Total No. of Questions—**8**] [Total No. of Printed Pages—**7**

Seat No.	

[5057]-218

S.E. (Mechanical/Automobile) (II Sem.) EXAMINATION, 2016
STRENGTH OF MATERIALS
(2012 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. :— (*i*) Answer *four* questions out of 8.
(*ii*) Solve Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.
(*iii*) *All* the *four* questions should be solved in one answer-book.
(*iv*) Neat diagrams must be drawn whenever necessary.
(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(*vi*) Assume suitable data whenever necessary.

1. (*a*) A square bar of 20 mm side is held between two rigid plates and loaded by an axial force P equal to 450 kN as shown in Fig. 1. Find the reactions at the ends A and C and the extension of the portion AB. Take E = 200 GPa. [6]

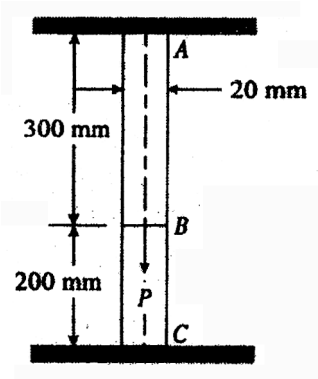


Fig. 1

P.T.O.

(*b*) Draw shear force and bending moment diagrams for a beam shown in Fig. 2. [6]

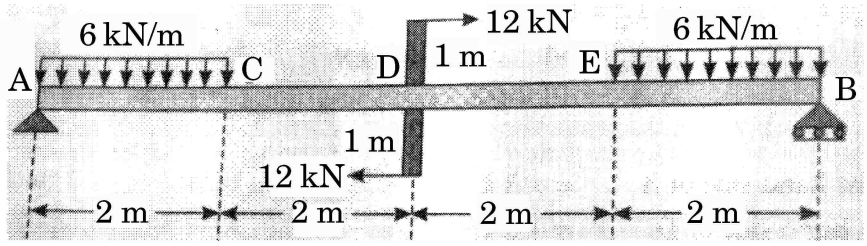


Fig. 2

Or

2. (*a*) A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take E for steel and copper as 200 GN/m^2 and 100 GN/m^2 and a for steel and copper as 12 × 10^{-6} per °C and 18 × 10^{-6} per °C. [6]

(*b*) Shear force diagram for a loaded beam is shown in Fig. 3. Determine loading on the beam hence draw bending moment diagram. Locate point of contraflecture if any. All values are in kN. [6]

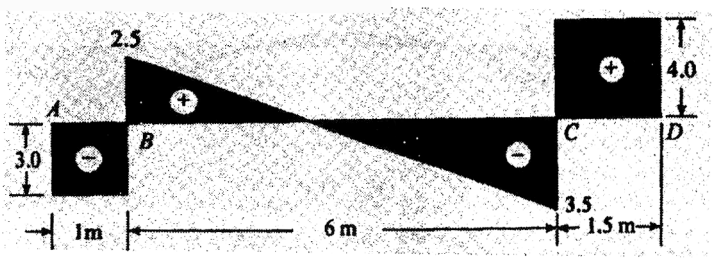


Fig. 3

3. (*a*) A cast iron bracket subject to bending has the cross-section of I-form with unequal flanges. The dimensions of the section are shown in Fig. 4. Find the position of the neutral axis and moment of inertia of the section about the neutral axis. If the maximum bending moment on the section is 40 MN mm, determine the maximum bending stress. What is the nature of the stress ? [6]

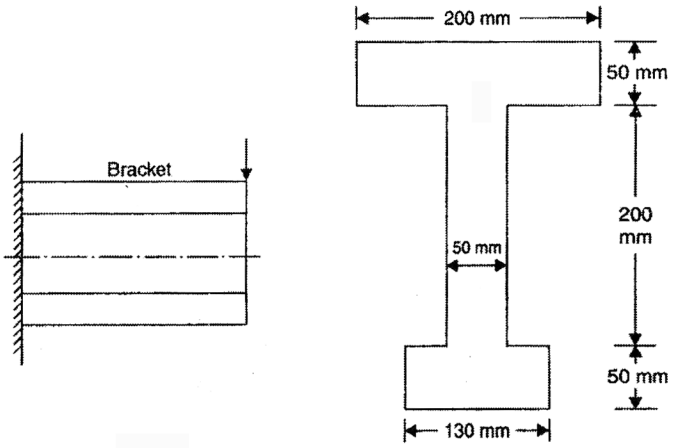


Fig. 4

(*b*) A cantilever 75 mm wide and 200 mm deep is loaded as shown in Fig. 5. Find the slope and deflection at B. Take E = 200 GPa. [6]

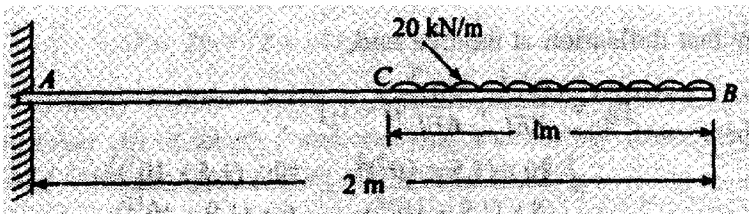
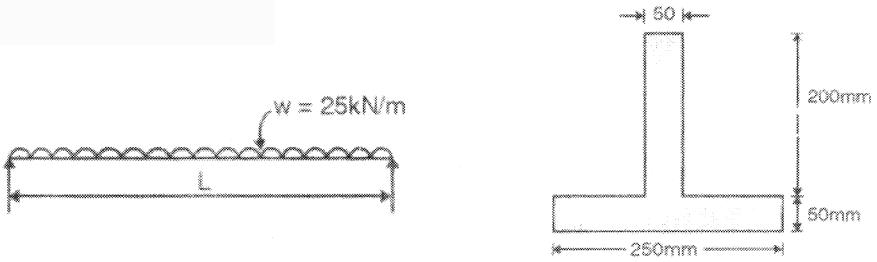


Fig. 5

Or

4. (*a*) A simply supported beam carries a UDL of 25 kN/m over the entire span of the beam is shown in Fig. 6. If the maximum bending stress is 60 MPa, find the span of the beam. Also find the maximum shear stress developed in the section. Draw the shear stress distribution diagram. [6]



(*a*) (*b*)

Fig. 6

(*b*) A wagon weighing 35 kN is attached to a wire rope and moving down an inclined at speed of 3.6 kmph, when the rope jams and wagon is suddenly brought to rest. If the length of rope is 60 m at the time of sudden stoppage, calculate the maximum instantaneous stress and maximum instantaneous elongation produced. Diameter of rope is 40 mm. $E = 2.1 \times 10^5$ N/mm^2. [6]

5. (*a*) Fig. 7 shows a horizontal shaft with keyed pulleys, rotating at 1800 rpm. The pulleys of the tight and slack sides of the belts over the pulleys are indicated in the figure. Neglecting the weight of the shaft and assuming smooth bearings close

to the pulleys, find the diameter of the shaft if the shear stress in the shaft is not to exceed 60 N/mm^2. [7]

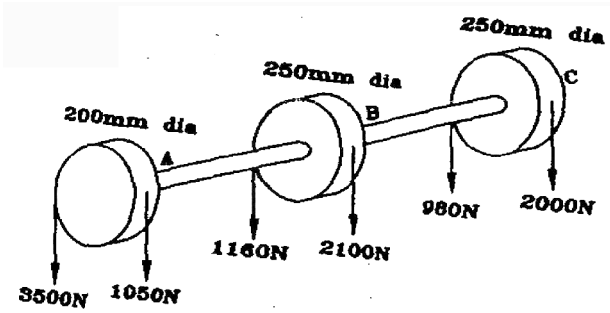


Fig. 7

(*b*) A hollow alloy tube 4 m long with external and internal diameter of 40 mm and 25 mm resp. is found to extend 4.8 mm under tensile load of 60 kN. Find the buckling load if both ends are pinned. Also find safe load on the tube, taking factor of safety as 5. [6]

Or

6. (*a*) The stepped steel shaft shown in Fig. 8 is 800 mm long and fixed at both ends subjected to a torque T at C. If allowable shear stress is 70 MPa, find the safe value of torque T at C. [7]

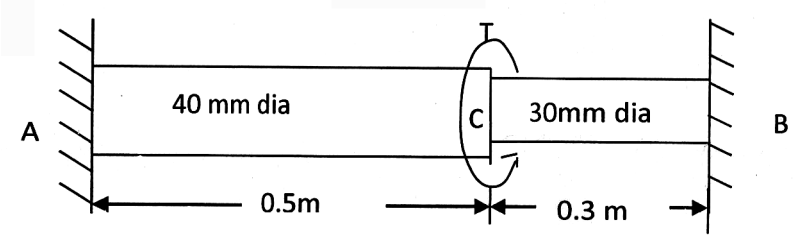


Fig. 8

(*b*) Fig. 9 T shows a T-section column of mild steel 3.50 m long, with both ends fixed. Find the safe axial load on the column. Take f_c = 385 N/mm^2 and α = 1/7500 and a factor of safety of 3. [6]

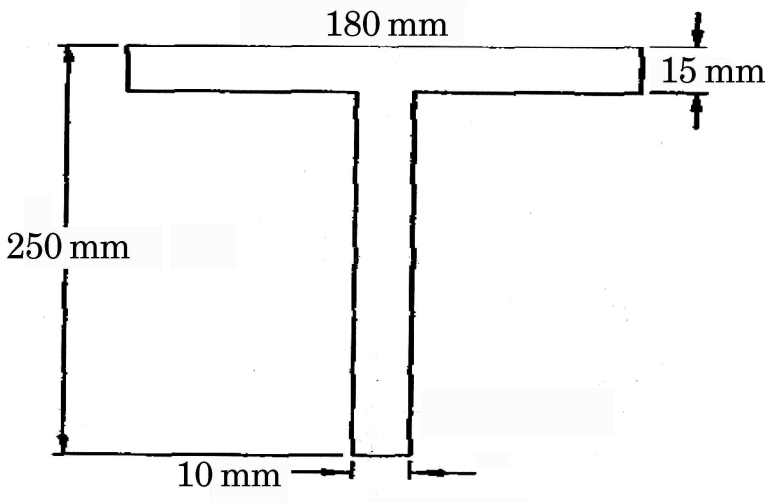


Fig. 9

7. (*a*) A point in a strained material is subjected to the stresses as shown in Fig. 10. Locate the principal planes, and evaluate the principal stresses. [7]

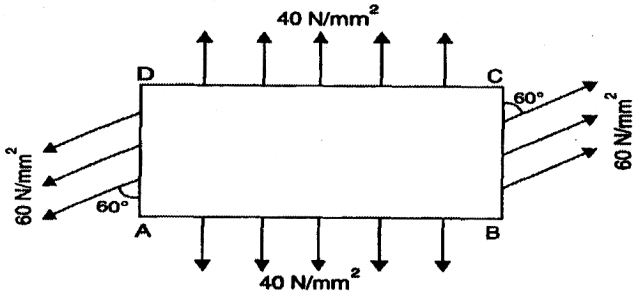


Fig. 10

(*b*) A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 100 MPa in the vertical direction. The point is also subjected to a simple shear stress of 25 MPa, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. What is the magnitude of the normal and shear stresses inclined on a section at an angle of 20° with the major tensile stress ? (Use Mohr's circle method) [6]

Or

8. (*a*) A bolt is under an axial pull of 24 kN together with a transverse shear force of 5 kN. Calculate its diameter according to :

(*i*) Maximum principal stress theory

(*ii*) Maximum shear stress theory, and

(*iii*) Strain energy theory.

Take the elastic limit in steel = 250 N/mm^2. Poisson's ratio = 0.3. Adopt factor of safety = 2.5. [7]

(*b*) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress. [6]