Total No. of Questions—12] [Total No. of Printed Pages—8

[3762]-103

S.E. (Civil) (I Sem.) EXAMINATION, 2010

STRENGTH OF MATERIALS

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer Q. **1** *or* Q. **2**; Q. **3** *or* Q. **4**; Q. **5** *or* Q. **6** from Section I and Q. No. **7** *or* Q. **8**; Q. **9** *or* Q. **10**; Q. **11** *or* Q. **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Figures to the right indicate full marks.

(*iv*) Neat diagrams should be drawn wherever necessary.

(*v*) If necessary, assume suitable data and indicate clearly.

(*vi*) Use of electronic pocket calculator is allowed.

(*vii*) Assessment will be based on complete solution and not on final answer.

SECTION I

1. (*a*) A 50 mm square steel bar is subjected to an axial tensile load of 250 kN. Determine the decrease in the lateral dimension if E = 200 GPa and υ = 0.30. [8]

(*b*) The rigid bar ABC shown in Fig. 1, is hinged at A and supported by a steel road at B. Determine the largest load

P.T.O.

P that can be applied at C if the stress in the steel rod is limited to 260 MPa and the vertical movement of end C must not exceed 40 mm. [10]

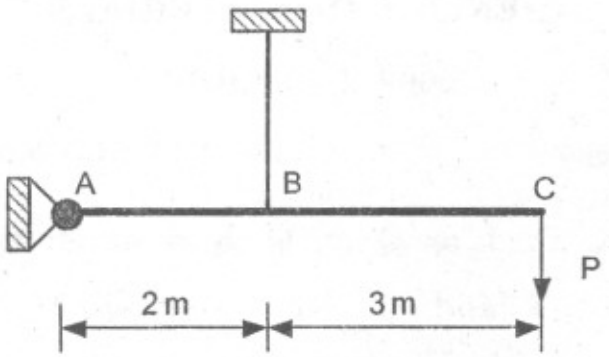

Fig. 1

Or

2. (*a*) Determine the total elongation of a uniform bar of area A and length L hanging freely under its self-weight W/unit volume. [8]

(*b*) Determine the temperature change that will cause a compressive stress of 36 MPa in the composite bar shown in the Fig. 2, if E_s = 210 GPa, E_A = 70 GPa and $a_S = 12 \times 10^{-6}$/°C, $a_A = 23 \times 10^{-6}$/°C. [10]

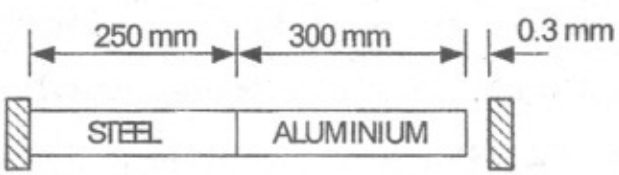

Fig. 2

3. (*a*) Plot the shear force and bending moment diagram showing the salient points for the compound beam shown in Fig. 3. The beam is supported at B and D and has an internal hinge at C. [8]

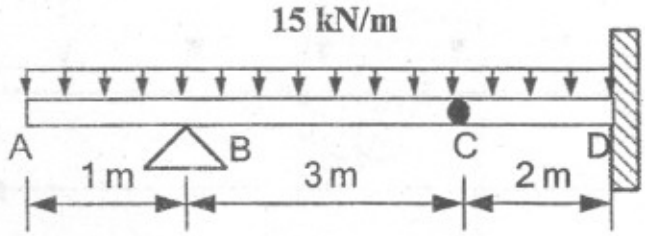

Fig. 3

(*b*) Plot the load and bending-moment diagram from the shear force diagram shown in Fig. 4 : [8]

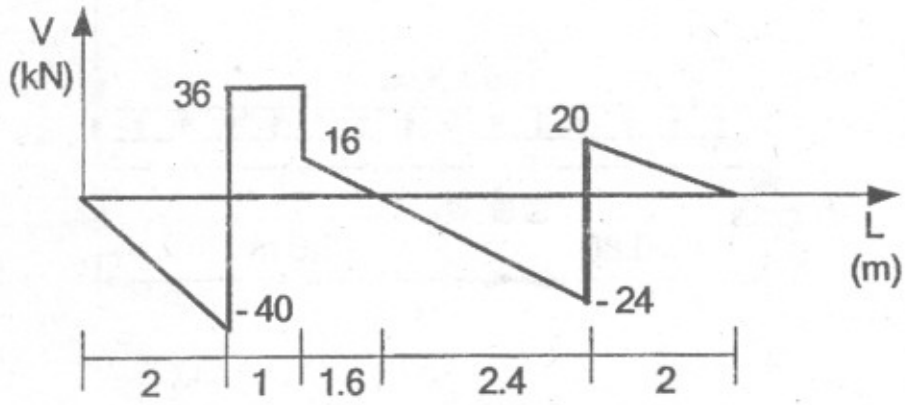

Fig. 4

Or

4. (*a*) Plot the shear force and bending moment diagrams for the cantilever beam loaded as shown in Fig. 5 : [8]

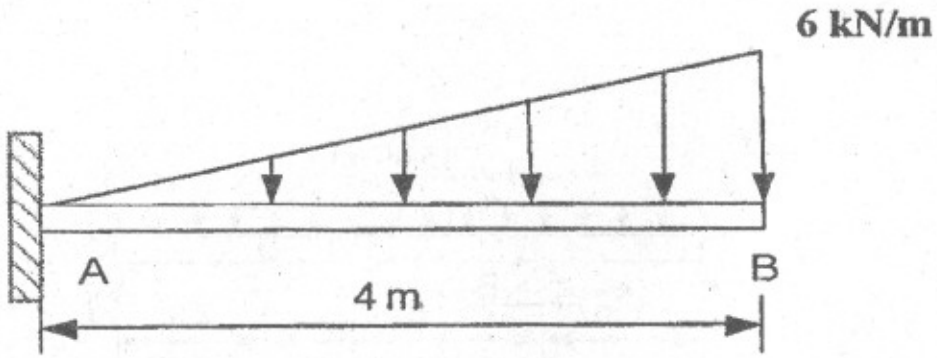

Fig. 5

(*b*) Plot the shear force and bending moment diagrams for the beam loaded as shown in Fig. 6 : [8]

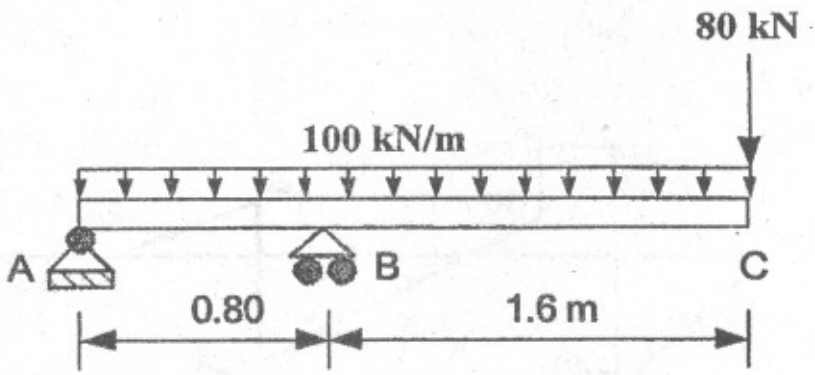

Fig. 6

5. (*a*) A high strength steel band saw, 20 mm wide by 0.80 mm thick, runs over pulleys 600 mm in diameter as shown in Fig. 7. What maximum flexural stress is developed ? What minimum diameter pulleys can be used without exceeding a flexural stress of 400 MPa ? Assume E = 200 GPa. [8]

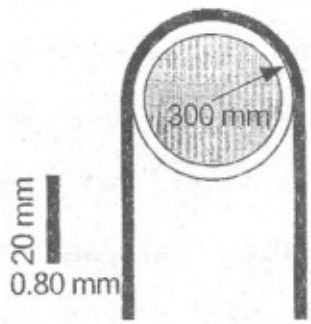

Fig. 7

(*b*) For the beam and loading shown in Fig. 8, consider section n-n and determine : [8]

(*i*) The largest shearing stress in that section

(*ii*) The shearing stress at point *a*.

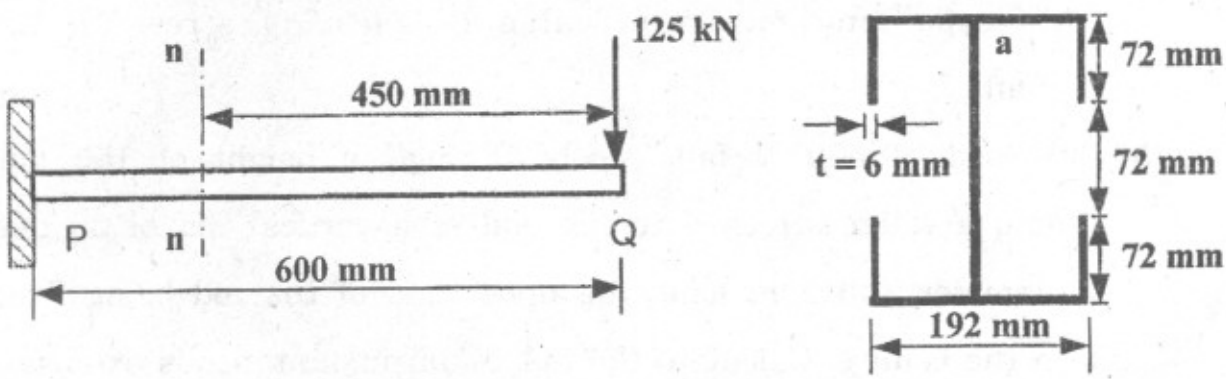

Fig. 8

Or

6. (*a*) What are flitched beams ? Derive the expression for moment of resistance of a rectangular flitched beam of cross-section $b \times d$ and thickness of steel plates t. [8]

(*b*) A simply supported beam carries a uniformly distributed load of 30 N/mm over the entire span of 1 m. The cross-section of the beam is a T section, with its top flange of (125 × 25) mm and web of (175 × 25) mm. Obtain the maximum shear stress and plot the shear stress distribution. [8]

SECTION II

7. (*a*) A hollow cylindrical shaft is 1.5 m long. It has an inner and outer diameter respectively equal to 40 and 60 mm. What is the largest torque that can be applied to the shaft if the shearing stress is not to exceed 120 MPa ? What is the corresponding minimum value of shearing stress in the shaft ? [8]

(*b*) A load of 500 N falls freely through a height of 150 mm onto a collar attached to the end of a vertical rod of 50 mm diameter and 2 m long, the upper end of the rod being fixed to the ceiling. Calculate the maximum instantaneous extension of the bar. Also calculate the maximum stress in the bar. Assume E = 200 GPa. [8]

Or

8. (*a*) A hollow circular steel shaft has external and internal diameters as 75 and 30 mm respectively. While the shaft rotates at 120 rpm, its twist is observed as 2° in 4 m length. Using G = 77 GPa, determine the power being transmitted. [8]

(*b*) Derive the expression for maximum stress in a member subjected to impact load. [8]

9. (*a*) Direct stresses of 160 N/mm^2 tensile and 120 N/mm^2 compressive, exists on two perpendicular planes at a certain point in a body. They are also accompanied by shear stresses on the planes. The greatest principal stress at the point is 200 N/mm^2. What must be magnitude of shearing stresses on the two planes and what will be the maximum shearing stress at the point. [8]

(*b*) Derive the expression for principal stresses and principal plane for a solid circular shaft of diameter D, subjected to combined torsion and bending effects. [8]

Or

10. (*a*) For the stress condition on an element as shown in Fig. 9, determine the principal planes and stresses. Also determine the maximum shear stress and the planes on which they act : [8]

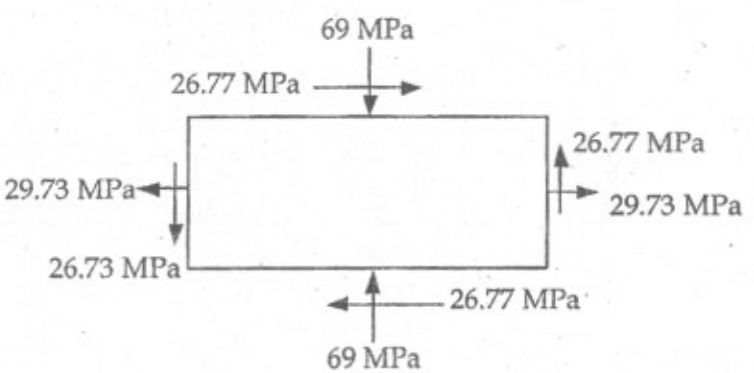

Fig. 9

(*b*) A solid shaft of 60 mm diameter has to resist a bending moment of 450 kN mm accompanied by torque of 360 kN mm. Calculate the maximum principal stress induced in the shaft, also calculate the maximum shear stress induced. [8]

11. (*a*) State the assumptions made in Euler's theory and derive the expression for the critical load for a column pinned at both its end. [8]

(*b*) A tapering chimney of hollow circular section is 30 m high. Its external diameter at the base is 2.4 m and at the top it is 1.6 m. It is subjected to a wind pressure of 2.2 kN/m^2 of the projected area. If the weight of the chimney is 4000 kN and the internal diameter at the base is 0.80 m, determine the maximum and minimum stress intensities at the base. [10]

Or

12. (*a*) A hollow 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 safe load by Rankine's formula using factor of safety of 4. Take σ_c = 550 MPa, a = 1/1600. [8]

(*b*) A column supports a load of 600 kN as shown in Fig. 10. Find the stresses at the corners of the column at its base. [10]

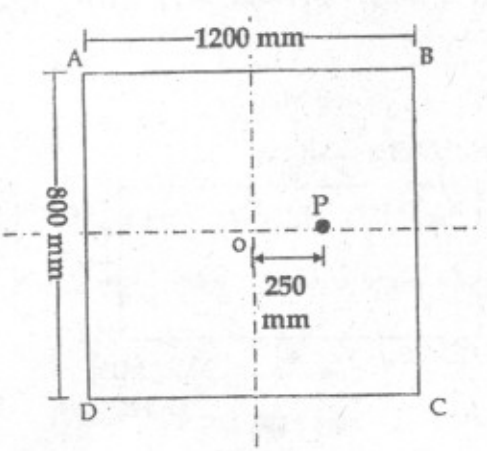

Fig. 10

(*b*) A solid shaft of 60 mm diameter has to resist a bending moment of 450 kN mm accompanied by torque of 360 kN mm. Calculate the maximum principal stress induced in the shaft, also calculate the maximum shear stress induced. [8]

11. (*a*) State the assumptions made in Euler's theory and derive the expression for the critical load for a column pinned at both its end. [8]

(*b*) A tapering chimney of hollow circular section is 30 m high. Its external diameter at the base is 2.4 m and at the top it is 1.6 m. It is subjected to a wind pressure of 2.2 kN/m^2 of the projected area. If the weight of the chimney is 4000 kN and the internal diameter at the base is 0.80 m, determine the maximum and minimum stress intensities at the base. [10]

Or

12. (*a*) A hollow 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 safe load by Rankine's formula using factor of safety of 4. Take σ_c = 550 MPa, a = 1/1600. [8]

(*b*) A column supports a load of 600 kN as shown in Fig. 10. Find the stresses at the corners of the column at its base. [10]

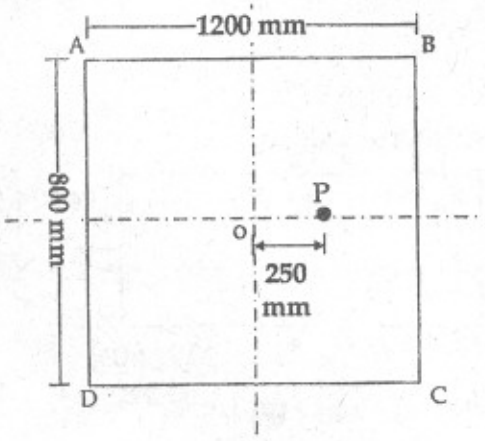

Fig. 10