*Total number of printed pages: 04* **Program (UG)/4th/UCE402**

**2025**

# Strength of Materials

*Full Marks : 100*

Time : Three hours

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

*Answer **any five** questions.*



1. a) Define point of contraflexure with the help of a sample diagram 5

   b) Write the principle of superposition 5

   c) Distinguish between lateral strain and linear strain. 5

   d) State Difference between torque and bending moment. 5

2. a) A hollow cylinder 2 m long has an outside diameter of 50 mm and inside diameter of 30 mm. If the cylinder is carrying a load of 25 kN, find the stress in the cylinder. Also find the deformation of the cylinder, if the value of modulus of elasticity for the cylinder material is 100 GPa. 6

   b) A hollow steel tube 3.5 m long has external diameter of 120 mm. In order to determine the internal diameter, the tube was subjected to a tensile load of 400 KN and extension was measured to be 2 mm. If the modulus of elasticity for the tube material is 200 GPa, determine the internal diameter of the tube. 7

   c) Two wires, one of steel and the other of copper, are of the same length and are subjected to the same tension. 7

If the diameter of the copper wire is 2 mm, find the diameter of the steel wire, if they are elongated by the same amount. Take E for steel as 200 GPa and that for copper as 100 GPa.

3. a) An alloy circular bar ABCD 3 m long is subjected to a tensile force of 50 KN as shown in fig. 1. 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 portion, if the total extension of the bar should not exceed by 3 mm. Take E as 100 GPa. All the diameters are in mm. 10

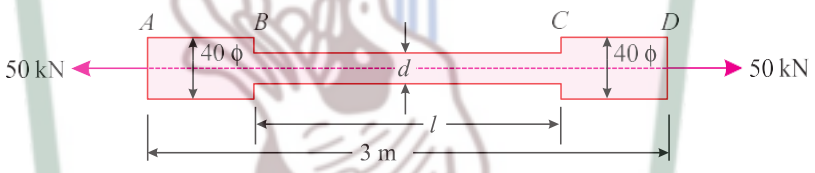


**Fig.1**



b) A steel bar ABCD 4 m long is subjected to forces as shown in fig. 2. Find the elongation of the bar. All the diameters are in mm. 10

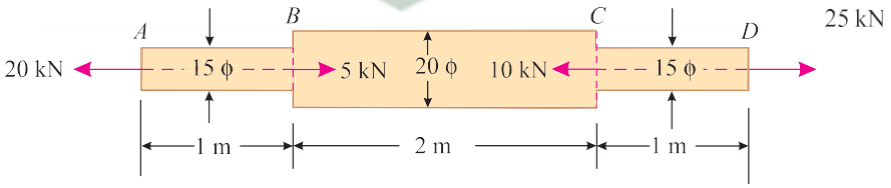


**Fig. 2**

4. a) Draw the SFD & BMD for the overhanging beam shown in fig. 3. Show all the calculations. 10

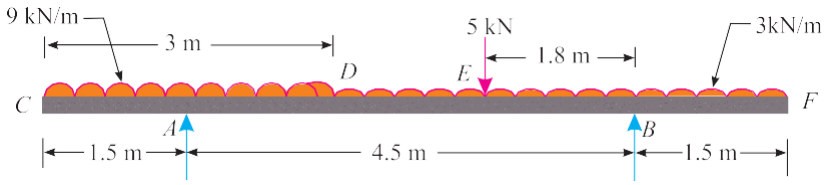


**Fig.3**

b) Draw the SFD & BMD for the simply supported beam, loaded as shown in fig. 4. Show all the calculations. 10



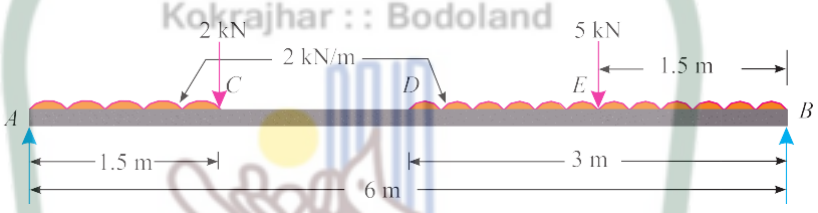


**Fig.4**

5. a) In an experiment, a bar of 30 mm diameter is subjected to a pull of 60 KN. The measured extension on gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and the values of the three moduli. 10



b) A load of 270 KN is carried by a short concrete column 250 mm × 250 mm in size. The column is reinforced with 8 bars of 16 mm diameter. Find the stresses in concrete and steel, if the modulus of elasticity for the steel is 18 times that of concrete. 6+4

If the stress in concrete is not to exceed 5 MPa, find the area of steel required, so that the column may carry a load of 500 KN.

6. a) A steel bar of 600 $mm^2$ cross-sectional area is carrying loads as shown in fig below (fig. 2.14). Determine the elongation of the bar if E for the steel is 200 GPa. 05

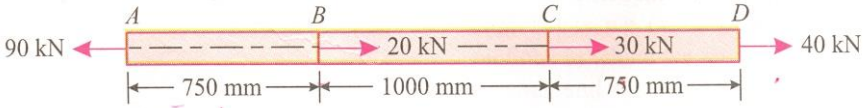


Fig. 2.14

b) Define stress and strain for a member subjected to any external load. For any given load P acting on a structural member, derive $\delta l = \frac{Pl}{AE}$, where symbols have their usual meaning. 1+1+3

c) A simply supported beam AB, 6 m long is loaded as shown in fig.13.21. Construct the shear force and bending moment diagrams for the beam and find the position and value of maximum bending moment. Show all the calculations. 10

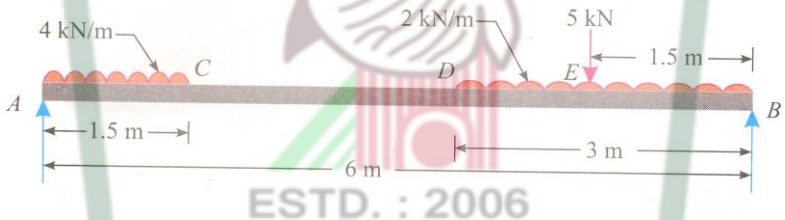


Fig. 13.21



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