No. of Printed Pages : 6

**BME-017**

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

## Term-End Examination

01330

## June, 2015

## 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.** Consider the compound bar shown in Figure 1 consisting of a steel bolt of diameter 18 mm, surrounded by a copper tube of outer and inner diameter 30 mm, and 20 mm respectively. The assembly is just snug at 15°C. The material properties are given as :

Young's modulus of steel, $E_s = 200$ kN/mm$^2$

Young's modulus of copper, $E_c = 120$ kN/mm$^2$

Coefficient of linear thermal expansion of steel, $\alpha_s = 12 \times 10^{-6}$ m/m/°C.

Coefficient of linear thermal expansion of copper, $\alpha_c = 18 \times 10^{-6}$ m/m/°C.

Calculate the thermal stresses in steel and copper when the temperature of the assembly is raised to 45°C. *10*

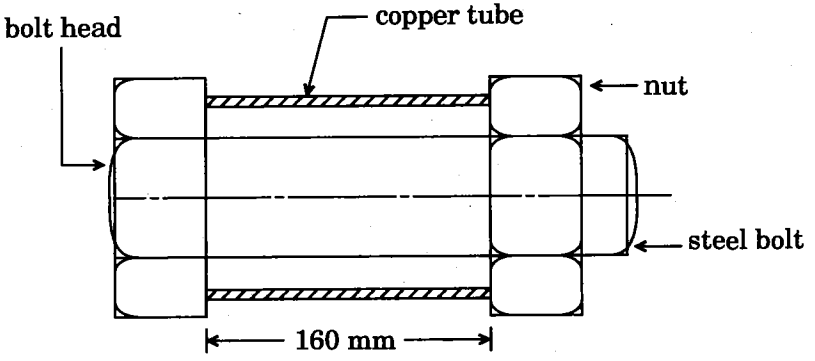


*Figure 1*

**2.** A raised slab weighing 600 kN is placed upon two bronze rods and one steel rod each of 60 $cm^2$ cross-sectional area at a temperature of 15°C. The bronze rods are 25 cm while the steel rod is 30 cm long. Before the slab was placed, the top of all three rods are level. Find the temperature, at which the stress in the steel rod will be zero.

E of steel = 200 $GNm^{-2}$ and E of bronze = 80 $GNm^{-2}$. $\alpha$ of steel = $12 \times 10^{-6}$ $K^{-1}$ and $\alpha$ of bronze = $18 \times 10^{-6}$ $K^{-1}$. *10*

**3.** A cantilever beam carries a uniformly distributed load of 2 t/m over the entire length of 6 m and point loads of 5t, 3t, 7t and 2t at a distance of 2 m, 4 m, 5 m, and 6 m, respectively from the fixed end. Draw SFD and BMD for the beam. *10*

4. A timber of rectangular section carries a load of 2 kN at mid-span. The beam is simply supported over a span of 3·6 m. If the depth of the section is to be twice the breadth and bending stress is not to exceed 9 N/mm$^2$, determine the cross-sectional dimensions. *10*

5. A bar of T-section as shown in Figure 2 is subjected to a longitudinal pull P applied at a point on the YY-axis but not at the centroid of the section. Determine the magnitude of P and the position of its line of section, if the stresses across the section vary from 10 N/mm$^2$ compression at the top to 120 N/mm$^2$ tension at the bottom. *10*

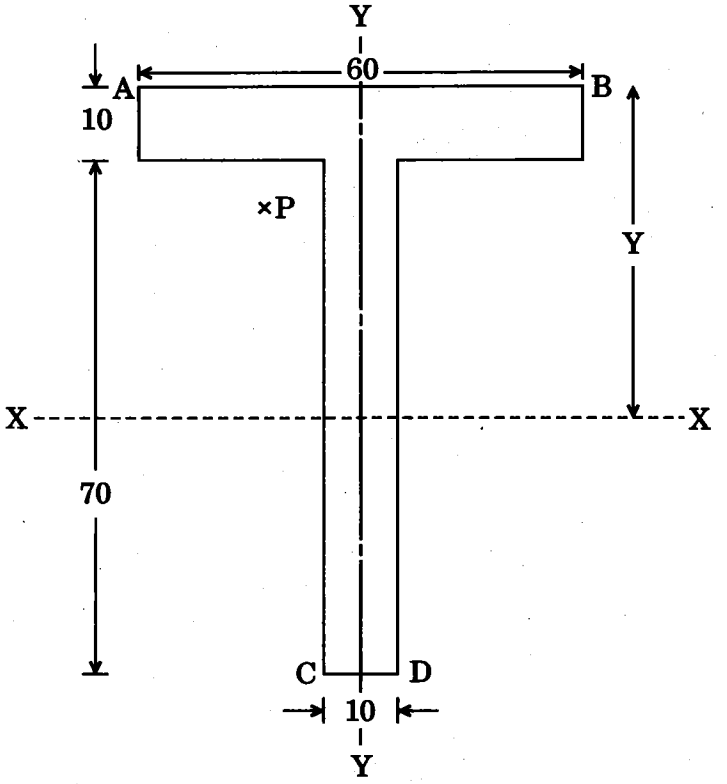


*Figure 2*

6. Determine the vertical deflection at the tip of the cantilever shown in Figure 3. *10*

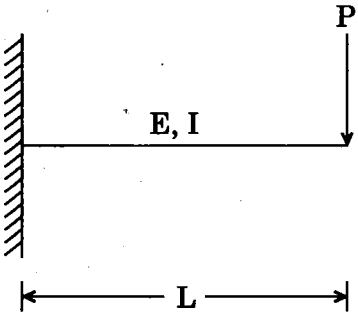


*Figure 3*

7. A beam of span 4 m is subjected to a point load of 20 kN at 1 m from the left support and a UDL of 10 kN/m over a length of 2 m from the right support. Determine :

(a) Slope at the ends

(b) Slope at the centre

(c) Deflection under the load

(d) Deflection at the centre

(e) Maximum deflection

Take EI = $20 \times 10^6$ N-$m^2$. *10*

8. The stepped shaft shown in Figure 4 is subjected to a torque at B and D of magnitude 2 kN-m and 4 kN-m respectively. Find the angular rotation of the free end at A. Take G = 80 GPa. *10*

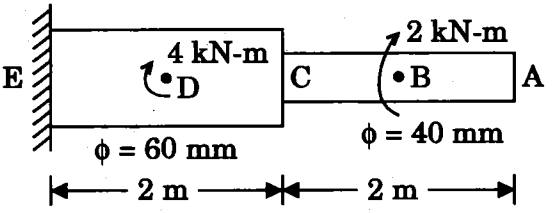


*Figure 4*

9. A close-coiled helical spring has a stiffness of 1 kN/m in compression with a maximum load of 50 N and a maximum shearing stress of 150 N/mm$^2$. The solid length of the spring is 45 mm. Find the wire diameter, mean coil radius and number of coils. Take G = 40 GPa. *10*

10. The table below gives particulars of a compound spring consisting of two coaxial close-coiled springs. If the spring is subjected to an axial load of 450 N, determine for each spring

(a) the change in length,

(b) the amount of load carried, and

(c) the maximum shearing stress.

Take G = $80 \times 10^3$ N/mm$^2$. *10*

| | Mean coil radius (mm) | Diameter of wire (mm) | n | Free length (mm) |
|---|---|---|---|---|
| Outer spring | 25 | 5 | 10 | 100 |
| Inner spring | 15 | 4 | 8 | 80 |