Total No. of Questions—**12**] [Total No. of Printed Pages—**8+3**

[4062]-103

S.E. (Civil) (First Semester) EXAMINATION, 2011

STRENGTH OF MATERIALS

(2008 PATTERN)

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

N.B. **:—** (*i*) Answer any *three* questions from each Section.

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

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

(*iv*) Figures to the write indicate full marks.

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

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

SECTION I

1. (*a*) A mild steel bar of 25 mm diameter and 200 mm gauge length has an extension of 0.15 mm under a maximum load of 75 kN. The load at elastic limit is 160 kN and maximum load is 250 kN. Total extension is 55 mm. The diameter at fracture is 18.5 mm.

Find :

(*i*) Elastic limit stress

(*ii*) Young's Modulus

P.T.O.

(*iii*) Percentage elongation

(*iv*) Percentage reduction in area. [8]

(*b*) A rod is composed of three segments as shown in Fig. 1 and held in two rigid supports. Find stress developed in each material if the temperature of the system is raised by 50°C under the following two conditions :

(*i*) If supports are perfectly rigid supports

(*ii*) If right hand support yield by 0.20 mm.

Assume for steel – E_s = 200 GN/m^2, α_s = 1.2 × 10^{-5}/ °C,

for copper – E_c = 100 GN/m^2, α_c = 1.8 × 10^{-5}/ °C,

for aluminium – E_a = 100 GN/m^2, α_a = 1.8 × 10^{-5}/ °C. [8]

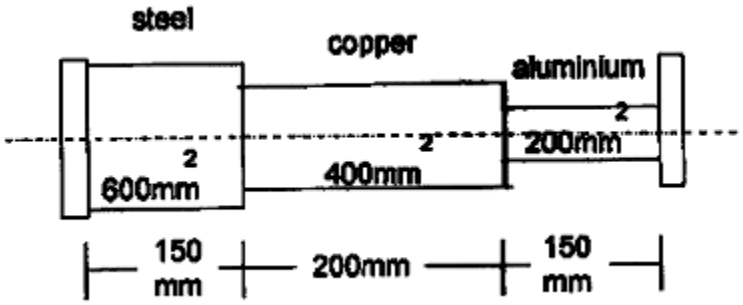


Fig. 1

Or

2. (*a*) A mild steel bar 200 mm long and 80 mm × 60 mm in cross-section is subjected to a longitudinal axial compression of 720 kN. Determine the value of the lateral forces necessary to prevent any transverse strain. Evaluate the resultant alternation in length. E = 200 GPa and μ = 0.25 [8]

(*b*) A tie bar has enlarged ends of square cross-section 60 mm × 60 mm as shown in Fig. 2. If the middle portion of the bar is also a square section, find the size and length of middle portion if stresse there is 140 N/mm^2 and total elongation is 0.14 mm. Take E = 2 × 10^5 N/mm^2. [8]

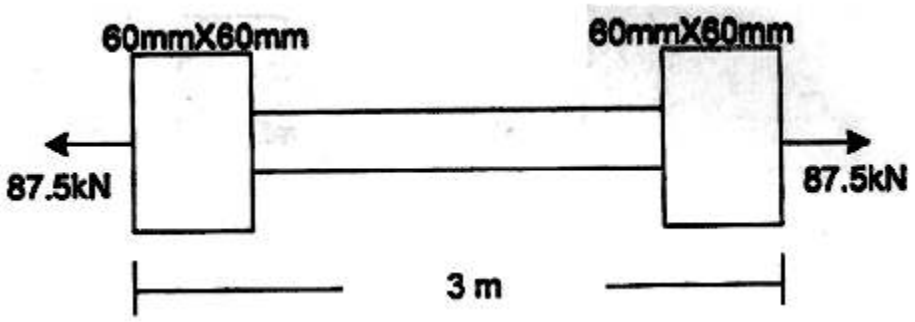


Fig. 2

3. (*a*) Draw S.F. and B.M. diagram for beam shown in Fig. 3. Show all important points on the diagrams. [10]

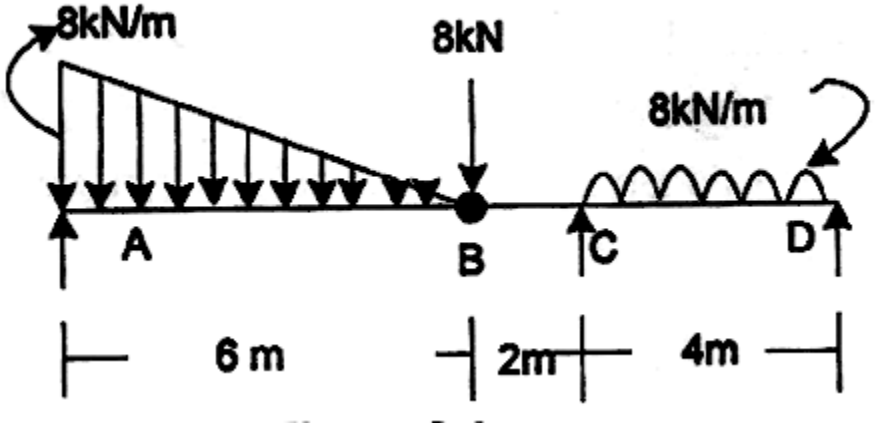


Fig. 3

(*b*) Derive expression for S.F. and B.M. for simply supported beam carrying uniformly distributed load whose intensity varies uniformly from zero at each end to 'w' per unit run at mid span. Also plot SFD and BMD. Assume length of bar 'L' m. [8]

Or

4. (*a*) Construct the corresponding loading diagram and B.M.D. for the beam whose S.F. diagram is as shown in Fig. 4. [10]

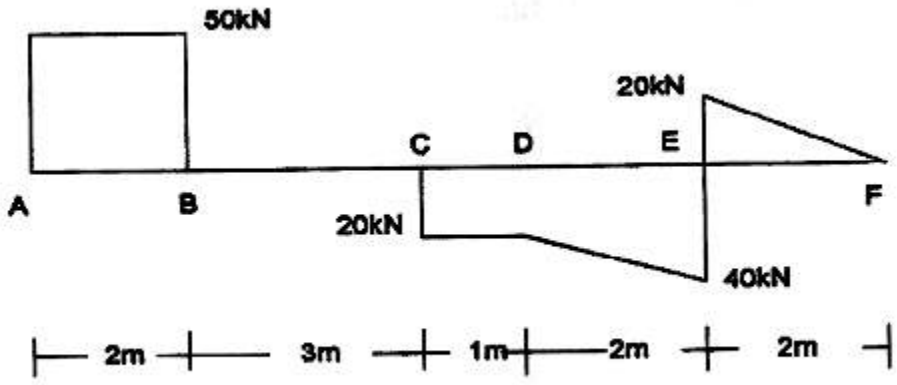


Fig. 4

(*b*) Draw S.F.D. and B.M.D. for the beam shown in Fig. 5. Show all the salient points. [8]

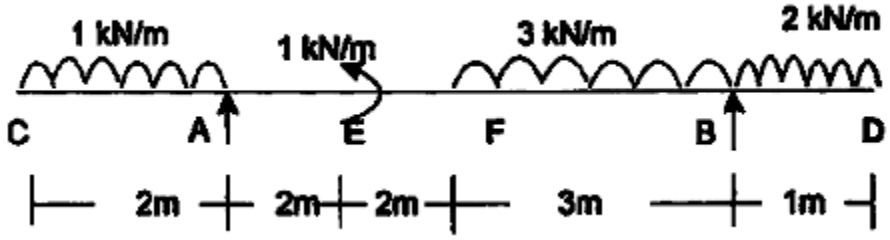


Fig. 5

5. (*a*) A Cast Iron beam of cross-section resembling a rail is symmetrical about a vertical axis in c/s. Total depth = 180 mm, Top Flange = 80 mm × 20 mm, Bottom Flange = 120 mm × 40 mm and Web = 120 mm × 20 mm. If the maximum allowable stress in tension is 30 MN/mm^2 and that of compression is 50 MN/mm^2, find moment of resistance of the cross-section. [8]

(*b*) A hollow box section is as shown in Fig. 6, spans a gap of 5 m and is subjected to a u.d.l. of intensity 30 kN/m including its self weight. Determine the maximum shear stress developed at a section 1.5 m from one end of the section assuming ends simply supported. [8]

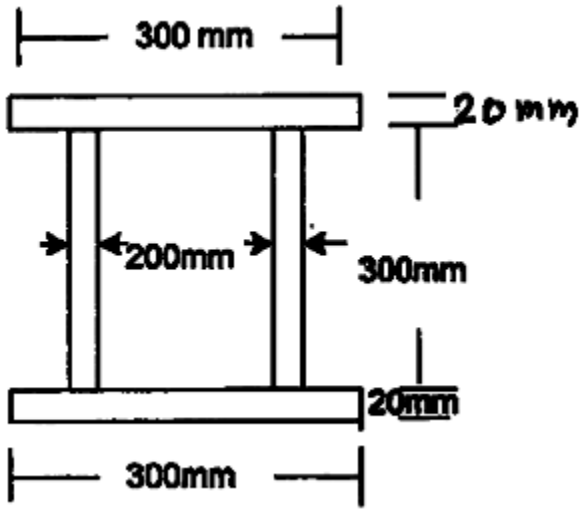


Fig. 6

Or

6. (*a*) A steel section shown in Fig. 7 is subjected to a shear force of 20 kN. Determine shear stresses at important points and sketch shear stress distribution diagram. [8]

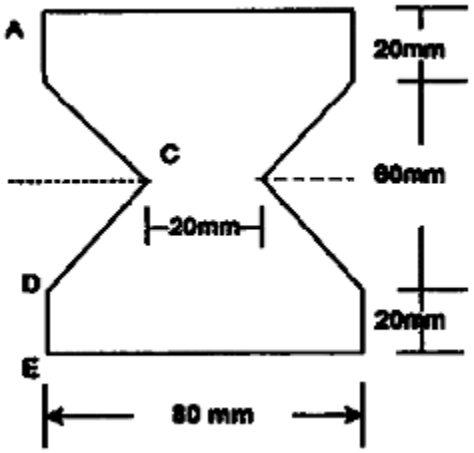


Fig. 7

(*b*) A flitched beam consists of two timber joists 150 mm wide and 350 mm deep with a steel plate 250 mm deep and 15 mm thick fixed symmetrically between the timber joist. Calculate moment of resistance of flitched beam if allowable stress in timber is 7 N/mm^2. Take E_s = 20 E_t. Refer Fig. 8. [8]

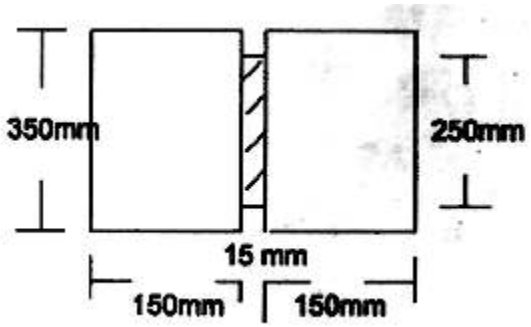
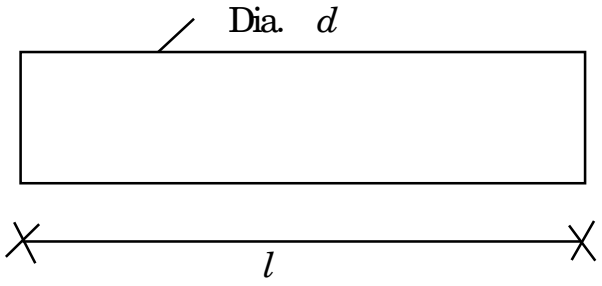


Fig. 8

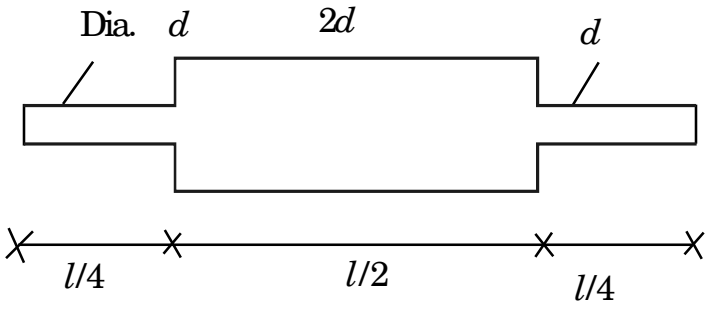
SECTION II

7. (*a*) Calculate the diameter of shaft required to transmit 60 kW at 160 r.p.m. if the maximum torque is likely to exceed the mean by 30% for maximum permissible shear stress of 55 MPa. Calculate also the angle of twist for length of 1.5 m, G = 80 GPa. [9]

(*b*) For the two bars of same material shown in (*a*) and (*b*) of Fig. 9, find the ratio of maximum stress of bar (*a*) to that of bar (*b*). If two bars are stressed to proportional limit, find the ratio of their proof resilience. [9]



(*a*)



(*b*)

Fig. 9

Or

8. (*a*) A uniform shaft of diameter *'d'* is fixed at the ends and is subjected to twisting couples T_1 = 160 kNmm and T_2 = 300 kNmm as shown in Fig. 10. Find the torque T_a, T_b and T_c in the three portions of shaft. [9]

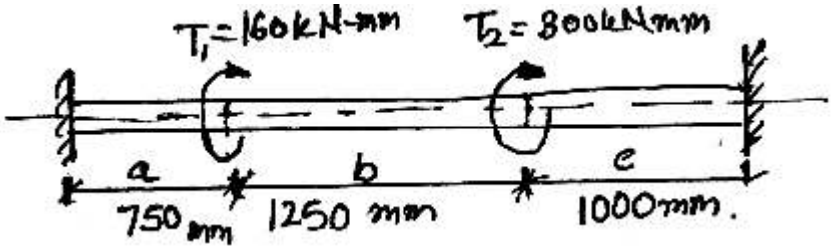


Fig. 10

(*b*) A weight of 2 kN is dropped onto a collar at the lower end of a vertical bar 3 m long and 28 mm in diameter. Calculate the maximum height of drop if the maximum instantaneous stress is not to exceed 140 MPa. What is the corresponding instantaneous elongation ? Also find the dynamic force at instant of maximum elongation. [9]

9. (*a*) A triangular prism is subjected to two-dimensional stress, the planes subjected to stress being perpendicular to the plane of triangle ABC [Fig. 11]. AC is principal plane. On AB there is a tensile stress of 90 MPa having an angle of obliquity of 20° as shown and on BC there is also an oblique stress.

Determine :

(*i*) the angle θ between the planes AC and BC

(*ii*) the tangential normal and resultant stresses on BC and

(*iii*) the value of the principal stress. [8]

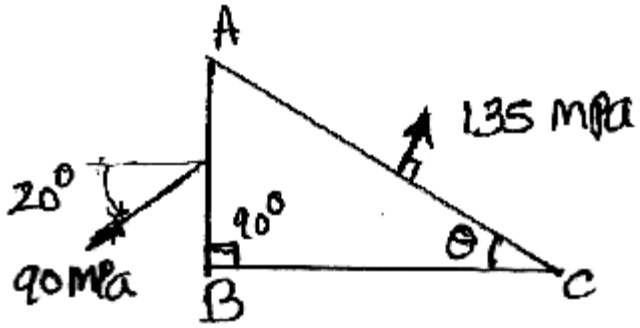


Fig. 11

(*b*) A bolt is subjected to an axial pull of 12 kN together with transverse shear force 6 kN. Determine the diameter of bolt according to maximum shear stress theory if elastic limit in tension 300 MPa. Factor of safety 3. [8]

Or

10. (*a*) At a certain point in an elastic material, normal stresses of 96 MPa tensile and 75 MPa compressive are acting on planes at right angle to each other. The greater principal stress in the material is limited to 120 MPa. To what shearing stress may the material be subjected to on the given planes, and what will be the maximum shearing stress at that point. [8]

(*b*) Derive the expression for equivalent torque 'T_e' and equivalent bending moment 'M_e' when a shaft is under combine action of bending moment 'M' and torsion T. [8]

11. (*a*) An aluminium tube of length 8 m is used as a simply supported column with two ends hinged carrying 1.2 kN axial load. If outer diameter is 50 mm, compute the inner one that would provide factor of safety 2 against buckling. Use E = 70 GPa for aluminum and Euler's formula. [8]

(*b*) A masonry chimney has external diameter 4 m and internal diameter 2 m is subjected to uniform wind pressure is 1500 N/m^2 over an entire height of 66 m. Determine maximum and minimum stresses at base. Unit weight of masonry wall is 22.41 kN/m^3, take $C = \frac{2}{3}$. [8]

Or

12. (*a*) Find by Rankine's formula the safe axial load which an angle iron strut 65 mm × 65 mm × 8 mm, 2 m long, one end fixed, the other hinged, will carry using a factor of safety 3. For the angle, area of section = 976 mm^2, minimum radius of gyration 12.5 mm and σ_c = 320 MPa. $a = \frac{1}{7500}$. [8]

(*b*) A rectangular pier is subjected to compressive load of 500 kN with an eccentricity of 250 mm from both the axes. Find the stress intensities and nature at the four corners of the pier. The dimension of pier 1500 mm × 1000 mm. [8]