**
	(c)	A steel beam is simply supported as shown in **Fig:(2)** at the ends on a span of 8 meters. Determine the location and magnitude of the maximum deflection by Macaulay's Method. I_{xx} = 4.79 x 10^8 mm^4, E = 200 GPa.	**07**
Q.4	**(a)**	Define (a) Axial load (b) Eccentricity (c) Core of a section	**03**
	(b)	Explain Moment -area theorem I and theorem II.	**04**
	(c)	A masonry pier shown in **Fig:(3)** supports a vertical load of 600 kN at a point shown in figure. Find the stresses at the corners of the pier.	**07**
		OR	
Q.4	**(a)**	Differentiate between column and strut.	**03**
	(b)	Write the assumptions and limitations of Euler's formula	**04**

(c) A hollow cylindrical cast iron column is 4 meter long, both ends being fixed. Design the column to carry an axial load of 250 kN. Use Rankine's formula and adopt a factor of safety 5. The internal diameter is 0.8 times the external diameter. Crushing stress for the column material is 550 N/mm^2, and $\alpha = 1/1600$. **07**

Q.5 **(a)** Discuss various types of Arches. **03**

(b) Draw a neat sketche of Kernel of following cross-sections: **04**

a) Rectangular 200mm x 300mm

b) Hollow circular cylinder with external dia. =300 mm, thickness= 50 mm

c) Square with 600 cm^2 area

(c) Determine the support reactions for the fixed beam shown in **Fig:(4)** Draw shear force and bending moment diagrams. **07**

OR

Q.5 **(a)** Distinguish between direct and bending stress. **03**

(b) Derive the equation of fixed end moment in a fixed beam of span 'L' having one of the support sink by δ. **04**

(c) Analyze the continuous beam shown in **Fig:(5)** by moment distribution method. **07**

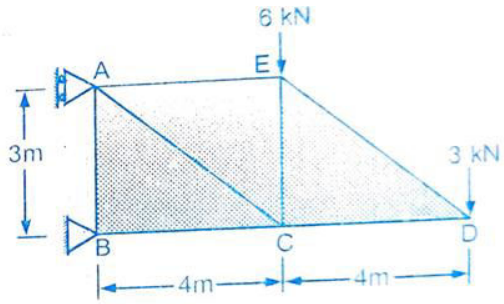

Fig:(1)

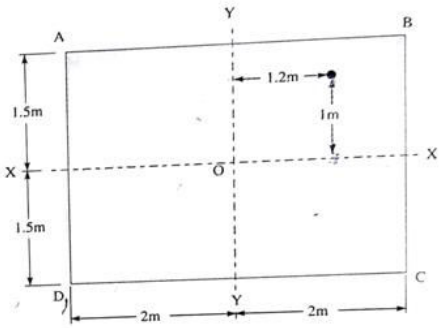

Fig:(3)

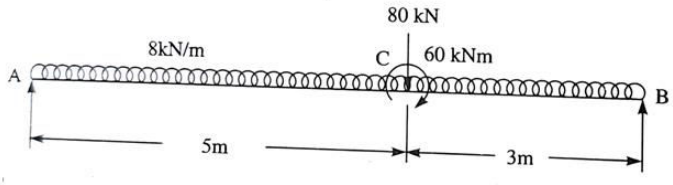

Fig:(2)

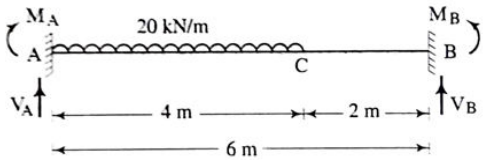

Fig:(4)

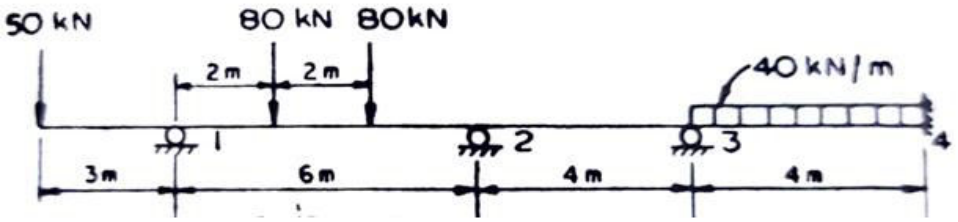

Fig:(5)

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code:3140603 Date:12-05-2025

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. **3140609Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Differentiate between direct stress and bending stress.	**03**
	(b)	State Moment Area theorems I and II.	**04**
	(c)	A vertical steel rod of uniform diameter, 3.0m long is rigidly secured at its upper end and a weight of 2 kN is allowed to slide freely on the rod through a distance of 25mm on to a collar at the lower end of the rod. Calculate the diameter of the rod, if the maximum strain is not to exceed 1/1600. Take E = 2 X 10^5N/mm^2.	**07**
Q.2	**(a)**	Find out fixed end moment for a fixed beam carrying uniformly distributed load for the whole span.	**03**
	(b)	Discuss Stability checks for a dam.	**04**
	(c)	A steel bar 1 meter in length is subjected to a pull such that the maximum stress is equal to 150 N/mm^2. Its cross-section is 200 mm^2 over a length of 950 mm and for the middle 50 mm length the sectional area is 100 mm^2. If E=2 X 10^5N/mm^2, calculate strain energy stored in the bar.	**07**
		OR	
	(c)	It is found that a bar 36 mm in diameter stretches 2.1 mm under a gradual load of 120 kN. If a weight of 1500 N is dropped on to a collar at the lower end of this bar, through a height of 60 mm before commencing to stretch the bar, calculate the maximum instantaneous stress and elongation produced in the bar.	**07**
Q.3	**(a)**	Explain in brief about stability of structures	**03**
	(b)	Derive the relation between slope, deflection and radius of curvature of the beam.	**04**
	(c)	A fixed beam AB of span 6 m carries two point loads of 20 kN each at distance 1.5 m from each end. Draw S.F. and B.M diagrams for the beam.	**07**
		OR	
Q.3	**(a)**	Draw neat sketch of kernel of the following cross-sections. (i). Rectangular block 200 mm x 300 mm (ii) Circular section of 300 mm diameter	**03**
	(b)	Derive formula for strain energy due to sudden loading.	**04**
	(c)	Explain in detail: i. Maxwell's reciprocal them ii. Principal of superposition	**07**
Q.4	**(a)**	Define(i) Strain energy (ii) Proof resilience (iii) Modulus of Resilience	**03**
	(b)	State basic difference between fixed and simply supported beams. State advantages of fixed beam over simply supported beam.	**04**

(c) A masonry dam 6 m high, 3 m wide at base and 1.2 m wide at top, retains water on vertical face for full height. Considering density of masonry as 17 kN/m^3 and density of water as 10 kN/m^3, find out maximum and minimum pressure intensities at the base. **07**

OR

Q.4 **(a)** Justify the support condition in conjugate beam. **03**

(b) Explain any two stability conditions for retaining wall. **04**

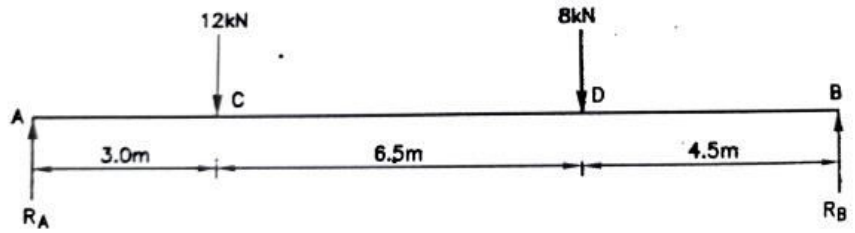
(c) A masonry trapezoidal dam is constructed with following data. Find the width of the dam at base so that 'no tension' is occurred on section. **07**

1. Top width = 1m
2. Height of dam = 5m
3. wt. of water = 10 kN/m^3
4. Height of water on vertical face of dam = 4.8 m
5. wt. of masonry = 20 10 kN/m^3.

Q.5 **(a)** Explain with neat sketch: Effective length of column with d ifferent end conditions. **03**

(b) Define and explain : Anchor cables. **04**

(c) Calculate deflections under the loads for a beam loaded as shown in figure.(By Macaulay's Method). **07**



OR

Q.5 **(a)** Prove that the maximum strain energy stored in a body is given by ,U= (σ^2/2E) x Volume. **03**

(b) A thin cylindrical shell of internal diameter d, wall thickness t and length L, is subjected to internal pressure p. Derive the expression for change in volume of the cylinder. **04**

(c) The external and internal diameter of a hollow cast iron column are 200 mm and 150 mm respectively. If column is hinged at both ends having a length of 4 m, determine the crippling load using Rankine formula. Take fs = 550N/mm^2 and α = 1/1600. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140603 Date:18-07-2024

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.**

			MARKS
Q.1	**(a)**	Define statically determinate and indeterminate structures.	**03**
	(b)	Calculate Static and Kinematic Indeterminacy for the structures shown in the figure 1	**04**
	(c)	A three hinged parabolic arch of 16 m span and 3 m central rise carries a point load of 150 kN at 4 m from left side support. Calculate Bending moment, Normal thrust and shear force at section under load.	**07**
Q.2	**(a)**	Define (a) Resilience (b) proof resilience (c) Modulus of resilience	**03**
	(b)	A thin cylindrical shell with internal diameter of 130 mm and 10 mm thickness is subjected to a pressure of 15 $N/mm^{2.}$ Find circumferential and longitudinal stress in shell material.	**04**
	(c)	A 2000 mm long wire of 30 $mm^{2.}$ Cross sectional area is hinged vertically. It receives a sliding collar weight of 150 N weight and stopper at bottom end. The collar is allowed to fall on stopper through 250 mm height. Determine the instantaneous stress induced in the wire and corresponding elongation. Also determine the strain energy stored in the wire. Take modulus of rigidity of wire as 200 Gpa.	**07**
		OR	
	(c)	A concrete dam, trapezoidal in cross section with 3 m width at base and 1.1 mt width at top, is 8 m high. It has to retain water up to full height. If unit weight of concrete is 25 kN/m^3 and that of water 10 kN/m^3, calculate maximum and minimum stress intensity induced at the base.	**07**
Q.3	**(a)**	Write moment area theorem -1 and moment area theorem 2	**03**
	(b)	Derive the expression to find slope and deflection at free end of cantilever beam having span L subjected to point load W at free end using double integration method.	**04**
	(c)	A simply supported beam of span 8 m is subjected to UDL of 25 kN/m over entire span. Calculate the slope at left support and deflection at center of beam. Take EI= $6X10^4$ $kN\text{-}m^2$	**07**
		OR	
Q.3	**(a)**	Define core or Kernel of a section and draw core for rectangular and circular section.	**03**
	(b)	Discuss stability checks for a dam.	**04**
	(c)	A simply supported beam of span 6 m carries a point load of 80 KN at 4-meter from left end support. Calculate defection under point load and slope at left support using Macaulay's method. Take EI=20000 $kN\text{-}m^2$	**07**
Q.4	**(a)**	Differentiate between column and strut.	**03**
	(b)	Discuss different column end conditions and effective length of columns.	**04**
	(c)	A short column of rectangular size 250 mm X 200 mm is subjected to a load of 500 kN at a point of 50 mm from longer side and 100 mm from shorter side. Find maximum and minimum stresses in the column.	**07**
		OR	

Q.4 **(a)** Define conjugate beam. What are the different kinds of a support condition in conjugate beam? **03**

(b) Differentiate between long and short column **04**

(c) A hollow cast iron column of 300 mm diameter and 25 mm thickness is used as 5 m long column with both ends fixed. Find the safe cripling load by (a) Euler's formula (b) Rankine's formula Take factor of safety as 3.5 and maximum compressive stress as 500 N/mm^2 take value of α as 1/1600 and E= 0.14 X 10^5 N/mm^2 **07**

Q.5 **(a)** State assumptions of Euler's formula. **03**

(b) Find fixed end moments for the fixed beam of span L m subjected to UDL of W kN/m on entire span. **04**

(c) Analyze the fixed beam shown in the figure 2. **07**

OR

Q.5 **(a)** Define (a) Carry over moment (b) Stiffness (c) Distribution factor **03**

(b) What are the advantages and disadvantages of fixed beam **04**

(c) Analyze the beam shown in the figure 3 using moment distribution method and draw bending moment diagram. **07**

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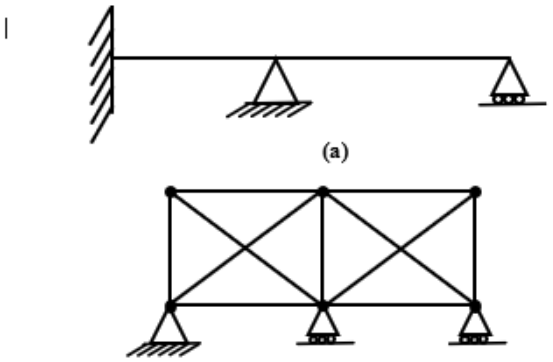


Figure 1

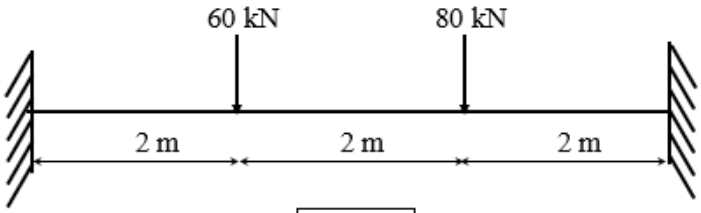


Figure 2

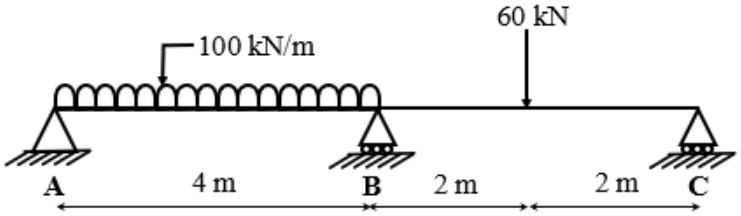


Figure 3

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140603 Date:11-07-2023

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.**

			MARKS
Q.1	**(a)**	State and explain principle of superposition with its application in this subject.	**03**
	(b)	Differentiate between (i) Plane frame and Grid (ii)Conjugate beam and real beam	**04**
	(c)	Define: Impact factor. A weight of 10kN falls by 30 mm on a collar rigidly attached to lower end of a vertical bar 4 m long and 1000 mm^2 in section. The upper end of the vertical bar is fixed. Find the instantaneous expansion, stress and energy absorbed by the bar. Find also impact factor. Take E = 210GPa.	**07**
Q.2	**(a)**	Derive equation of circumferential and longitudinal stresses in cylindrical shell due to internal pressure.	**03**
	(b)	Find SI and KI of structures shown in fig. 1 (a), 1(b).	**04**
	(c)	Draw shear force, bending moment and axial force diagrams for the frame shown in fig. 2	**07**
		OR	
	(c)	Analyse the truss shown in fig. 3	**07**
Q.3	**(a)**	Define: (i) Strain energy (ii) Resilience (iii) Modulus of resilience	**03**
	(b)	A beam simply supported over a span of 6m is carrying a point load 50kN at mid span. Find slope at supports using Macaulay's method. EI= 20000kNm^2	**04**
	(c)	A three hinged parabolic arch has a span of 20m and central rise 5 m. It carries two point loads of 20 kN of each at 3m and 6m from the left hinge. Calculate normal thrust, shear and bending moment at a section 5m from left end hinge.	**07**
		OR	
Q.3	**(a)**	Define: (i) Crippling load (ii) Statically indeterminate structure (iii) Strut	**03**
	(b)	Draw S.F. and B.M. diagram for fixed beam carrying central point load 'W' using basic principle.	**04**
	(c)	Find out slope at 'A' and deflection at 'C' for the beams shown in fig.4 using Conjugate beam method. $2I_{AC} = I_{CB}$ .EI = 12000kNm^2.	**07**
Q.4	**(a)**	What is middle third rule? What is importance of this rule in stability check for dam section?	**03**
	(b)	A strut 2 m long is 50mm in diameter. One end of the strut is fixed while its other end is hinged. Find the compressive load for the member using Euler's formula, allowing a factor of safety of 3.5. Take E=2.1 x $10^5 N/mm^2$.	**04**

(c) A rectangular pier of 1.5 m X 1 m is subjected to a compressive load of 500 kN with 0.25m eccentricities in both directions. Find the stress on all four corners of the pier and draw stress disribution. **07**

OR

Q.4 **(a)** Draw a neat sketch for Kernel of section for rectangular 400 mm X 300mm **03**

(b) A column of size 250mm (b) x 350mm (d), 4.2 m in length with its both ends are fixed. Find load carrying capacity of the column by Rankine's formula. Take fc=320 N/mm^2, E = 2.1 x 10^5 N/mm^2, α= 1/6400. **04**

(c) A masonry retaining wall of trapezoidal section is 12 m high and retains earth which is level up to the top. The width at the top and bottom are 3 m and 6 m respectively. Exposed face is vertical. Determine the stresses at base and check the section for its stability. Take density of earth = 16 kN/m^3 and density of masonry =24 kN/m^3 and angle of repose of earth= 30◦ and μ =0.5 **07**

Q.5 **(a)** Define & explain the following terms **03**
Relative stiffness, Carry-over factor, Distribution factor

(b) Find the deflection at the free end of cantilever of span '*l*' subjected to point load 'P' at free end by equating strain energy to work done. **04**

(c) Analyse the propped cantilever beam AB, fixed at 'A' and simply supported at 'B' subjected to UDL of 20kN/m^2 throughout span using consistent deformation method. Draws shear force and bending moment diagrams. **07**

OR

Q.5 **(a)** State moment area theorems with net sketches. **03**

(b) Find fixed end moments due to rotation of support B by Θ in clockwise direction for fixed beam AB. **04**

(c) Determine end moments for the beam ABC loaded as shown in fig.5 using moment distribution method. **07**

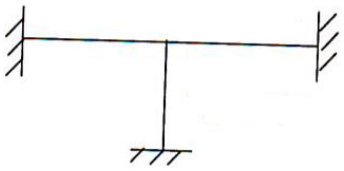


Fig. 1(a)

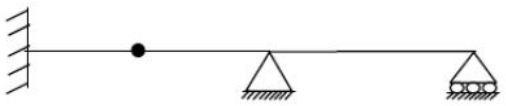


Fig. 1(b)

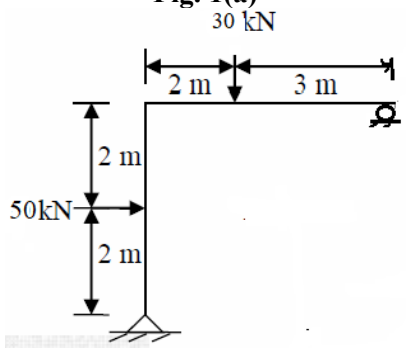


Fig. 2

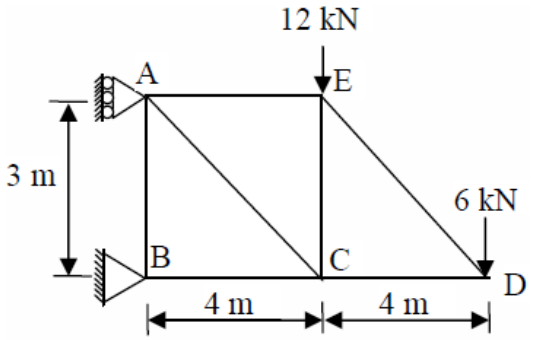
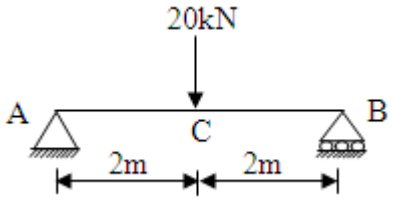


Fig. 3



$2I_{AC} = I_{CB}$

Fig. 4

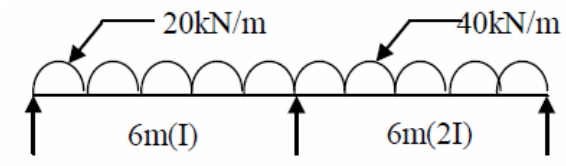


Fig.5

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3140603 Date:27-06-2022

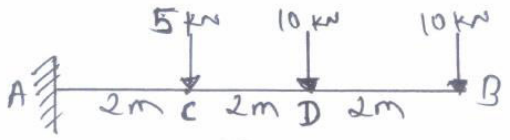
Subject Name:Structural Analysis-I

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

Instructions:

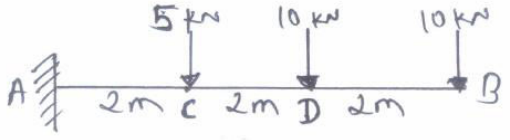
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Define resilience, proof resilience and modulus of resilience.	**03**
	(b)	Differentiate conjugate beam and real beam	**04**
	(c)	A short column rectangular section 250 mm x 200 mm is subjected to load of 400 kN at a point 50 mm from longer side and 100 mm from shorter side. Find maximum and minimum stress in the column.	**07**
Q.2	**(a)**	Derive Euler's formula of critical load for column having both ends hinged	**03**
	(b)	Explain Maxwell's theorem of reciprocal deflections.	**04**
	(c)	Using conjugate beam method, find the slope and deflection at point B in terms of EI of the cantilever beam shown in figure.	**07**

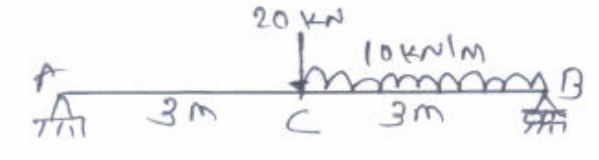


OR

	(c)	Using moment area method, find slope & deflection at point C in terms of EI for the beam shown in figure.	**07**



Q.3	**(a)**	State Moment area theorems I and II	**03**
	(b)	Determine degree of redundancy of simply supported beam, cantilever beam and propped cantilever beam.	**04**
	(c)	Find slope at point A and B & deflection at point C for the beam shown in figure. Take EI = 3000 kN.m^2.	**07**



OR

Q.3	**(a)**	Discuss stability checks for a dam.	**03**

(b) A cable loaded with 10 kN/m is stretched between two supports in the same horizontal line 200 m apart. If the central dip is 15 m, find the support reaction. **04**

(c) A three hinged circular arch hinged at the support and at the crown has a span of 20 m and a central rise of 4 m. It carries a concentrated load of 120 kN at 6 m from left support. Determine the moment under point load and at 6 m from right support. **07**

Q.4 **(a)** Define Core of the section. Derive and locate the same for a Circular cross section. **03**

(b) Define and explain: Kernel of rectangular section. **04**

(c) A cylindrical shell has 3.5 m length, 1.2 m diameter and 10 mm thickness, the shell is subjected to internal pressure of 2 N/mm^2. Calculate the maximum shear and change in dimension of the shell. **07**

OR

Q.4 **(a)** Explain Arch and Cable. **03**

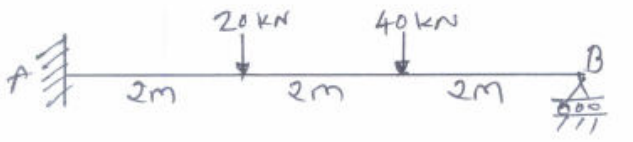
(b) Write difference between strut and column. **04**

(c) A column has one end fixed and other end hinged with length of 6.0 m. It is made up of a tube having external diameter of 100 mm and wall thickness of 10 mm. If yield strength of the material is 410 N/mm^2 and Rankine constant is 1/4800, calculate Euler's critical load and Rankine's critical load. **07**

Q.5 **(a)** State assumptions and limitations of Euler's formula **03**

(b) Derive formula for strain energy due to gradually applied loading. **04**

(c) Using method of consistent deformation, analyse the propped cantilever beam shown in Figure, and draw shear force and bending moment diagrams. Choose V_B as a redundant. **07**



OR

Q.5 **(a)** State advantages of fixed beam over simply supported beam. **03**

(b) A fixed beam of 5 m span carries central uniformly distributed load of 10 kN/m on entire span. Find fixed end moment equation using area moment method. **04**

(c) A small concrete dam, triangular in cross section with one face vertical, is 8 m high and 3 m wide at base. It has to retain water on one face up to a depth 7 m. If unit weight of concrete is 25 kN/m^3 and that of water 10 kN/m^3, calculate maximum and minimum stress intensity induced at the base. Sketch also stress distribution diagram under the base of dam. **07**

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