Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV EXAMINATION – WINTER 2025

Subject Code:3140603 Date:15-11-2025

Subject Name:Structural Analysis-I

Time:02:30 PM TO 05:00 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)	State and explain principle of superposition.	**04**
	(c)	Draw shear force, bending moment and Axial Force diagram for the rigid frame as sown in Figure 1.	**07**
Q.2	**(a)**	Define resilience, proof resilience and modulus of resilience.	**03**
	(b)	Explain gradual load, sudden load and load applied with impact.	**04**
	(c)	It is found that 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**
		OR	
	(c)	A simply supported beam AB of span 5m carries a uniformly distributed load of 5kN/m over its span. Determine the strain energy stored due to bending in the beam. Take E=200 GPa, I = 200cm^4.	**07**
Q.3	**(a)**	Derive the relation between slope, Deflection and Radius of Curvature.	**03**
	(b)	Differentiate Conjugate beam and real beam.	**04**
	(c)	A simply Supported beam of span 10 m is loaded as shown in Figure 2 determine the position and maximum deflection, Take E = 200 GPa, I = 6.95 x 10^8 mm^4	**07**
		OR	
Q.3	**(a)**	State advantages of fixed beam over simply supported beam	**03**
	(b)	Explain Moment -area theorem 1 and 2	**04**
	(c)	Determine maximum slope and deflection for a beam By moment area method show Figure 3. Take E = 200 GPa, I = 2 x 10^8 mm^4	**07**
Q.4	**(a)**	Define and explain: Kernel of Hollow circular section.	**03**
	(b)	A rectangular column of size 30 cm x 50 cm is acted upon by compressive force of 9000 kN at an eccentricity of 'é' cm from C.G. on axis parallel to 50 cm side. Find the eccentricity. If maximum tensile stress not to exceed by 4.8 N/mm^2.	**04**
	(c)	A masonry wall, 6 m high, is of solid rectangular section, 3 m wide and 1 m thick. A horizontal wind pressure of 1.2 kN/m^2 acts on the 3 m side. Find	**07**

the maximum and minimum stress induced on the base, if unit weight of masonry is 24 kN/m^3.

OR

Q.4	**(a)**	Differentiate between long and short column	**03**
	(b)	Derive the Euler's formula for crippling load for strut hinged at both ends.	**04**
	(c)	A cast iron column of hollow circular section having 200 mm external diameter and 20 mm metal thickness. 5 m length has to carry a load 120 kN at an eccentricity of 20 mm from the geometrical axis. Calculate the maximum and minimum stresses included in the section, if the ends are fixed. Also calculate the maximum permissible eccentricity so that in tension is induced at the base. Take E = 120 Gpa.	**07**
Q.5	**(a)**	Explain advantages of three hinged arch over beam.	**03**
	(b)	A thin cylindrical shell 900 mm diameter, 3m long and 10 mm thick is subjected to an internal pressure of 2MPa. Find the circumferential stress if the eccentricity of longitudinal joints is 75%	**04**
	(c)	Using method of consistent deformation, analyze the propped cantilever beam shown in Figure 4, and draw shear force and bending moment diagrams.	**07**

OR

Q.5	**(a)**	What are the advantages and disadvantages of fixed beam?	**03**
	(b)	Derive the expression for horizontal reaction, tension at the ends for a uniformly loaded cable	**04**
	(c)	A propped cantilever beam of span 'L' is subjected to a point load 'P' at mid span. Determine the reactions at the supports.	**07**

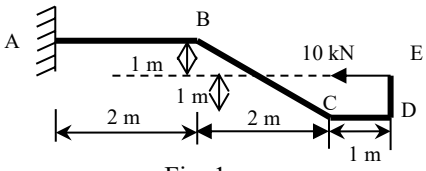

Fig .1

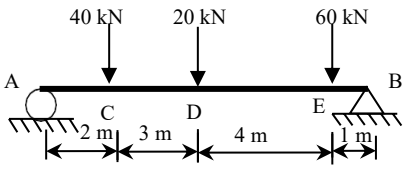

Fig .2

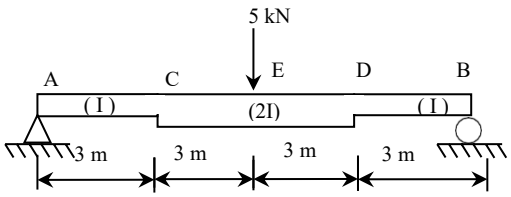

Fig. 3

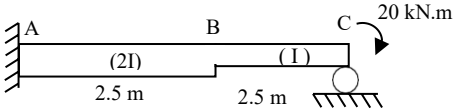

Fig. 4

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140603 Date:21-11-2024

Subject Name: Structural Analysis-I

Time:02:30 PM TO 05:00 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)**	Explain the External Stability and internal stability of structure.	**03**
	(b)	Explain Maxwell Reciprocal deformation.	**04**
	(c)	Draw shear force, bending moment and Axial Force diagram for the rigid frame as sown in Fig. 1.	**07**
Q.2	**(a)**	Derive the expression for strain energy due to impact loading. Explain the key factors influencing the energy absorption and discuss its relevance in engineering applications.	**03**
	(b)	An unknown weight falls through 20 mm on caller rigidly attached to the lower end of vertical bar. 3 m long and 25 mm in diameter. If the maximum instantaneous extension is known to be 4 mm. what is the corresponding stress and the value of unknown weight? Take E = 210 kN/mm^2.	**04**
	(c)	Determine the ratio of strain energy stored in the simply supported beam AB of span 5 m carries 25 KN load at a central point and the same load distribution over its entire span.	**07**
		OR	
	(c)	A copper rod 30 mm diameter, 2 m long is enclosed in a steel tube, 35 mm internal diameter 5 mm thickness co-axially. The composite member is held vertically. The top end is fixed and rigid collar is provided at the bottom. A body of mass 50 kg is to be dropped centrally on the collar through a height h. the maximum instantaneous stress in copper is not to exceed 60MPa. Compute the maximum value of 'h' take E_s = 200GPa and E_c= 120GPa.	**07**
Q.3	**(a)**	State advantages of fixed beam over simply supported beam.	**03**
	(b)	A cantilever 3 m long carries a uniformly distributed load the entire length. If the slope at free end is 1^0 find the deflection at the free end.	**04**
	(c)	Calculate the slope and deflection at pint A for a beam loaded as shown Fig. 2 as shown below take E = 200 GPa. I = 3 x 10^7 mm^4.	**07**
		OR	
Q.3	**(a)**	Evaluate the stability conditions for retaining walls. Describe the key factors that affect their stability and analyze how these factors contribute to overall wall performance.	**03**
	(b)	A cast iron having 160 mm diameter carries an eccentric load of 50 kN. If maximum tensile stress is not to exceed 7.5 N/mm^2, find possible eccentricity of load on column.	**04**
	(c)	A tabular C/S of column as shown in the Fig. 3 is subjected to a P kN vertical load on the centroid of the hole. Determine the maximum value of P, if maximum compressive stress allowed is 50 kN/mm^2.	**07**
Q.4	**(a)**	Define the following terms and explain their significance in structural engineering: (i) Crippling load; (ii) Statically indeterminate structure; (iii) Strut.	**03**
	(b)	Explain the Euler's formula assumption and its limitation.	**04**

(c) A solid cast iron circular column of 4 m height is to be erected such that its one end remains fixed and other end remain hinged. Find the size if the section. If column has to carry a safe axial load of 300kN. Take factor of safety of 5, $F_c = 500$ N/mm^2. Renkine's Constant $\alpha = 1/1500$. **07**

OR

Q.4 **(a)** Define & explain the following terms Relative stiffness, Carry-over factor, Distribution factor. **03**

(b) What is conjugate beam? Differentiate between real beam and conjugate beam. Justify the support condition in conjugate beam. **04**

(c) Finds reaction of support for the beam shown in Fig. 4 with using consistant deformation method. **07**

Q.5 **(a)** Explain advantages of three hinged arch over beam. **03**

(b) A thin cylindrical shell 900 mm diameter, 4 m long and 10 mm thick is subjected to an internal pressure of 2MPa. Find the circumferential stress if the eccentricity of longitudinal joints is 75%. **04**

(c) Determine the support movement for a continuous beam as shown in Fig. 5 by moment distribution method. Also draw bending moment diagram. **07**

OR

Q.5 **(a)** What are the advantages and disadvantages of fixed beam? **03**

(b) Derive the expression for horizontal reaction, tension at the ends for a uniformly loaded cable. **04**

(c) A beam AB span 5 m fixed at both ends carries a uniformly distributed load of 20 kN/m over the whole span. The left end 'A' rotates clockwise by 0.8" and right end 'B' sinks by 10 mm. determine the fixed end moments and reactions at the supports. Draw also shear force and bending moment diagram. Take E 200 kN/mm^2 and I = 10 x 10^3 mm^2. **07**

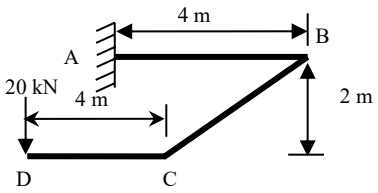

Fig .1

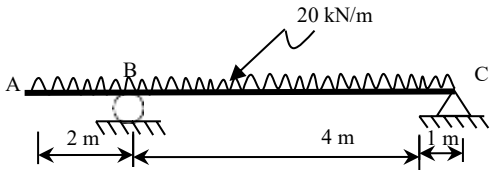

Fig .2

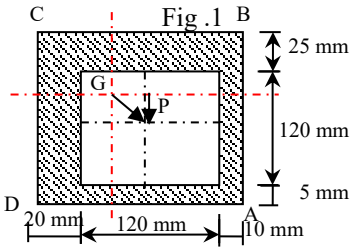

Fig .3

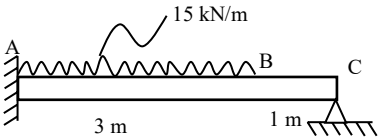

Fig. 4

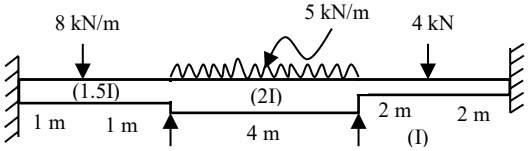

Fig. 5

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140603 Date:17-01-2024

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.**

			MARKS
Q.1	**(a)**	Explain the Maxwell reciprocal deflection theorem with neat sketch.	**03**
	(b)	Calculate the static and kinematic indeterminacies of the structure in Fig 1 and 2	**04**

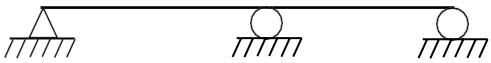

Fig. 1

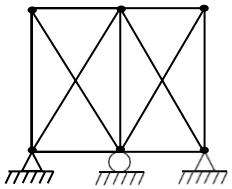

Fig. 2

	(c)	A three hinged parabolic arch of 20 m span and 4 m central rise carries a point load of 160 kN at 4 m from left side support. Calculate Normal thrust and shear force at sectionunder load. Draw BMD.	**07**
Q.2	**(a)**	A thin cylindrical shell of internal diameter d, wall thickness t and length l, is subjected to internal pressure p. Derive the expression for circumferential stress produced if the efficiencyof the longitudinal joint is η.	**03**
	(b)	A thin cylindrical shell has 100 mm internal diameter and wall thickness is 12 mm. It carries a steam pressure of 11 N/mm^2, Find hoop stress and longitudinal stress in the shell material.	**04**
	(c)	A thin cylindrical shell is 3000 mm long 1000 mm in diameter and thickness of metal 10 mm after being filled with water at atmosphere pressure, more water is pumped in until the pressure is 2.4 N/mm^2 on relieving the pressure, what should be amount of additional water let out if the water is assumed to incompressible. Take E for steel = 200 kN/m^2, Poisson's ratio = 0.3	**07**
		OR	
	(c)	Find a slope at A and deflection at C for the beam shown in Figure 3 using a Macaulay method. Take EI 3000 $kN.m^2$.	**07**

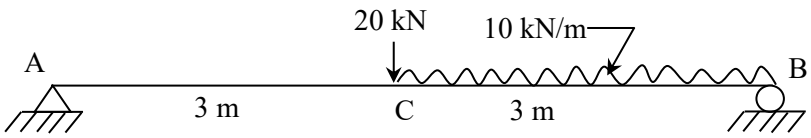

Fig. 3

Q.3	**(a)**	Explain following Terms, i) Resilience; ii) Proof Resilience; iii) Modulus of Resilience.	**03**
	(b)	Derive the formula for strain due to sudden loading.	**04**

(c) A 1500 mm long wire of 30 mm^2 cross sectional area is hanged vertically. It receives a sliding collarof 100 N weight and stopper at bottom end. The collar is allowed to full on stopper through 200 mmheight. Determine the instantaneous stress included in the wire and corresponding elongation. Alsodetermine the strain energy stored in the wire. Take modulus of elasticity of wire as 200GPa **07**

OR

Q.3 **(a)** What are the fundamental principles to consider when analyzing a fixed beam in structural engineering?" **03**

(b) Determine slope and deflection at free end of cantilever as shown in Figure 4. Take E= 200GPa, and I = 150 x 10^6mm. **04**

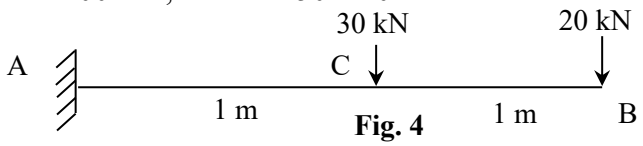

Fig. 4

(c) Using a moment area method, determine the slope at B and c and deflection at B of the cantilever beam as shown in Figure 5. **07**

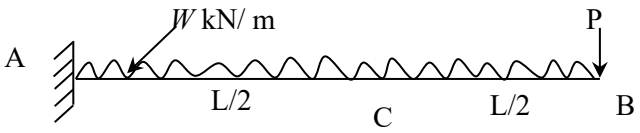

Fig. 5

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

(b) A propped cantilever beam of span 'l' is subjected to a point load 'w' at the center of the span.Determine all and draw shear force and bending moment diagram. **04**

(c) A 20 m height masonry chimney is 2 m square at base and trapper to 1 m square at top the tapped central flue is circular in cross- section and 1 m diameter at the base. If the total weight of the brick work, about the base is 1300 kN. Find for what uniform intensity of wind pressure and one face of chimney the stress distribution the base just ceases to be wholly compressive. **07**

OR

Q.4 **(a)** Define "core" or "Kernel" of section. Obtained the "core" or "Kernel" of solid square section. **03**

(b) A cast iron column having a 150 mm diameter carries an eccentricity load of 50 kN. If maximum tensile stress is not exceed 7.5 N/mm^2, find permissible eccentricity of load column. **04**

(c) A rectangular retaining wall section is 2 m wide. It retains water up to full height. Fin the maximum height required for following: (a) when it is just at the point of overturning; (b) when it is just on the point of sliding; (c) there is a no tensile stress is produced at the base of section. The density of wall material and water is 22 kN/m^3 respectively and take efficiently of friction as 0.5. **07**

Q.5 **(a)** Discuss Euler's formula for column buckling. What are its key assumptions, and how is it used in column design? **03**

(b) Describe the behavior of columns with initial curvature. How does this initial curvature affect their stability, and what considerations are needed in their design? **04**

(c) A hollow cast iron column 6 m. long is fixed at both ends, and has an external diameter of 400 mm. find the internal diameter of column if it supports an axial load of 1000 kN. Factor of safety = 5; $\alpha = 1/1600$, fc= 550 N/mm^2. **07**

OR

Q.5	**(a)**	Differentiate between long and short column.	**03**
	(b)	Distinguish between direct stresses and bending stresses.	**04**
	(c)	A rectangular column section ABCD having AB = CD = 400 mm and BC = AD = 300 mm carries a compressive load 300 kN at corner B. Find the stress at each corner A, B, C and D and draw stress –distribution diagram for each side.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140603 Date:14-12-2022

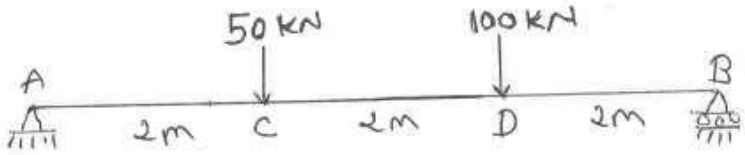
Subject Name:Structural Analysis-I

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.**

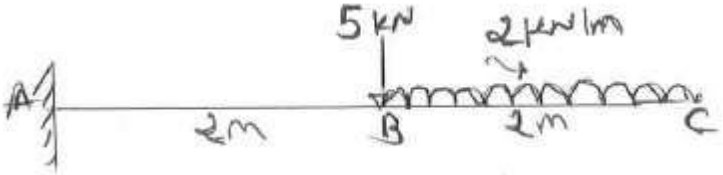
Q.1	**(a)**	State Moment Area theorems I and II.	**03**
	(b)	State and explain principle of superposition.	**04**
	(c)	Calculate slope at ends and deflection under point load for simply supported beam shown in figure by Macaulay's method. Take EI = 10,000 kN.m^2.	**07**



Q.2	**(a)**	Explain Maxwell's theorem of reciprocal deflections.	**03**
	(b)	Give advantages of fixed beam.	**04**
	(c)	A symmetrical three hinged circular arch has san 20 m and central rise 4 m. It is carrying point load 12 kN at 6 m from left side hinge. Calculate B.M. at 4 m from left support and also find maximum positive and negative bending moment.	**07**

OR

	(c)	Using conjugate beam method, find slope & deflection at point B and C for the beam shown in figure. Take EI = 2000 kN.m^2	**07**



Q.3	**(a)**	Differentiate between long and short column.	**03**
	(b)	A symmetrical three hinged parabolic arch of span 40 m and center rise of 8 m carries UDL of 30 kN/m over the left half of the san. Find out support reaction of the arch.	**04**
	(c)	A rectangular pier of size 300 mm x 300 mm is subjected to a compressive load of 900 kN at one of the corner. Find the stress intensities at all four corners of the pier and draw stress distribution diagram. If the load is acting at the center of the pier, also draw stress distribution diagram.	**07**

OR

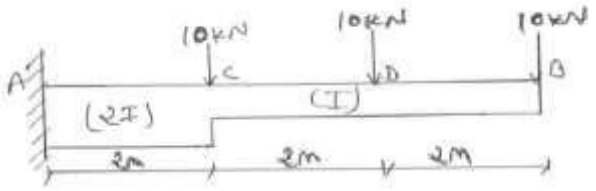
Q.3	**(a)**	Derive the formula for no tension condition at base for a dam.	**03**
	(b)	Obtain a relation for the maximum and minimum stresses at the base of a symmetrical column when it is subjected to an eccentric load about two axis.	**04**

(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 f_s = 550 N/mm^2 and α = 1/1600. **07**

Q.4 **(a)** Explain advantages of three hinged arch over beam. **03**

(b) State assumptions and limitations of Euler's formula. **04**

(c) Determine maximum slope and deflection for a cantilever beam as shown in figure. Take E = 2 x 10^5 N/mm^2 and I = 2 x 10^8 mm^4. **07**



OR

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

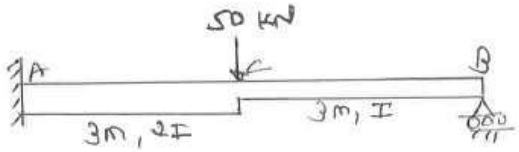
(b) A thin spherical shell of internal diameter 'd' and wall thickness 't', is subjected to internal pressure 'p'. Derive the expression for change in volume of the shell. **04**

(c) A thin cylindrical shell of 600 mm diameter is 1500 mm long and 10 mm thick. It is subjected to an internal pressure of 2 N/mm^2. Calculate the change in diameter, length and volume. Take E = 200 GPa and μ = 0.27. **07**

Q.5 **(a)** Find out fixed end moment for a fixed beam carrying uniformly distributed load for the whole span. **03**

(b) A fixed beam of 10 m span carries U.D.L. of 10 kN/m on its entire span . Find fixed end moment equation using area moment method. **04**

(c) Using method of consistent deformation, analyse the propped cantilever beam shown in Figure. Draw shear force and bending moment diagrams also. **07**



OR

Q.5 **(a)** Define resilience, proof resilience and modulus of resilience. **03**

(b) Explain strain energy due to flexure in beam. **04**

(c) A cylindrical chimney, 25 m high, of uniform circular section is 5 m external diameter and 2 m internal diameter. It is subjected to a horizontal wind pressure of 1400 N/m^2. If the coefficient of wind pressure is 0.6 and unit weight of masonry is 22 kN/m^3, find the maximum and minimum stress at the base of section. **07**

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