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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 19ME3DCSOM/15ME3DCSOM **Max Marks: 100**
Course: Strength of Materials **Date: 20.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) What do you mean by an isotropic, homogeneous, linear, elastic body? Define the different engineering constants associated with such materials. **08**

   b) Define true stress and true strain. Show engineering stress-strain curve and true stress-strain curve on a graph. **04**

   c) A 400 mm long bar has rectangular cross section 10 mm x 30 mm. This bar is subjected to; i) 15 kN tensile force on 10 mm x 30 mm faces, ii) 80 kN compressive force on 10 mm x 400 mm faces, and iii) 180 kN tensile force on 30 mm x 400 mm faces. Determine the change in volume if E= 200 GPa and v=0.3. **08**

OR

2. a) A steel rail is 12 m long and is laid at a temperature of 18°C. The maximum temperature expected is 40°C. **10**

   (i) Estimate the minimum gap between two rails to be left so that the temperature stresses do not develop.

   (ii) Calculate the temperature stresses developed in the rails, if:

   (ii-a) No expansion joint is provided.

   (ii-b) If a 1.5 mm gap is provided for expansion.

   (iii) If the stress developed is 20 N/mm^2, what is the gap provided between the rails? Take E = 2×10^5 N/mm^2 and $\alpha = 12 \times 10^{-6}$/°C.

   b) The stress system at a point in the strained material is shown in figure 2b. Find the normal and tangential stresses on the plane AC. Also find the principal stresses and maximum shear stress. Use Mohr's circle method. **10**

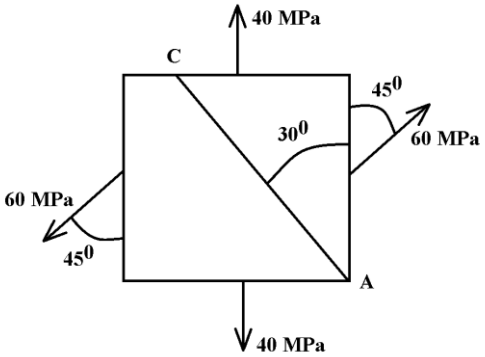

Figure 2b

UNIT - II

3. a) Draw SFD and BMD for a simply supported beam subjected to a uniformly distributed load of intensity w per unit length over the entire span L. What is the maximum value of shear force and bending moment? **08**

b) A cantilever beam of length 4m is subjected to loads as shown in figure 3b. Draw SFD and BMD (indicate the vaues in the diagram). Locate the point of contraflexure if any. Also find the reactions. **12**

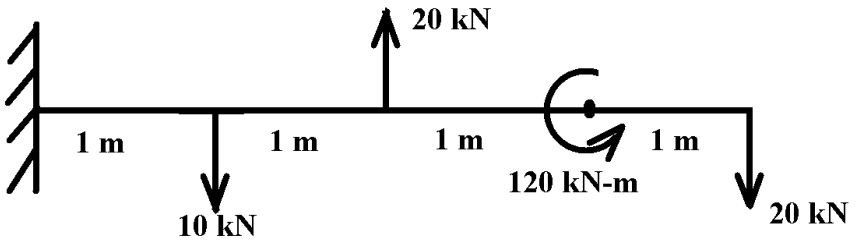

Figure 3b

UNIT - III

4. a) What is meant by pure bending? Explain with the example of simple four-point bending case. Write the assumptions made in simple bending. **06**

b) A circular pipe of external diameter 100 mm and internal diameter 80 mm is used as a simply supported beam. The span of the beam is 4 m. Find the safe concentrated load that the beam can carry at the midspan if the permissible stresses in the beam is 120 MPa. **06**

c) The section of a beam as shown in figure 4c is subjected to a hogging bending moment of magnitude 800 N-m. Determine the bending stresses induced at layers a-a, b-b and c-c. Draw the bending stress distribution across the section. **08**

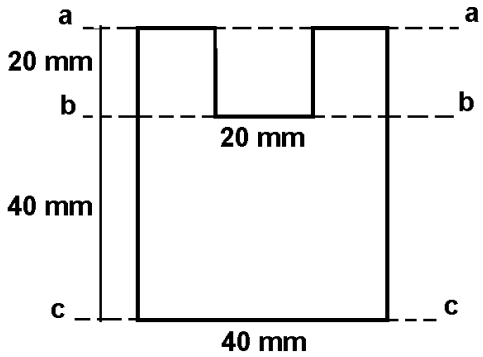

Figure 4c

OR

5. a) An I section beam has the following dimensions: Flanges 200 mm x 10 mm; Web 380 mm x 8 mm. The maximum shear stress developed in the beam is 20 MPa. Determine the shear force to which the beam is subjected. **08**

b) A simply supported beam of uniform cross section 6 m long is loaded at points 2 m from each end with load of 50 kN. Find the ratio of maximum deflection to the deflection at the point under one of the loads. Also calculate the slope at the supports. **12**

UNIT - IV

6. a) Derive the torsion equation; $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. Write the assumptions. **08**

b) A shaft transmits 280 kW of power at 160 rpm. Determine; **12**

i) The diameter of solid shaft to transmit the required power.

ii) The inner and outer diameters of a hollow circular shaft if the ratio of inner to the outer diameter is 0.6667.

iii) The percentage saving in material on using a hollow shaft instead of a solid shaft.

Take allowable shear stress as 80 MPa and density of material 78 kN/m^3

UNIT - V

7. a) For a tube having E=200 GPa and v=0.3, the hoop stress at the inner face is twice the internal pressure. Determine the wall thickness if the inner radius is 60 cm. **08**

b) Wall thickness of a cylindrical shell of 800 mm internal diameter and 2 m long is 10 mm. If the shell is subjected to an internal pressure of 1.5 MPa, determine the intensity of maximum shear stress induced. **04**

c) A 1.5 m long column has a circular cross section of 5 cm diameter. One of the ends of the column is fixed and the other end is free. Considering FOS of 3, determine the safe load using; **08**

i) Rankine's formula with $\sigma_c = 560MPa, \alpha = \frac{1}{1600}$

ii) Euler's formula with E=120 GPa

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