

S 9074

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Second Semester

Mechatronics Engineering

CE 251 — STRENGTH OF MATERIALS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the relation between (a) Young's modulus and Shear modulus (b) Young's modulus and bulk modulus.
2. Find the minimum diameter of steel wire to carry a tensile load of 4 kN if the stress in the wire is not to exceed 95 N/mm².
3. What is the maximum bending moment in a simply supported beam of span 4 m carrying a point load of 10 kN at midspan.
4. Draw the shear stress distribution across the rectangular cross section and I-section.
5. Define the stiffness of a helical spring.
6. Write the expressions for principal stresses in terms of normal and shear stresses.
7. Draw the Mohr's circle for the $p_x = 0$, $p_y = 0$, $q = 10$ N/mm².
8. State the methods of finding deflection of beams.
9. State Castigliano's theorem to find the deflection of a beam.
10. What is the strain energy stored in a cantilever beam of span L and carrying a point load P at free end. $EI = \text{constant}$.

PART B — (5 × 16 = 80 marks)

11. (a) A bar 30 mm × 30 mm × 250 mm was subjected to a pull of 90 kN in the direction of its length. The extension of the bar was found to be 0.125 mm, while decrease in each lateral dimension was found to be 0.00375 mm. Find the Young's modulus, shear modulus, bulk modulus and Poisson's ratio.

Or

- (b) A steel rod of 30 mm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if
- the ends do not yield
 - the ends yield by 1.2 mm

Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $\alpha = 12 \times 10^{-6} / ^\circ\text{C}$.

12. (a) Draw the shear force and bending moment diagrams for the beam shown in Fig. Q 12 (a)

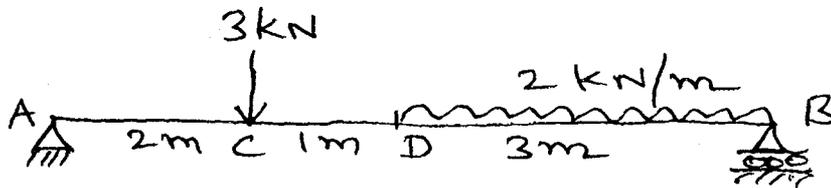


Fig. Q. 12 (a)

Or

- (b) A Timber beam 150 mm wide and 300 mm deep is simply supported over a span of 4 m. Find the maximum uniformly distributed load that the beam can carry if the bending stress is not to exceed 8 N/mm².
13. (a) A shaft is transmitting 100 kW at 180 rpm. If the allowable shear stress in the metal is 60 N/mm² and the twist in the shaft is not to exceed 1° in a length of 3 m determine the diameter of the shaft. $G = 80 \text{ kN/mm}^2$.

Or

- (b) A cylindrical shell 3 m long which is closed at the ends has an internal diameter of 800 mm and wall thickness of 10 mm. The internal pressure is 2.5 N/mm². Calculate the change in dimensions and volume. $E = 2 \times 10^5$ N/mm², Poisson's ratio = 0.25.
14. (a) The normal and shear stresses acting on the two planes AB and BC are shown in Fig. Q 14 (a). Determine the principal planes and principal stresses. Also determine the maximum shear stress

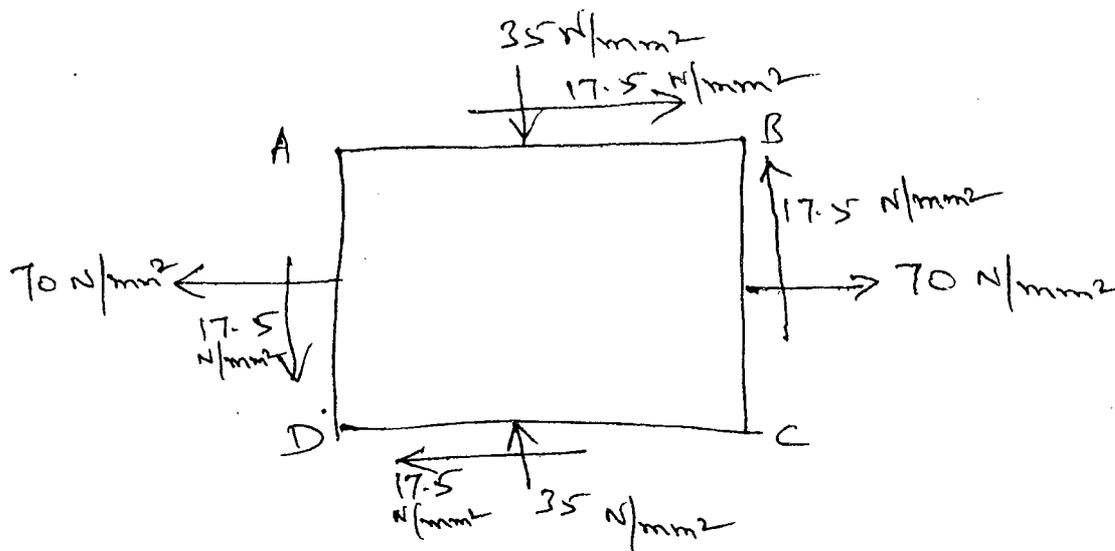


Fig. Q 14 (a)

Or

- (b) Find the deflection under the loads for the beam shown in Fig. Q 14 (b). Use Macaulay's method. $EI = 170 \times 10^{-4}$ m⁴.

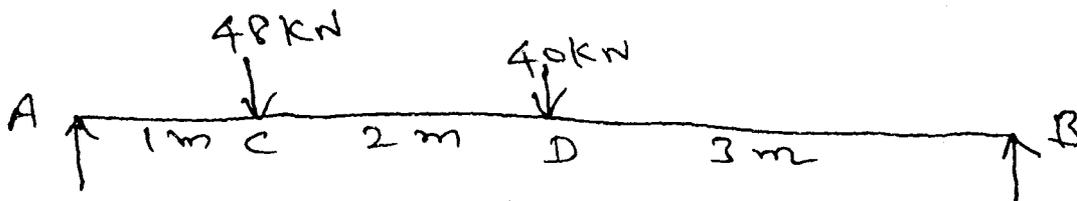


Fig. Q. 14 (b)

15. (a) Find the deflection at C and D by conjugate beam method for the beam shown in Fig. Q 15 (a). $EI = 2 \times 10^{13} \text{ N mm}^2$

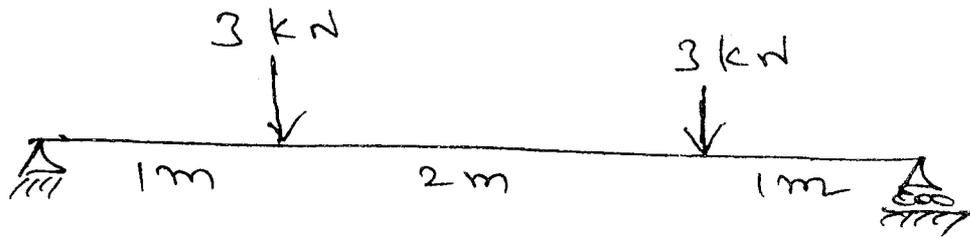


Fig. Q 15 (a)

Or

- (b) Find the deflection at free end of the cantilever beam of span 4 m and carrying a point load of 10 kN at midspan. $EI = 60000 \text{ kNm}^2$. Use principle of virtual work method.