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BME-017

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

00132

Term-End Examination

December, 2017

BME-017 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **seven** questions. All questions carry equal marks. Assume suitable data, if missing. All notations have their usual meaning. Use of scientific calculator is allowed.*

1. A steel rod, 20 mm diameter and 800 mm long, is rigidly attached to an aluminium rod, 40 mm diameter and 1 m long as shown in Figure 1. The combination is subjected to a tensile load of 40 kN. Find the stress in the materials and the total elongation of the bar. E_s = 200 GPa, E_{al} = 70 GPa. *10*

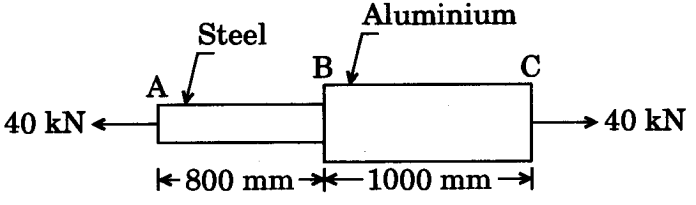

Figure 1

2. A copper bar 25 cm long is fixed by means of a sinking support at its ends which yields by an amount of 0·01 cm. If the temperature of the bar is raised by 120°C, calculate the stresses induced in the bar. Coefficient of linear expansion for copper $\alpha_c = 17{\cdot}5 \times 10^{-6}$/°C and $E_c = 98$ GPa. *10*

3. The state of a stressed material is given by $\sigma_x = 20$ MPa, $\sigma_y = 10$ MPa and $\tau_{xy} = 25$ MPa. Determine the direction and magnitude of the principal stresses in the materials. *10*

4. A shaft 7·5 cm diameter is subjected to a bending moment of 400 N-m and a torque of 300 N-m. Determine
   (a) the maximum normal stress on a section perpendicular to the axis,
   (b) the maximum shear stress on a section perpendicular to the axis,
   (c) the principal stress, and
   (d) the maximum shear stress. *10*

5. What are the assumptions made for analysis of theory of simple bending ? Also derive $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$. *10*

6. A horizontal girder which is freely supported at its ends and has a span of 9 m supports a uniformly distributed load of 20 kN/m that runs over the whole span and also two concentrated loads of 30 kN and 40 kN at points 6 m and 7·5 m respectively from the left support. Draw the shear force and bending moment diagrams and state the values of the maximum bending moment and maximum shear force. *10*

7. A steel specimen 1·5 cm^2 in cross-section stretches 0·005 cm over a 5 cm gauge length under an axial load of 30 kN. Calculate the strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50 kN, calculate the elongation at elastic limit and the proof resilience. *10*

8. Prove that the maximum deflection for a simply supported beam with point load (W) at mid-point is $WL^3/48$ EI, where L = span of the beam, EI = flexural rigidity of the beam. *10*

9. Determine the diameter of a 3 m long shaft that will be required to transmit 80 kW at 80 rpm. The maximum torque is 30 percent greater than the mean torque and the limit of torsional stress is to be 56 MPa. Determine the maximum angle of twist. Take the modulus of rigidity as 84 GPa. *10*

10. A close-coiled helical spring 10 cm mean diameter is made of 20 turns of 1 cm diameter steel rod. The spring carries an axial load of 100 N. Find the shearing stress developed in the spring and the deflection of the load. Assume modulus of rigidity as 84 GPa. *10*
