BME-017

# BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

## Term-End Examination

## June, 2008

## BME-017 : STRENGTH OF MATERIALS

*Time : 3 hours* *Maximum Marks : 70*

**Note :** *Answer any* ***seven*** *questions. All questions carry equal marks. Assume suitable missing data, if any.*

1. A concrete cylinder of height 300 mm and diameter 150 mm is tested for compression in a Universal Testing Machine. Within the elastic limit, the cylinder was found to be shortened by 0·12 mm and its diameter was found to be increased by 0·01 mm under the axial load of 90 kN. Calculate the Young's Modulus, E, and Poisson's Ratio $\nu$ for the specimen. 10

2. At a certain point in a strained material, there are two mutually perpendicular planes. The normal stresses acting on them are 80 MPa tensile and 30 MPa compressive. If the major principal stress is 100 MPa tensile, find the following :

(a) The shear stress acting on two planes

(b) The minor principal stress, and

(c) The maximum shear stress at the point. 15

3. A composite bar made of brass and steel is fixed between two supports as shown in Figure 1. If the temperature is increased by 80° C, find the stresses induced in the steel and the brass section assuming

(a) if the supports do not yield, and

(b) if the supports yield by 0·15 mm. 10

Take

$$E_s = 2 \times 10^5 \text{ N/mm}^2$$

$$E_b = 1 \times 10^5 \text{ N/mm}^2$$

$$\alpha_s = 1{\cdot}2 \times 10^{-5} \text{ K}^{-1}$$

$$\alpha_b = 1{\cdot}9 \times 10^{-5} \text{ K}^{-1}$$

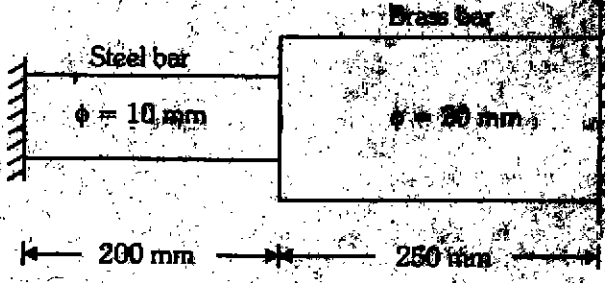


*Figure 1*

4. Draw the shear force and bending moment diagrams for simply supported beam loaded as shown in Figure 2. *10*

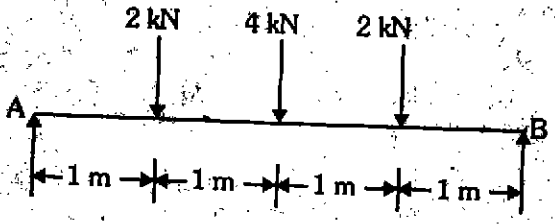


*Figure 2*

5. A rectangular beam 240 mm × 400 mm is simply supported over a span of 4 m. Find the safe concentrated load at mid-span if the allowable bending stress is 120 $N/mm^2$. *10*

6. A 2 m simply supported beam having cross-section 150 mm × 500 mm carries a point load of 20 kN at a distance of 0·5 m from the left end. Find the slope at the two ends, deflection under the load and the maximum deflection of the beam. Take $E = 2 \times 10^4$ $N/mm^2$. *10*

7. A stepped steel shaft shown in Figure 3, is subjected to a torque of 100 N-m (anti-clockwise) at C and another torque of 200 N-m (clockwise) at B. Determine the angle of twist at the free end. Shear stress in the shaft is not to exceed 60 MPa and modulus of rigidity is 84 GPa. 10

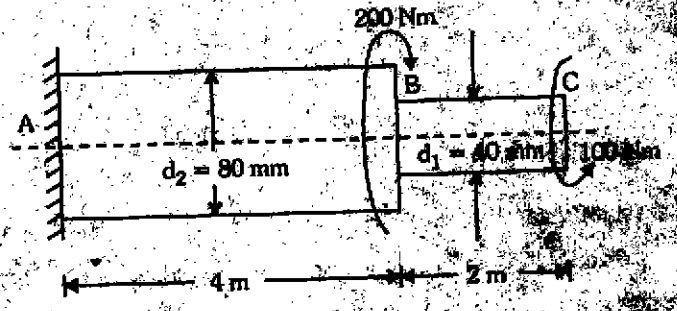


*Figure 3*

8. A laminated steel spring of length 900 mm carries a central proof load of 8 kN. The maximum deflection at the centre is 60 mm and the bending stress should not exceed 0·5 kN/mm$^2$. Determine the thickness, width, number of plates and the radius to which the plates should be bent. Assume the plate width to be ten times its thickness. Take E = 200 kN/mm$^2$. 10

9. A cube of side 100 mm fixed at the bottom is subjected to a shear force of 50 kN on its top face. Find strain energy stored in the cube and modulus of resilience. Take G = 80 kN/mm$^2$. 10

**10.** A structural steel column is in the form of a tube of thickness 15 mm and external diameter 250 mm and is 3 m long. Its one end is fixed while the other end is free. Find the maximum axial load to be applied on the column. How will this load vary for the following end conditions :

(i) Both ends hinged

(ii) Both ends fixed ?

Take E = 200 GPa

*10*