Total No. of Questions—**12**] [Total No. of Printed Pages—**8+2**

Seat No.	

[4162]-103

S.E. (Civil) (First Semester) EXAMINATION, 2012

STRENGTH OF MATERIALS

(2008 PATTERN)

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

***N.B.* :—** (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

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

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

(*v*) Assume suitable data, if necessary.

(*vi*) Answer Q. No. **1** *or* Q. No. **2,** Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8,** Q. No. **9** *or* Q. No. **10** and Q. No. **11** *or* Q. No. **12** from Section II.

SECTION I

1. (*a*) A bar made of Brass and having cross-sectional area 1000 mm^2 is subjected to axial forces as shown in Fig. 1. Find the total change in length of the bar.

Take $E = 1.05 \times 10^5$ N/mm^2. [8]

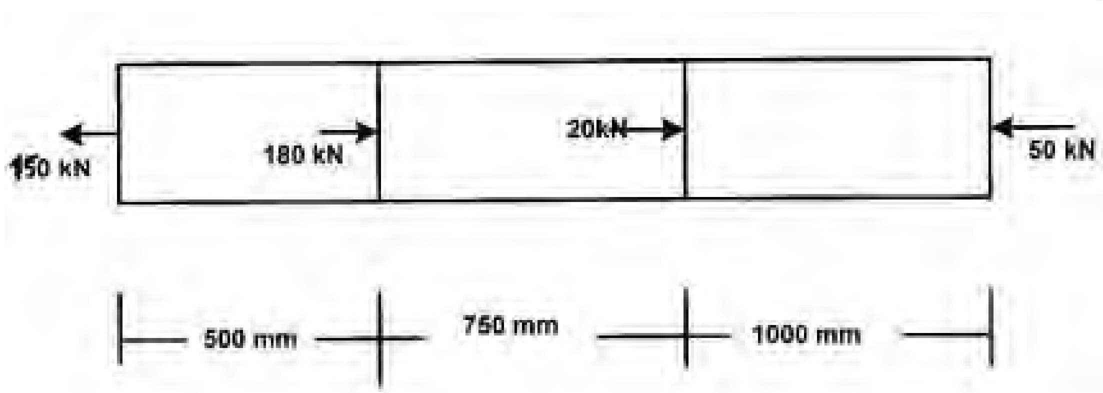

Fig. 1

P.T.O.

(*b*) For the composite section fixed at both ends as shown in Fig. 2, find : [10]

(*i*) Reactions at both ends

(*ii*) Stresses in each part

(*iii*) Construct axial force diagram.

Assume :

for Copper, $A_C = 4000 \text{ mm}^2$, $E_C = 120 \text{ kN/mm}^2$

for Aluminium, $A_{al} = 6000 \text{ mm}^2$, $E_{al} = 70 \text{ kN/mm}^2$

for Brass, $A_b = 5500 \text{ mm}^2$, $E_b = 100 \text{ kN/mm}^2$.

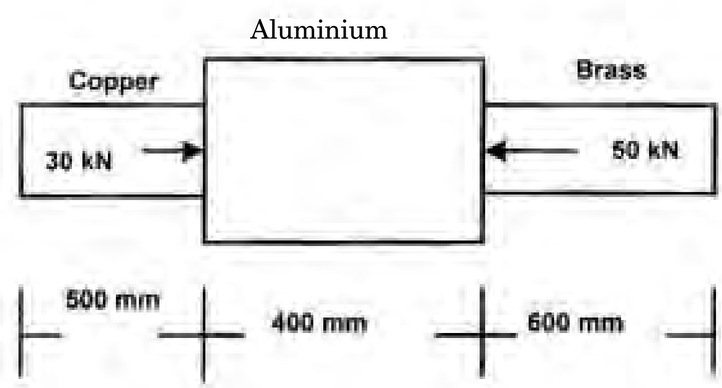

Fig. 2

Or

2. (*a*) A cylindrical piece of steel 80 mm diameter and 120 mm long is subjected to an axial compressive force 70 kN. Calculate the change in volume of the piece if Bulk modulus is $1.7 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio is 0.3. [8]

(*b*) A steel rod of 30 mm diameter is placed centrally inside a hollow Bronze tube of external diameter 40 mm. The steel rod is tightly fitted with bronze tube so that entire section acts as composite section subjected to compressive force of 30 kN. Determine stresses in rod and tube when temperature falls by 30°C. Assume : [10]

$E_{steel} = 2 \times 10^5$ N/mm^2 $E_{bronze} = 8 \times 10^4$ N/mm^2

$\alpha_{steel} = 12 \times 10^{-6}$/°C $\alpha_{bronze} = 18 \times 10^{-6}$/°C.

3. (*a*) Construct shear force and bending moment diagrams for a beam loaded as shown in Fig. 3 and locate point of contraflexure : [8]

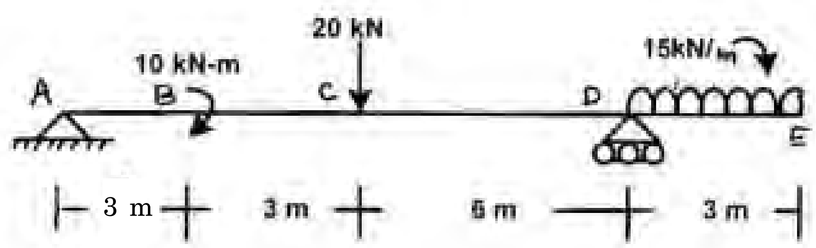

Fig. 3

(*b*) The beam with overhangs on both sides is having total length of 10 m. It carries a u.d.l. of 180 N/m all over the span in addition to a point load of 200 N at the left end. The beam is supported at two points 7 m apart so chosen that each support carries half the total load. Draw S.F.D. and B.M.D. [8]

Or

4. (*a*) The bending moment diagram of a beam of span 12 m is as shown in Fig. 4. Construct shear force diagram and load diagram : [8]

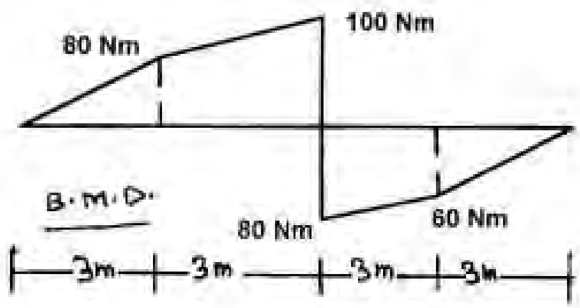

Fig. 4

(*b*) Draw S.F.D. and B.M.D. for the beam ABCD loaded as shown in Fig. 5 : [8]

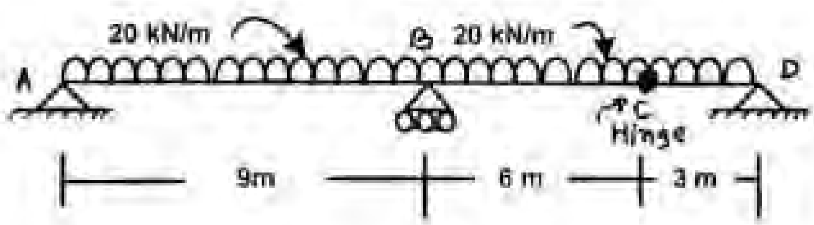

Fig. 5

5. (*a*) A beam of span 4 m carries u.d.l. of 15 kN/m. The cross-section of the beam is as shown in Fig. 6. Find maximum stress induced. Draw bending stress diagram. [8]

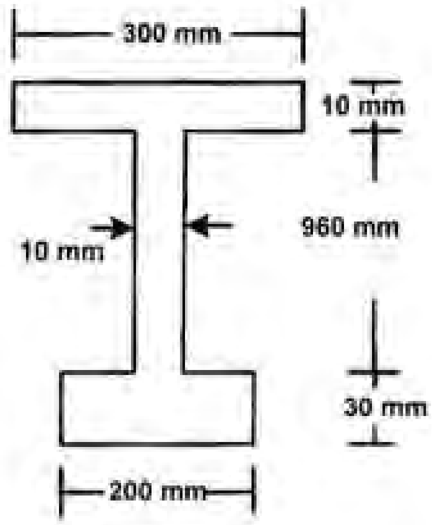

Fig. 6

(*b*) The cross-section of the beam is as shown in Fig. 7. If this cross-section is subjected to a shear force of 15 kN, draw shear stress distribution diagram and find ratio of maximum shear stress to average shear stress. [8]

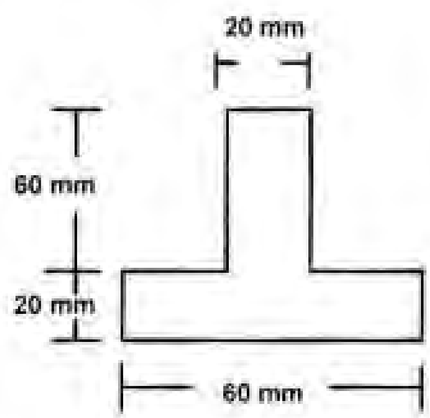

Fig. 7

Or

6. (*a*) Construct the shear stress distribution diagrams showing salient points : [8]

(*i*) Rectangular section

(*ii*) Symmetrical I-section

(*iii*) Triangular section

(*iv*) Hollow circular section.

(*b*) A cast iron beam section is an I section with top flange 80 mm × 20 mm, bottom flange 160 mm × 40 mm and web 200 mm deep and 20 mm thick. The beam is simply supported on a span of 5 m. If the tensile stress is not to exceed 20 N/mm^2, find the safe u.d.l. which the beam can carry and also maximum compressive stress. [8]

SECTION II

7. (*a*) A shaft transmits 75 kW power at 120 rpm. Determine the diameter of shaft if allowable shear stress is 50 N/mm^2. The twist in the shaft shall not exceed 1.5° in 5 m length. Take G = 85 kN/mm^2. [9]

(*b*) A hollow shaft whose internal diameter is 0.55 times its external diameter and is to replace a solid shaft of the same material to transmit the same power at the same speed. Find the ratio of external diameter of hollow shaft to the diameter of solid shaft. Find also the % saving in the weight. [9]

Or

8. (*a*) Using equation of strain energy, derive the stress intensity due to the following types of axial loading : [9]

(*i*) Gradually Applied Load

(*ii*) Suddenly Applied Load

(*iii*) Impact Load.

(*b*) A load of 50 N falls by gravity through a vertical distance of 2000 mm. When it is suddenly stopped by a collar at the end of a vertical rod of length 6 m and diameter 20 mm, calculate the maximum stress and strain induced in the bar. The top of the bar is rigidly fixed to ceiling. Assume $E = 1.96 \times 10^5$ N/mm^2. [9]

9. (*a*) The principal tensile stresses at a point are 100 N/mm^2 and 60 N/mm^2. Find normal tangential and resultant stress on a plane at 30° with major principal plane. What is angle of obliquity ? Show by sketch how normal stress and tangential stress act. [8]

(*b*) Find magnitudes of principal stresses and show position of principal plane and maximum shear stress and position of plane of maximum shear stress for the state of stress as shown in Fig. 8 (*a*) & (*b*) : [8]

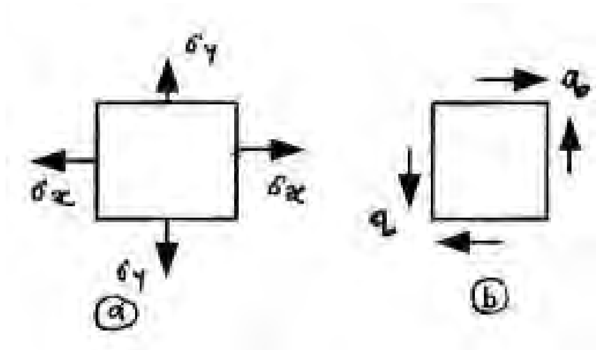

Fig. 8 (*a*) & (*b*)

Or

10. (*a*) A shaft section 100 mm diameter is subjected to a bending moment of 4000 N.m and a torque of 6000 N.m. Find the maximum direct stress induced on the section and specify the position of the plane on which it acts. Find also what stress acting alone can produce the same maximum strain. Take Poisson's ratio = 0.25. [8]

(*b*) Derive the expression for equivalent bending moment and equivalent torque for element subjected to combined action of B.M. and torque. [8]

11. (*a*) State assumptions made in Euler's theory and its limitations. [8]

(*b*) Find the greatest length of mild steel rod 25 mm × 25 mm which can be used as a compression member with one end fixed and other end free to carry a working load of 50 kN. Allow factor of safety of 5. [8]

Take :

$\alpha = 1/7500$ and $f_c = 320$ N/mm^2.

Or

12. (*a*) The T-section shown in Fig. 9, is subjected to a tensile force 220 kN, the line of action of the force being at 40 mm from the lower edge. Find the extreme stresses for the section. [8]

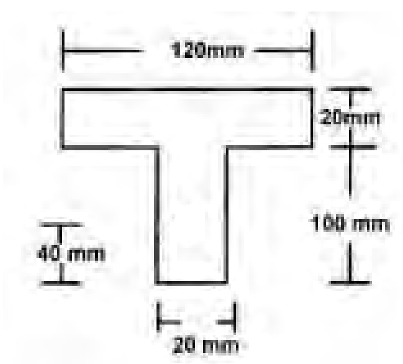

Fig. 9

(*b*) Compare the crippling loads given by Rankine's formula and Euler's formula for a tubular strut 3 m long having outer diameter 47.5 mm and 42.5 mm as inner diameter. Assume both ends pin-jointed. Take f_y = 315 MPa, α = 1/7500, E = 200 GPa. [8]