Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III(Civil) Examination December 2009

Subject code: 130604 **Subject Name: Structural Analysis-I**
Date: 19 / 12 /2009 **Time: 11.00 am – 1.30 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 **(a)** 1. Find static indeterminancy and kinematic indeterminancy of structures given in **Fig.1** and **Fig.2** **04**

2. Differentiate between real beam and conjugate beam **03**

(b) A horizontal steel girder having uniform cross-section is 14 m long and is simply supported at its ends. It carries two concentrated loads as shown in **Fig.3.** Calculate the deflections of the beam under the loads by Macaulay's method. Take E = 200GPa and I = 160×10^6 mm^4. **07**

Q 2 **(a)** A masonry dam 4.5 m high, 1 m wide at the top and 3.5 m wide at the base retains water to the full height. The water face of the dam is vertical. Determine the extreme pressure intensities at the base. Water and masonry weigh 9810 N/m^3 and 22500 N/m^3 respectively. Find also the extreme pressure intensities at the base when the dam is empty. **07**

(b) A solid shaft of 80 mm diameter is to be replaced by a hollow shaft of external diameter 100 mm. Determine the internal diameter of the hollow shaft if the same power is to be transmitted by both the shafts at the same angular velocity and shear stress. **07**

OR

(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 6m from the left hand hinge. **07**

Q.3 **(a)** A steel bar of rectangular cross-section 30 mm x 40 mm pinned at each end is subjected to an axial compressive load. The bar is 1.75 m long. Determine the buckling load and the corresponding stress using Euler's formula. Also find the minimum length for which Euler's formula may be used to determine the buckling load, if the proportional limit of material is 200 MPa. Take E = 200 GPa. **07**

(b) Two wheel loads of 16 and 8 kN, at a fixed distance apart of 2 m, crosses a beam of 10 m span. Draw the influence line for bending moment and shear force for a point 4 m from the left support, and find the maximum bending moment and shear force at that point. **07**

OR

Q.3 **(a)** A hollow C.I Column whose outside diameter is 200 mm has a thickness of 20 mm. It is 4.5 m long and is fixed at both ends. Calculate the critical loads by Euler's theory and also by Rankine's theory. For cast iron take F_c = 550 N/mm^2 and $\alpha = 1/1600$, E = 8×10^4 N/mm^2. **07**

(b) A cylindrical vessel 2 m long and 500 mm in diameter with 10 mm thick plates is subjected to an internal pressure of 3 MPa. Calculate the change in **07**

volume of the vessel. Take E = 200 GPa and poisson's ratio = 0.3 for the vessel material.

Q.4 **(a)** A steel bar 100 cm. long and rectangular in section 40 mm x 80 mm is subjected to an axial load of 1 kN. Find the maximum stress if **07**

(a) The load is applied gradually.
(b) The load is applied suddenly, and
(c) The load is applied after falling through a height of 8 cm.

What are the strain energies in each of the above cases? Take E = 200 GPa.

(b) Find the slope and deflection at B, C and D for the cantilever shown in **Fig.4** by conjugate beam method. **07**

OR

Q.4 **(a)** 1. Define strain energy, resilience and modulus of resilience **03**

2. An object of weight 100 N falls by gravity a vertical distance of 5 m when it is suddenly stopped by a collar at the end of a vertical rod of length 10 metres and diameter 20 mm. The top of the bar is rigidly fixed to a support. Calculate the maximum stress and strain induced in the bar due to the impact. Take E = 200 GPa. **04**

(b) A masonry pier of 3 m x 4 m supports a vertical load of 80 kN as shown in **Fig.5**. Find the stresses developed at each corner of the pier. **07**

Q.5 **(a)** A 60 mm diameter shaft transmits 80 kW at 100 r.p.m. The shaft is connected to machine components by means of key, which is 20 mm wide and 100 mm long. Find the shear stress developed in the shaft and key. **07**

(b) 1. Draw neat sketch of kernel of the following cross-sections **03**

a. Rectangular block 200 mm x 300 mm
b. Circular section of 300 mm diameter

2. Derive the relation between moment, slope and deflection. **04**

OR

Q.5 **(a)** 1. State the significance of ILD in the analysis of structures **02**

2. Analyze the structure shown in **Fig.6.** Draw the free body diagram, Shear force diagram, bending moment diagram and axial force diagram. **05**

(b) A flexible rope weighing 1 N per metre span between two points 40 m apart and at the same level, 12 m above the ground. It is to carry a concentrated load of 300 N at a point 'P' on the rope which is to be at a horizontal distance of 10 m from the left hand support. What is the maximum height above the ground to which the point 'P' may be raised if the maximum tension in the rope is not to exceed 1000 N? Assume that the distances measured along the rope are equal to their horizontal projection. **07**

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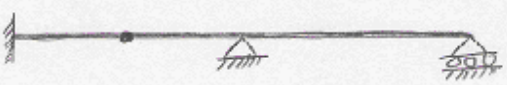

Fig. 1 (Q.1.A.1)

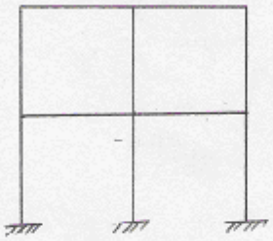

Fig. 2 (Q.1.A.1)

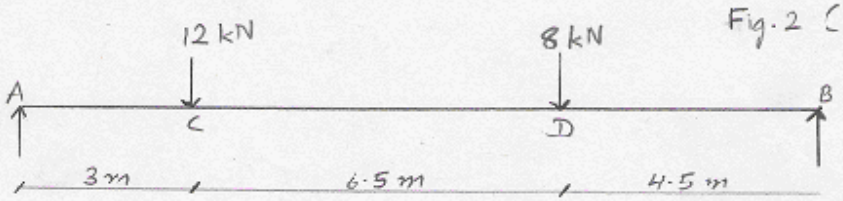

Fig. 3 (Q. 1. B)

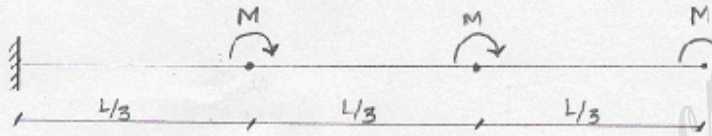

Fig. 4 (Q.4.B)

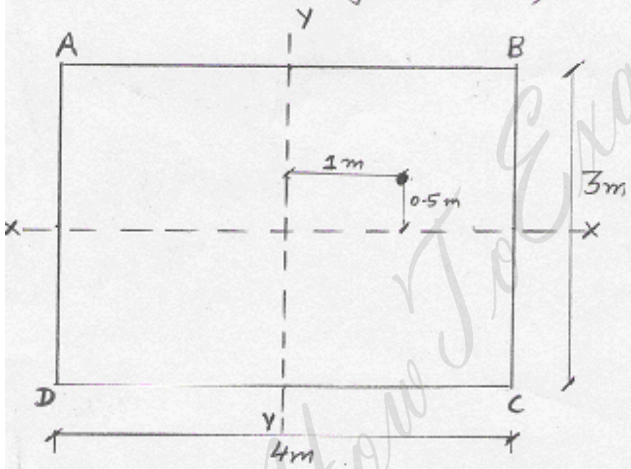

Fig. 5 (Q.4.B)

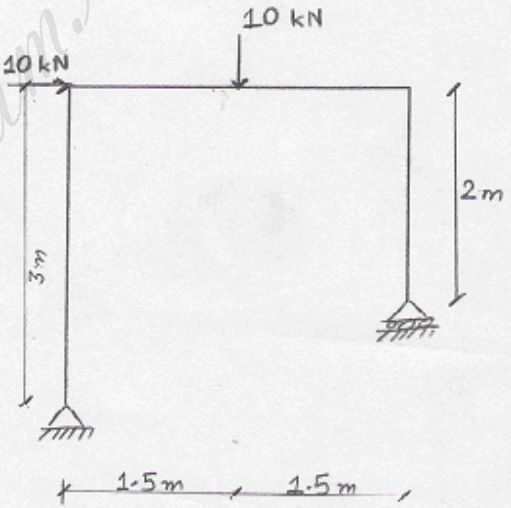

Fig. 6 (Q. 5.A.2)