53 (CE 302) STMT

2021

STRENGTH OF MATERIALS

Paper : CE 302

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer **any five** questions out of **six**.

1. (a) A hollow steel tube 4m long has external diameter of 80mm. In order to determine the internal diameter, the tube was subjected to a tensile load of 300kN and extension was measured to be 2·5mm. If the modulus of elasticity for the tube material is 100GPa, determine the internal diameter of the tube. 10

(b) A steel bar *ABCD* 4*m* long is subjected to forces as shown in *Fig.* 01.

Fig. 01

Find the elongation of the bar. Take *E* for the steel as 200*GPa*.   10

2. Write short notes on the following :
                                                    2×10=20

(a) Shear force and bending moment

(b) Bulk modulus

(c) Modulus of elasticity

(d) Modulus of rigidity

(e) Principal plane

(f) Principle of Superposition

(g) Homogeneous and isotropic behavior

(h) Secondary strain

(i) Types of stresses

(j) Point of contraflexure.

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3. An element in a strained body is subjected to a tensile stress of 150 MPa and a shear stress of 50 MPa tending to rotate the element in an anticlockwise direction. Find (i) the magnitude of the normal and shear stresses on a section inclined at 40° with the tensile stress and (ii) the magnitude of maximum shear stress that can exist on the element.   20

4. An alloy circular bar ABCD, 3m long is subjected to a tensile load of 50kN as shown in Fig. 02. If the stress in the middle portion BC is not to exceed 150 MPa, then what should be its diameter ? Also find the length of the middle section, if the total extension of the bar should not exceed by 3mm. Take E as 100 GPa.   20
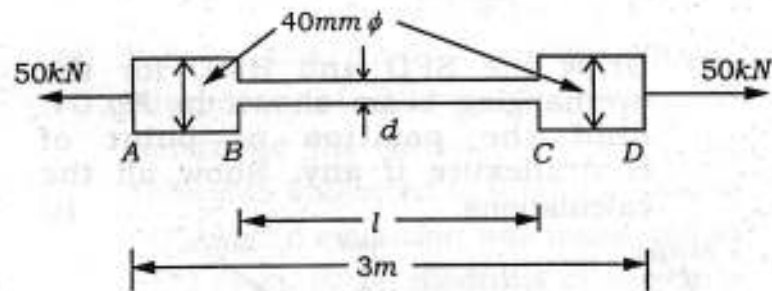

Fig. 02

5. Derive the relationship among

   (a) Young's modulus and Bulk modulus.   5

(b) Young's modulus and Shear modulus. 5

(c) Young's modulus, Bulk modulus and Shear modulus. 10

6. (a) Draw the shear force and bending moment diagrams for a simply-supported beam, loaded as shown in *Fig.* 03. Show all the calculations. 10
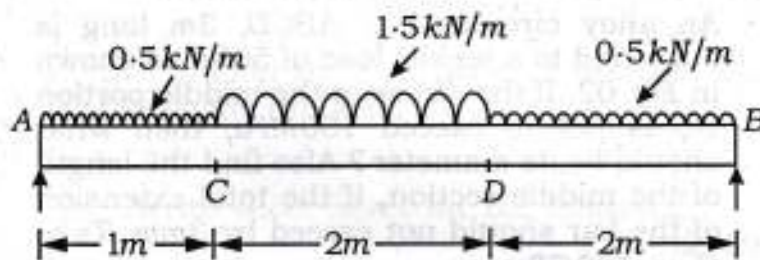
$1.5 kN/m$

$0.5 kN/m$ $0.5 kN/m$

A ⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋ B

C   D

|← 1m →|← 2m →|← 2m →|

Fig. 03

(b) Draw the SFD and BMD for the overhanging beam shown in *Fig.* 04. Find the position of point of contraflexure if any. Show all the calculations. 10
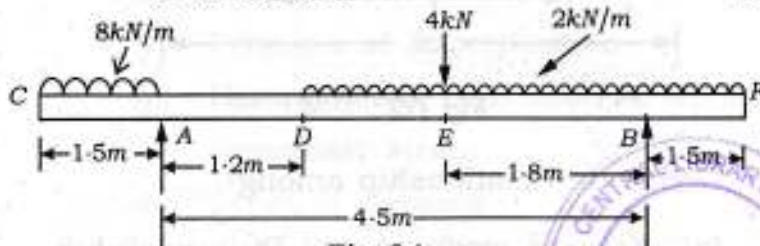
$8kN/m$ $4kN$ $2kN/m$

C ⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋⟋ F

A   D   E   B

|←1·5m→|← 1·2m →| |← 1·8m →| |←1·5m→|

|← 4·5m →|

Fig. 04