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BME-017

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) BTCLEVI / BTMEVI / BTELVI / BTCSVI / BTECVI

Term-End Examination

00485 **December, 2014**

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. Use of scientific calculator is permitted.*

1. If the bar shown in Figure 1 is 1 m long with rectangular cross-section 300 mm deep and 400 mm wide, calculate the change in volume of the solid due to a longitudinal compressive force of 720 kN, if the elastic constants E and v for the material are known to be 120 kN/mm^2 and 0·2 respectively. *10*

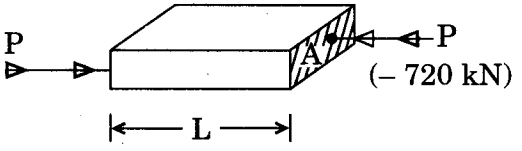


Figure 1

2. A steel rod of 20 mm diameter passes centrally through a tight fitting copper tube of external diameter 40 mm. The tube is closed with the help of rigid washers of negligible thickness and nuts threaded on the rod. The nuts are tightened till the compressive load on the tube is 50 kN. Determine the stresses in the rod and the tube, when the temperature of the assembly falls by 50°C.

For steel, $E = 200\ GNm^{-2}$ and $\alpha = 12 \times 10^{-6}\ K^{-1}$

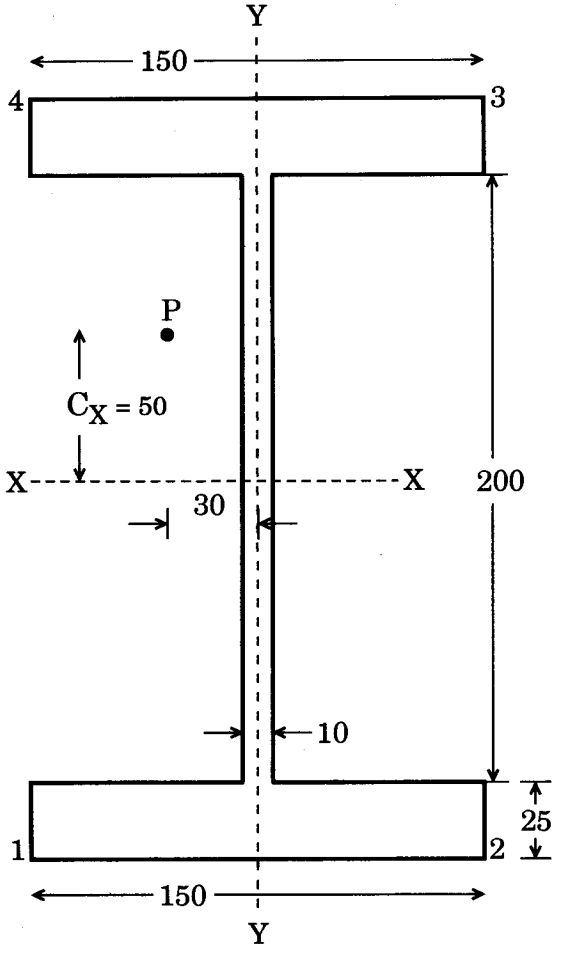
For copper, $E = 100\ GNm^{-2}$ and

$\alpha = 18 \times 10^{-6}\ K^{-1}$. *10*

3. A cantilever beam of 8 m length is subjected to point loads of 10 kN, 15 kN, 25 kN and 20 kN at distances of 2 m, 4 m, 6 m and 8 m respectively from the fixed end. Draw the shear force diagram and bending moment diagram. *10*

4. A timber beam of rectangular section is simply supported over a span of 5 m. It carries a uniformly distributed load of 15 kN/m over the entire span. Find the width and depth of the beam, if the bending stress is limited to $8\ N/mm^2$. The depth to width ratio may be taken as 1·5. *10*

5. A Rolled Steel I-Section, Flanges 150 mm wide and 25 mm thick, web 200 mm long and 10 mm thick shown in Figure 2 is used to carry an axial load of 800 kN at point P. The load line is eccentric, 50 mm above XX and 30 mm to the left of YY. Find the maximum and minimum stress intensities in the section. *10*



(All dimensions in mm)

Figure 2

6. A beam of uniform cross-section with centroid at mid-depth and length 7 m, is simply supported at its ends and carries a point load of 5 kN at 3 m from one end. If the maximum bending stress is not to exceed 90 MN/m^2 and the beam is 150 mm deep,

(i) working from the first principles, find the deflection under the load, and

(ii) what load dropped from a height of 75 mm onto the beam at 3 m from one end would produce a stress of 150 MN/m^2 at the point of application of the load ?

Take E = 200 GPa. *10*

7. A simply supported beam of span 6 m carries a udl of 48 kN/m for a length 3 m from the right support and a clockwise moment of 20 kN-m is applied at a distance of 1 m from left support. Determine the deflection at a distance of 1 m from left end. *10*

8. A solid shaft 6·5 m long is securely fixed at each end. A torque of 91 Nm is applied to the shaft at a section 2·5 m from one end as shown in Figure 3. Find the fixing torques set up at the ends of the shaft.

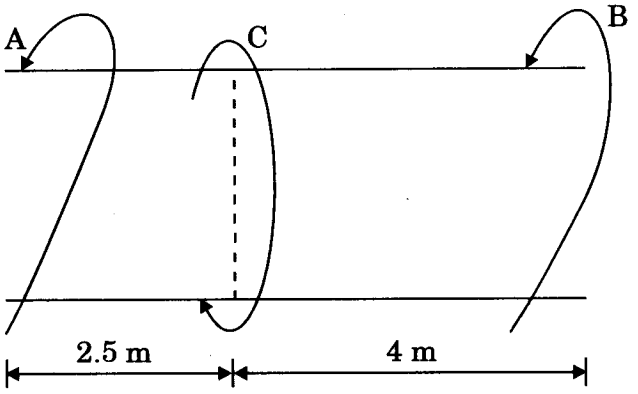


Figure 3

If the shaft is 35 mm diameter, find the maximum shear stresses in two portions. Also find the angle of twist for the section where the torque is applied. Take $G = 8{\cdot}4 \times 10^4$ N/mm^2. *10*

9. A steel cylinder 160 mm external diameter and 120 mm internal diameter has another cylinder 200 mm external diameter shrunk on it. If the maximum tensile stress induced in the outer cylinder is 80 N/mm^2, find the radial compressive stress between the cylinders. Determine the circumferential stress at inner and outer diameter of both cylinders. Also find the initial difference in the common diameter of the two cylinders required.

Take Young's modulus = 200 GPa. *10*

10. Two close-coiled springs A and B are connected in series to form a composite spring of stiffness 1000 N/m. The spring A has 20 effective turns with a wire diameter 2 mm, while spring B has 30 effective turns. If the spring index of the springs A and B is 8, find the wire diameter of spring B. Also calculate the maximum tensile load that can be applied to the composite spring and the maximum extension of the composite spring under this load.

τ_{max} = 200 N/mm^2 (Maximum shear stress).

G = 80 GPa.

Neglect the effect of spring index on shear stress. *10*