PVP 14

Code: ME3T5

II B.Tech - I Semester – Regular/Supplementary Examinations
November 2019

MECHANICS OF SOLIDS - I
(MECHANICAL ENGINEERING)

**Assume the suitable data wherever if necessary.*

Duration: 3 hours Max. Marks: 70

PART – A

Answer ***all*** the questions. All questions carry equal marks
11x 2 = 22 M

1.

a) What is meant by toughness and ductility of a material?
b) A steel bar of 40 mm x 40 mm square cross-section is subjected to an axial compressive load of 200 kN. If the length of the bar is 2 m and E= 200 GPa, find the elongation of the bar.
c) In a strained material, if one of the principal stresses doubles the other and the maximum shear stress is τ_{max}, then what will be the major principal stress?
d) The state of stress at a point is given by σ_x= 6 MPa, σ_y = 4 MPa and τ_{xy}=−8 MPa, then find the maximum tensile stress (in MPa) at that point.
e) If the Poisson's ratio of an elastic material is 0.4, compute the ratio of modulus of elasticity to shear modulus.

f) A circular rod of length 'L' and area of cross-section 'A' has a modulus of elasticity 'E' and coefficient of thermal expansion 'α '. One end of the rod is fixed and other end is free. If the temperature of the rod is increased by ΔT, then what are the values of thermal stress and strain?

g) A steel bar 15mm in diameter is pulled axially by a force of 10 kN. If the bar is 250 mm long, determine the strain energy stored/unit volume of the bar.

h) A simply supported beam 3.6 m span carries uniformly distributed load of 3 kN/m run. Find the values of shear force at the supports.

i) Define shear force and bending moment.

j) A simply supported beam of span length 6 m and 75 mm diameter carries a uniformly distributed load of 1.5 kN/m. What is the maximum value of bending stress?

k) A hollow circular section has 80 mm external diameter 50 mm internal diameter. Find its section modulus.

PART – B

Answer any ***THREE*** questions. All questions carry equal marks.

3 x 16 = 48 M

2. a) A steel bar of 25 mm diameter acted upon by forces as shown in the Figure 1. Determine the total elongation of the bar. Take E= 190 GPa. Also calculate the stresses in each portion of the bar. 12 M

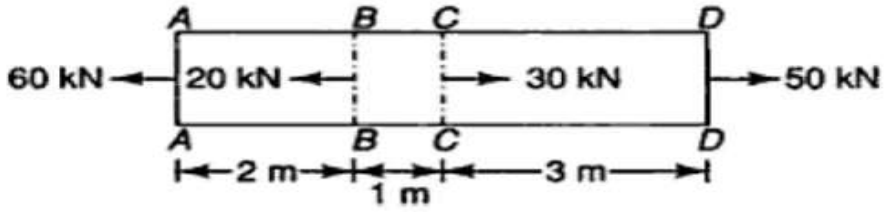

Figure 1

b) Find the modulus of steel rod, which tapers uniformly from 35 mm to 20 mm diameter in a length of 350 mm. The rod is subjected to a tensile load of 6 kN and extension of the rod is .0035 mm. 4 M

3. The principal stresses at a point across two mutually perpendicular planes are 140 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Use Mohr's circle method. Compute normal, tangential and resultant stress on an oblique plane inclined at an angle of 45^0 with the axis of major principal stress. Also calculate the obliquity. Check the answer analytically. 16 M

4. a) A bar of 30 mm diameter is tested in tension. It is observed that when a load of 50 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 and contraction in diameter is 0.0045 mm. Find the Poisson's ratio and elastic constants E, G and K. 8 M

b) A steel bar is 4 m long and its both ends are firmly fixed to two walls. The original temperature of the bar is 40^0C. If the bar is cooled to 25^0C, determine (i) change in

length (ii) thermal strain and (iii) thermal stress in the bar. Take E = $2x10^5$ N/mm^2 and linear expansion of the material $\alpha = 12x10^{-6}$ per ^{0}C. Also state the nature of stress setup. 8 M

5. Draw the shear force and bending moment diagrams for the simply supported beam as shown in Figure 2. Also calculate the maximum bending moment. 16 M

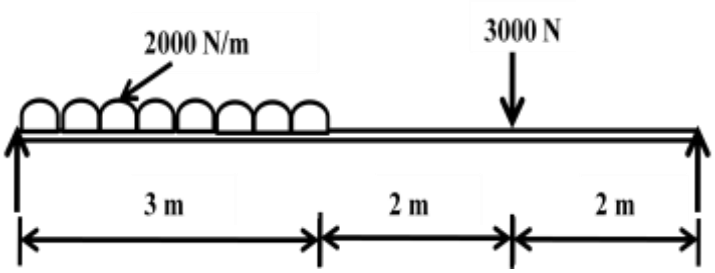

Figure 2

6. a) A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. Determine (i) average shear stress (ii) maximum shear stress and (iii) shear stress at a distance of 25 mm above the neutral axis. 8 M

b) A simply supported beam of a building having span of 5 m is subjected to UDL of 25 kN/m over entire span. Determine the maximum bending stresses induced if the cross sectional dimensions of the beam is 200 mm × 400mm. Take E = $2.1x10^5$ N/mm^2. 8 M