Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Remedial Examination March 2010

Subject code: 130604 **Subject Name: Structural Analysis - I**

Date: 10 / 03 / 2010 **Time: 11.00 am – 01.30 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1		Answer the following.(**Any seven**)	**14**
	(i)	State Maxwell's reciprocal theorem with its validity.	
	(ii)	Define the terms: (i) slenderness ratio.(ii) proof resilience.	
	(iii)	Which points should be taken care while using Macaulay's method?	
	(iv)	Differentiate between the terms flexural rigidity and torsional rigidity.	
	(v)		
	(vi)	What do you understand by influence line diagram?	
	(vii)	Draw the conjugate beam diagram corresponding to real beam shown in **fig.(I).**	
	(viii)	A shaft PQRS is subjected to a torque at P, Q, R and S as shown in **fig.(II).** In which section the maximum torque will occur?	
		A three hinged parabolic arch with central hinge at the crown is subjected to a uniformly distributed load of w kN/m over the entire span. The bending moment at the quarter span is _____ .	
Q.2	**(a)**	"Indeterminate structures are always better than determinate structures". Comment on the statement.	**03**
	(b)	Find the structural indeterminacy for the **fig.(III)**	**04**
	(c)	Calculate the diameter of the shaft required to transmit 45 kW at 120 rpm. The maximum torque is likely to exceed the mean by 30%, for a maximum permissible shear stress of 55 N/mm^2. Calculate also the angle of twist for a length of 2 m. G = 80 x 10^3 N/mm^2.	**07**
		OR	
	(c)	A three hinged parabolic arch carries a uniformly distributed load of 30 kN/m on the left half of the span. The arch has a span of 16 m and central rise of 3 m. Determine the bending moment, normal thrust and radial shear at 2 m from the left support. Refer **fig.(IV).**	**07**
Q.3	**(a)**	State the theorems of moment area method.	**03**
	(b)	Explain the condition to avoid tensile stresses at the base of a masonry dam when subjected to hydrostatic pressure.	**04**
	(c)	A beam of span 4 m is simply supported at the ends and loaded as shown in f**ig.(V).**Using Macaulay's method, determine the slope at end A and deflection under point C. Take EI = 2 x 10^3 kNm^2.	**07**
		OR	
Q.3	**(a)**	Write the equations of Euler's crippling load for different column end condition.	**03**

(b) A load 'P' is acting on the diagonal of the square column of size 'D'. For no tension to develop what would be the maximum distance of the load from centre? What would be the shape of the 'core' or 'kernal' of the section? **04**

(c) Determine the slope at A and deflection at C for the over hanging beam as shown in **fig.(VI)** by conjugate beam method. EI = 4 x 10^3 kNm^2. **07**

Q.4 **(a)** The external and internal diameter of a hollow cast iron column are 200 mm and 150 mm respectively. If the column is hinged at both ends having a length of 4 m , determine the crippling load using Rankine's formula. Take fs = 550 N/mm^2 and $\alpha = 1/1600$. **06**

(b) A composite shaft consisting of a solid steel core 80 mm diameter is enclosed in a closely fitting bronze sleeve. Find the out side diameter of the sleeve so that a pure torque applied to the composite shaft is shared equally by the two materials. If the torque is 16 kN.m calculate maximum shear stress induced in each material. G_{steel} = 80 x 10^3 N/mm^2, G_{bronze} = 40 x 10^3 N/mm^2. **08**

OR

Q.4 **(a)** A load of 100 N falls through a height of 20 mm on to a collar rigidly attached to the lower end of the vertical bar 1.5 m long and of 150 mm^2 cross sectional area . The upper end of the vertical bar is fixed. Find : (i) maximum instantaneous stress induced in the vertical bar (ii) instantaneous elongation (iii) strain energy stored in the bar. Take E = 200 x 10^3 N/mm^2. **06**

(b) A masonry pier of size 3 m x 4 m is subjected to a compressive load of 600 kN as shown in **fig.(VII).** Find the stresses produced at each corner of the pier. What additional load can be placed at the center of the pier to avoid tension in the pier section? **08**

Q.5 **(a)** Draw the influence line diagram for the beam shown in **fig.(VIII)** for **08**

(i) reaction at A (ii) bending moment at D

(iii) shear force at D (iv) shear force at E

(b) A cylindrical shell of length 1 m and internal diameter 150mm has a thickness of 10 mm. If the shell is subjected to an internal pressure of 3 N/mm^2, find the change in the volume. Take E = 200 x 10^3 N/mm^2, $\mu = 0.25$. **06**

OR

Q.5 **(a)** A suspension cable of span 100 m and dip 10 m carries a uniformly distributed load of 8 kN/m over the full span. Find the vertical and horizontal forces transmitted to the supporting pylons, (i) if the cable is passed over the smooth pulley (ii) the cable is clamped to a saddle with rollers on the top of the piers. The anchor cable makes 30° to the horizontal at the pylons. Refer **fig.(IX)** **07**

(b) A column of circular section has an external diameter 200 mm and thickness 20 mm. The a length of column is 4 m with both hinged ends. The column carries a load of 100 kN at an eccentricity of 20 mm. Find the maximum stress on the column section. Also find maximum eccentricity to avoid tension any where in the section. Take E = 100 x 10^3 N/mm^2. Use appropriate formula. **07**

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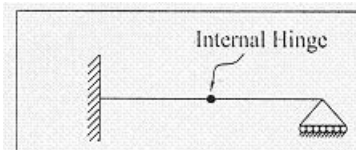

Fig. (I) Q-1 (vi)

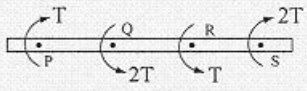

Fig. (II) Q-1 (vii)

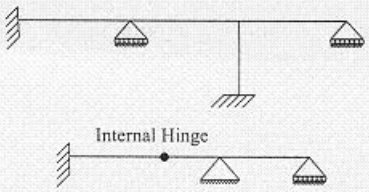

Fig. (III) Q-2 (b)

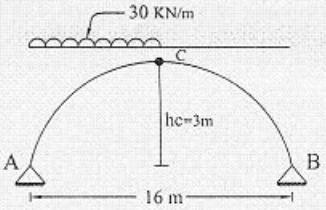

Fig. (IV) Q-2 (C) (OR)

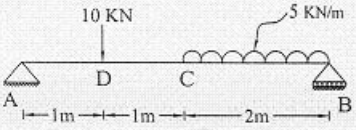

Fig. (V) Q-3 (C)

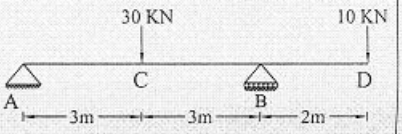

Fig. (VI) Q-3 (C) (OR)

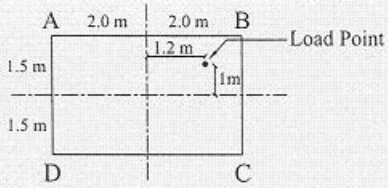

Fig. (VII) Q-4 (b) (OR)

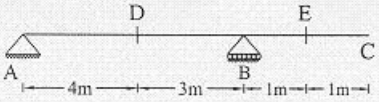

Fig. (VIII) Q-5 (a)

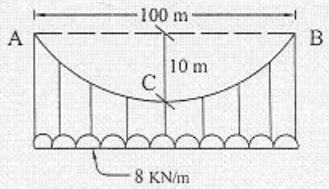

Fig. (IX) Q-5 (a) (OR)