QP Code:CE2T01-3 **(Pages: 3)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Third Semester B.Tech. Degree (SAY) Examination, February, 2026

Course Code: B24CE2T01

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

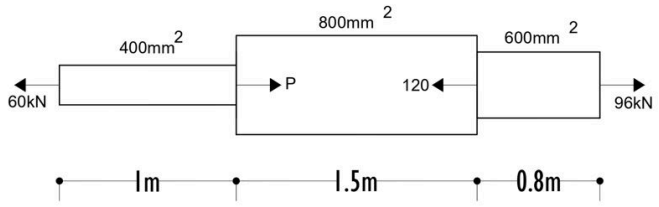
1. Define stress. How shear stress differ from direct stress?
2. What is meant by 'obliquity' in stress analysis, and how can it be determined?
3. Explain the concept of thermal stress in a simple bar fixed at both ends, and derive the expression for thermal stress due to temperature change.
4. Define strain energy and derive the expression for strain energy stored in a bar under axial loading in terms of stress and volume.
5. How does the intensity of load affect the shear force in a beam?
6. Explain how the point of contraflexure can be identified in a bending moment diagram.
7. Draw the shear stress distribution of a rectangular cross-section of width 'b' and depth '2b'. Also determine the maximum shear stress.
8. Derive an expression of section modulus for Circular section.
9. Explain why hollow shafts are preferred over solid shafts for power transmission.
10. Explain the significance of the critical load in slender columns.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module

Module 1

11. A non-prismatic steel bar ABCD of varying sections is subjected to the axial forces as shown in figure. Find the value of *P* necessary for equilibrium. If E = 2×10^5 N/mm^2, determine the total elongation of the bar.

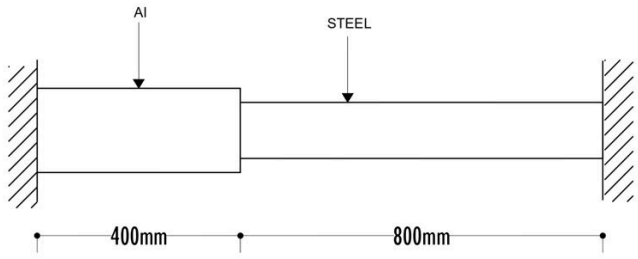


OR

12. At a point in a bracket, the stresses on two mutually perpendicular planes are 100 N/mm^2 (tensile) and 50 N/mm^2 (tensile). The shear stress across these planes is 25 N/mm^2. Determine, using Mohr's circle, the magnitude and direction of the resultant stress on a plane making an angle of 30° with the plane of the first stress. Find also, the normal and tangential stresses on this plane.

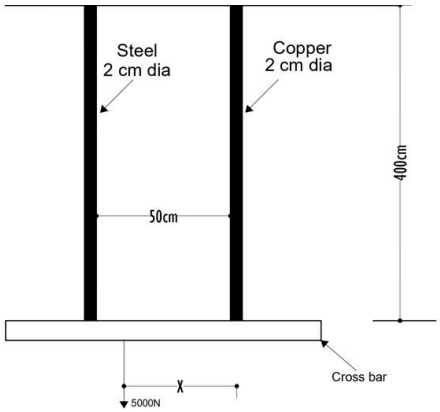
Module 2

13. A composite bar made up of aluminium and steel is rigidly attached to the end supports at 60°C as shown in figure. Find the stresses in the two portions of the bar when the temperature of the composite system falls to 20°C. E_s = 2 x 10^5 N/mm^2, E_a = 0.7 x 10^5 N/mm^2, α_s= 11.7 × 10^{-6}/°C, α_a=23.4 x 10^{-6}/°C, Cross-sectional areas, A_s = 250 mm^2 and A_a = 375 mm^2.



OR

14. Two vertical rods one of steel and other of copper are each rigidly fixed at the top and 50 cm apart as shown. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E for steel = 2 × 10^5 N/mm^2 and for copper = 1 x 10^5 N/mm^2.



Module 3

15. A cantilever beam of 3 m length has a concentrated load of 20 kN at 1.5 m and a UDL of 8 kN/m throughout. Calculate SF and BM at key points and draw the diagrams.

OR

16. A simply supported beam of 7 m length has point loads of 10 kN at 1 m, 15 kN at 3 m, and 20 kN at 5 m from the left, plus a UDL of 3 kN/m over the last 2 m. Determine the reactions and draw the SFD and BMD.

Module 4

17. A I-section has flanges of size 200 x 12 mm and its overall depth is 360 mm. Thickness of web is also 12 mm. It is used as a simply supported beam over a span of 4 m to carry a load of 60 kN/m over its entire span. Draw the variation of bending and shearing stresses across the depth.

OR

18. (a) Derive the expression for shearing stress in a beam section stating the assumptions made. (6 marks)

(b) A rectangular beam 100 mm wide and 250mm 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 marks)

Module 5

19. A solid circular shaft of diameter 80 mm and length 2 m (G = 80 GPa) is subjected to a torque of 12 kN·m. Analyze the maximum shear stress developed in the shaft, calculate the angle of twist, and determine the strain energy stored. Compare the strain energy with that of a hollow shaft of the same outer diameter and inner diameter of 50 mm under the same torque.

OR

20. A short column of rectangular cross section 80 mm x 60 mm carries a load of 40 kN at a point 20 mm from the longer side and 35 mm from the shorter side. Determine the maximum compressive and tensile stresses in the section.

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