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

Seat No.	

[4757]-103

S.E. (Civil) (First Semester) EXAMINATION, 2015

STRENGTH OF MATERIALS

(2008 PATTERN)

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

N.B. :— (*i*) Neat diagrams must be drawn wherever necessary.

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

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

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

(*v*) 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, Q. No. 11 or Q. No. 12 from Section II.

(*vi*) Answers to the two sections should be written in separate answer books.

SECTION I

1. (*a*) A circular bar of 500 mm length has cross-sectional area as shown in Fig. 1. Determine the maximum axial pull 'P' for

P.T.O.

which the bar may be subjected if the maximum stress is limited to 100 MPa. Also find the total change in length. Diameter of (AB) = 12 mm, (BC) = 20 mm and (CD) = 30 mm. [5]

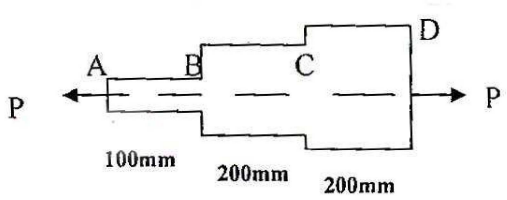

Fig. 1

(*b*) Calculate the support reactions of the bar at junction 'B' of the member loaded as shown in Fig. 2. Assume E = 200 MPa and diameter = 25 mm. [5]

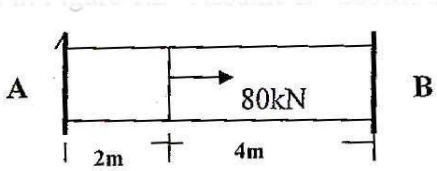

Fig. 2

(*c*) A steel bar 120 mm long, 40 mm × 40 mm in cross-section is subjected to tensile load 200 kN along longitudinal axis and tensile loads of 500 kN and 400 kN on lateral faces as shown

in Fig. 3. Change in volume was observed to be 100 mm^3. Find the value of Poisson's ratio and Bulk Modulus. Take E = 200 GPa. [6]

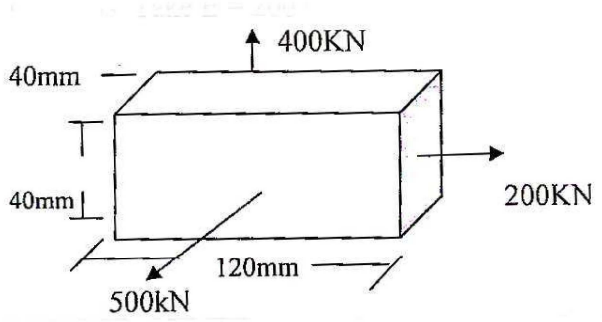

Fig. 3

Or

2. (*a*) A bar of steel is 50 mm × 100 mm in cross-section and is 1.4 m long. It is subjected to a tensile load of 250 kN along the longitudinal axis. Find the change in dimension of the bar and change in volume. [8]

(*b*) An axial compressive force 300 kN is applied to the assembly shown in Fig. 4 by means of rigid end plates. The diameter of Brass core is 20 mm and outside diameter of aluminium tube is 60 mm. Determine : [8]

(*i*) Normal stress in Aluminium Shell

(*ii*) Normal stress in the Brass Core

(*iii*) Corresponding deformation of the assembly.

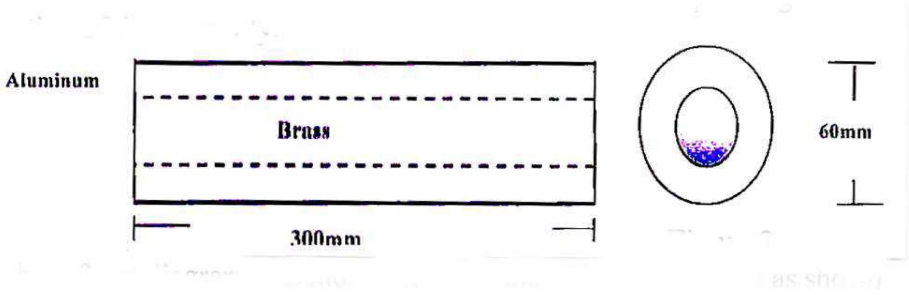

Fig. 4

3. (*a*) Draw shear force diagram and Bending Moment diagram for the beam as shown in Fig. 5. Indicate the numerical values at all important section. Find the position of contraflexure are, if any. [10]

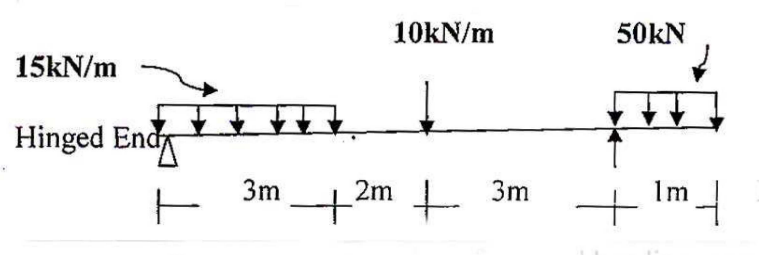

Fig. 5

(*b*) Derive relation between load intensity, shear force and bending moment at a section of a prismatic bar. Show that the bending moment is maximum at a section where shear force is zero. [8]

Or

4. (*a*) Draw SFD and BMD for the beam loaded as shown in Fig. 6. [9]

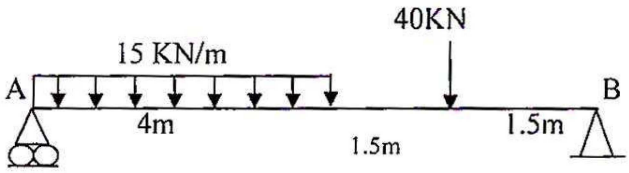

Fig. 6

(*b*) Draw the bending moment diagram and loading diagram from given shear force diagram if beam is subjected to a moment at a distance 2 m from end A. (Refer Fig. 7). [9]

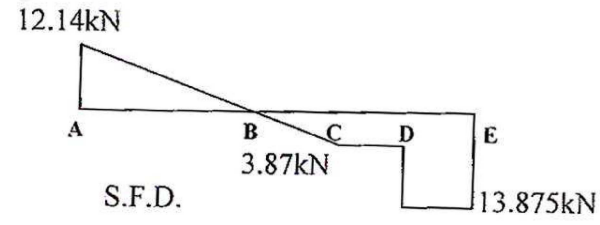

Fig. 7

5. (*a*) Show that the ratio of maximum to mean shear stress on rectangular cross-section of a beam is 1.5. [8]

(*b*) A timber beam 100 mm wide and 200 mm deep is strengthened by a steel plate 100 mm wide and 10 mm thick as shown in Fig. 8. Calculate the moment of resistance of the beam if the safe stress in timber and steel are 10 MPa and 150 MPa respectively. Take $E_{steel} = 20\ E_{Timber}$. [8]

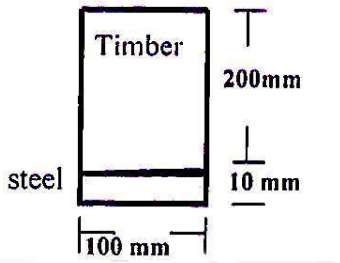

Fig. 8

Or

6. (*a*) Draw shear stress distribution diagram for cross-section of beam shown in Fig. 9. The shear force at section is 200 kN and M.I. is 1.134×10^8 mm^4. [8]

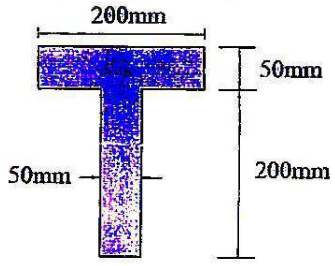

Fig. 9

(*b*) The cross-section of a simply supported beam of 6 m span is shown in Fig. 10. If permissible stresses are 100 MPa in compression and 40 MPa in tension. Find the safe UDL the beam can carry. [8]

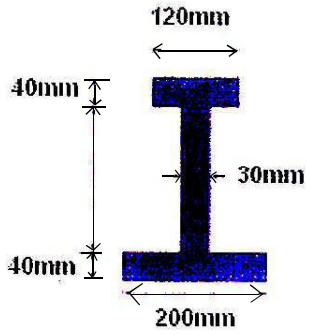

Fig. 10

SECTION II

7. (*a*) A load 600 N falls freely through a height of 160 mm onto a collar attached to the end of vertical rod of 50 mm diameter and 2.5 m long, the upper end being fixed to the ceiling. Calculate the maximum instantaneous extension of bar. Also calculate the maximum stress in the bar. Assume E = 200 GPa. [8]

(*b*) A composite shaft consists of a steel rod 100 mm in diameter surrounded by a closely fitting brass tube fixed to it. Find the outer diameter of the tube so that when a torque is applied to composite bar, it will be shared equally by both the materials. If the torque is 20 kN.m, calculate the maximum shear stress in each material and angle of twist in a length of 4 m. Take G_{st} = 80 GPa, G_{Br} = 40 GPa. [10]

Or

8. (*a*) Derive the expression for instantaneous stress induced in the rod due to fall of weight 'W' through a height '*h*'. The cross-sectional area of rod is 'A' and modulus of elasticity 'E'. [8]

(*b*) The Fig. 11 shows a horizontal shaft AD subjected to torque at 'B' and 'C'. Determine : [10]

(*i*) The diameter of the shaft if maximum shear stress is not to exceed 120 MPa.

(*ii*) The end fixing couples in magnitude and direction.

(*iii*) Plot twisting moment diagram.

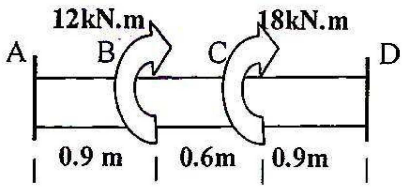

Fig. 11

9. (*a*) For the element shown in Fig. 12, locate the planes on which magnitude of the shear stress are equal. Show the results on properly oriented elements. Also find principal stress. [8]

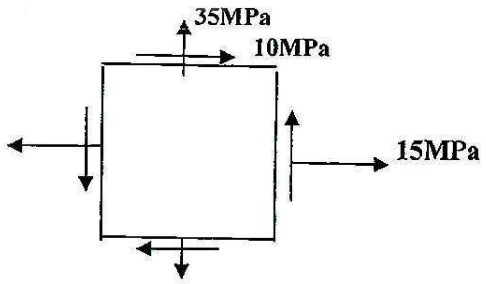

Fig. 12

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

Or

10. (*a*) At a section in a strained material, the stresses on two mutually perpendicular planes are as shown in Fig. 13. Find stresses and maximum shear stress. [8]

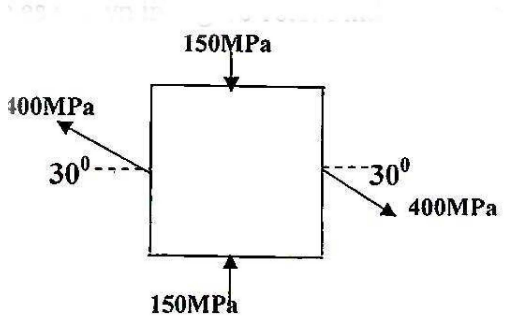

Fig. 13

(*b*) A shaft of hollow circular cross-section with outside diameter 200 mm and inside diameter 160 mm is subjected to a torque of 11.1 kN.m and axial compressive force of 362 kN. Determine the maximum tensile stress, maximum compressive stress and maximum shear stress in the shaft. [8]

11. (*a*) Explain the limitations of Euler's formula ? Define effective length of column. [8]

(*b*) A tapering chimney of hollow circular cross-section is 25 m high. Its external diameter at the base is 3 m and at the top 2 m. If the weight of the chimney is 1800 kN, find the uniform horizontal wind pressure that may act per unit projected area of the chimney in order to just avoid tension at the base. [8]

Or

12. (*a*) State the assumptions made in Euler's Theory. Derive the expression for the critical load for a column pinned at both ends. [8]

(*b*) The cross-section of a column is hollow rectangular section having external dimension 120 mm × 80 mm, internal dimensions 100 mm × 60 mm with uniform thickness 10 mm. It is 5 m long having one end fixed and other end hinged. Find safe load it can carry by : [8]

(*i*) Euler's formula

(*ii*) Rankine's formula.

Assume E = 200 GPa, σ_C = 320 MPa, α = 1/7500 and factor of safety = 3.