Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- II Remedial Examination Nov / Dec. 2010

Subject code: X 20603 **Subject Name: Structural Analysis I**

Date: 01 / 12 / 2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

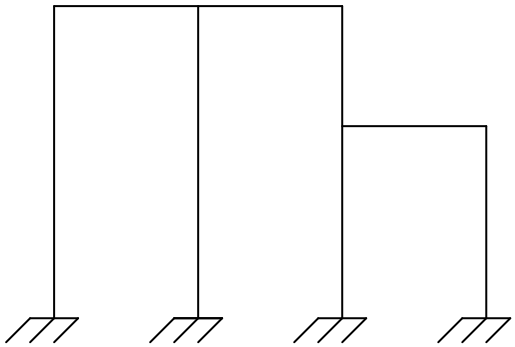
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define : (i) Core of a section (ii) Proof resilience (iii) Thin cylinder (iv) Strut (v) Modulus of resilience **05**

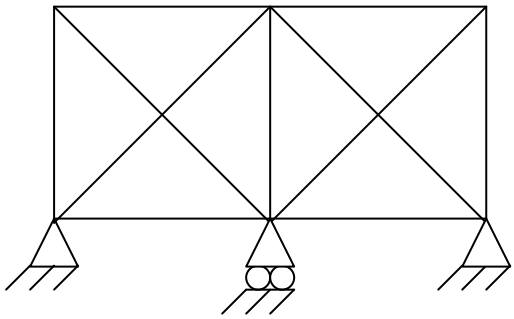
(b) Write assumptions made by Euler for deriving critical load for long columns **03**

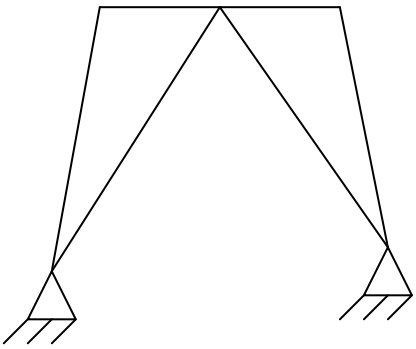
(c) Find S.I. and K.I. for the system shown in Figure below. **06**

(A)



(B)





(C)

Q.2 **(a)** A copper tube of outside diameter 38 mm and inside diameter 35.5 mm, is closely wound with steel wire of 0.75 mm diameter. Estimate the tension at which the wire must have been wound, if an internal gauge pressure of 20 kg/cm^2 produce a tensile circumferential stress of 70 kg $/cm^2$ in the copper tube. Take E for steel = 1.6 E for copper **07**

(b) A beam AB of 4 m span is simply supported at the ends and loaded with a point load of 10 kN at 1 m and an u.d.l. of 5 kN/m of 2 m length at 2 m from left end. Determine (i) deflection at the point where udl starts, (ii) maximum deflection and (iii) slope at left end. Take E = 2 X 10^5 N/mm^2 and I = 1000 cm^4 Use Macaulay's method. **07**

OR

(b) A beam ACB, simply supported at the ends, has moment of inertia 4I for the length AC and I for length CB, and is loaded with a point load W at C. Determine (i) slope at end A, (ii) deflection at mid-span, (iii) maximum deflection. AC = 8 m, CB = 2m, W = 10 kN, I = 4000 cm^4 and E = 2 X 10^5 N/mm^2. **07**

Q.3 **(a)** Four wheel loads of 6, 4, 8 and 5 kN cross a girder of 20 m span, from left to right followed by and u.d.l. of 4 kN/m and 4 m long with the 6 kN load leading. The spacing between the loads in the same order are 3m, 2m and 2m. The head of the u.d.l. is at 2m from the last 5 kN load. Using influence lines, calculate the S.F. and B.M. at a section 8m from the left support when the 4 kN is at centre of the span. **07**

(b) A suspension bridge cable hangs between two points A and B separated horizontally by 120m and with A 20 m above B. The lowest point in the cable is 4 m below B. the cable supports a stiffening girder which is hinged vertically below A, B and lowest point in the cable. Find the position and magnitude of the largest bending moment which a point load of 10 kN can induce in the girder together with the position of load. **07**

OR

Q.3 **(a)** A beam ABC is supported at A, B and C, and has hinge at D distance 3 m form A. AB = 7 m and BC = 10m. Draw the influence lines for reactions at A, B and C. If an u.d.l of intensity 2 kN/m and length 3 m, travels from left to right, calculate quantities for which I.L. are drawn. **07**

(b) A symmetrical three hinged circular arch has a span of 16 m and a rise to the central hinge of 4 m. It carries a vertical load of 16 kN at 4 m from the left hand end. Find (a) the magnitude of the thrust at the springings, (b) the reactions at the supports, (c) bending moment at 6 m from the left hand hinge and (d) maximum positive and negative moment. **07**

Q.4 **(a)** A vertical tie fixed rigidly at the top consists of a steel rod 2 m long and 20 mm diameter encased throughout in a brass tube 20 mm internal diameter and 30 mm external diameter. The rod and casing are fixed together at both ends. The compound rod is suddenly loaded in tension by a weight of 15 kN falling through a height of 3 mm before being arrested by the tie. Determine the maximum stress in steel and brass. Take E = 2 X 10^5 N/mm^2 for steel and E =1 X 10^5 N/mm^2 for brass. **07**

(b) 450 kW power has to be transmitted at 100 R.P.M. Find (i) the necessary diameter of solid circular shaft, (ii) the necessary diameter of circular section, the inside diameter being ¾ of the external diameter. Allowable shear stress = 75 N/mm^2 and the density of material = 77 kN/m^3. **07**

OR

Q.4 **(a)** Two bars A and B are each 20 cm long and are of the same material. Bar A is 2 cm in diameter for a length of 5 cm and 4 cm in diameter for the remaining 15 cm length. Bar B is 2 cm in diameter for the length of 15 cm and 4 cm in diameter for the remaining 5 cm length. An axial blow given to A produces a maximum instantaneous stress of 1200 kg/cm^2. Calculate the maximum instantaneous stress produced by the same blow on B. If each bar is stressed up to the elastic limit, calculate the ratio of energy stored by A and B at proof stress. Also, calculate the ratio of strain energy per unit volume of each bar at the same stress. **07**

(b) A hollow steel shaft 4 m long is to transmit 150 kW power at 150 R.P.M. The total angle of twist in this length is not to exceed 2.5^0C and the allowable shear stress is N/mm^2. Determine the inside and outside diameters, if $N = 0.082 \times 10^6$ N/mm^2. **07**

Q.5 **(a)** Compare the crippling loads given by Euler's and Rankine's formula for a tubular steel strut 2.3 m long having outer and inner diameters 38 mm and 33 mm respectively, loaded through pin joints at each end. Take the yield stress as 335 N/mm^2, the Rankine's constant = 1/7500 and $E = 0.205 \times 10^6$ N/mm^2. For what length of strut of this cross section does the Euler formula cease to apply? **07**

(b) A short hollow cylindrical cast iron column having outside diameter 30 cm and inside diameter 20 cm was cast in a factory. On inspection it was found that the bore is eccentric in such a way that the thickness varies from 3 cm at one end to 7 cm at the other. Calculate extreme intensities of stress induced in the section, if column carries a load of 800 kN along the axis of the bore. **07**

OR

Q.5 **(a)** Derive the equation of crippling load for the column having one end fixed and other hinged with usual notations by Euler's theory. Also, explain why Rankine's theory is better than Euler's theory for short columns? **07**

(b) A masonry retaining wall trapezoidal in section with one face vertical is 1m wide at top and 3 m at the base and 8 m high. The material retained on the vertical face exerts a lateral pressure varying form zero at top to 25 kN/m^2 at the base. If the unit weight of masonry is 21 kN/m^2, calculate the maximum and minimum stress intensities induced in the base. **07**

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