



Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define the following :
i) Stress ii) Strain iii) Poisson's ratio iv) Volumetric strain v) Bulk modulus. (05 Marks)
- b. Explain with a neat sketch, stress strain curve for mild steel material. (05 Marks)
- c. Find the extension of the bar as shown in Fig Q1(c) under an axial load of 20 kN. Take $E = 200$ GPa.

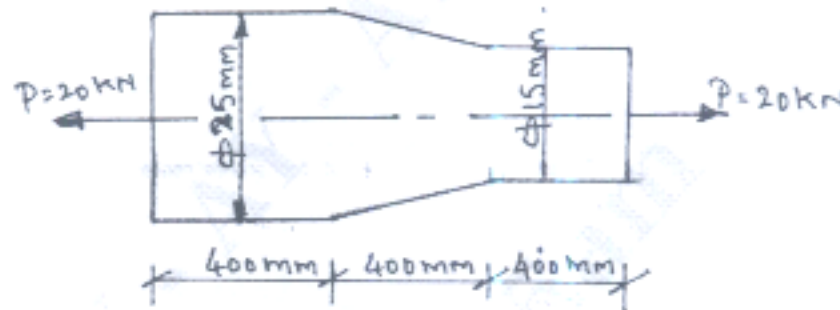


Fig Q1(c)

(10 Marks)

OR

- 2 a. Establish the relationship Young's Modulus and Modulus of Rigidity. (10 Marks)
- b. A weight of 300 kN is supported by a sharp concrete column of 250 mm square section. Column is reinforced with 4 steel bars of cross sectional area 5500 mm^2 . Find the stresses in steel and concrete. If $m = 15$. If stress in concrete must not exceed 4.5 MPa. What area of steel is required in order that the column may support a load of 500 kN? (10 Marks)

Module-2

- 3 a. Define Principal stress and Principal plane. (05 Marks)
- b. Prove that the sum of any two orthogonal components of stresses at a point is constant. (05 Marks)
- c. A point in the machine member is subjected to shear stress of magnitude 60 MPa. Determine :
i) Principal stresses and its orientation
ii) Max. shear stress and its direction
iii) Stresses acting on a plane which is at an angle of 40° with respect to vertical plane (10 Marks)

OR

- 4 An element with the stresses acting on it as shown in Fig Q4. Determine principle stresses and its direction, max shear stress and its direction and normal stress and shear stress acting on a plane whose normal is at an angle of 120° with respect to x-axis.

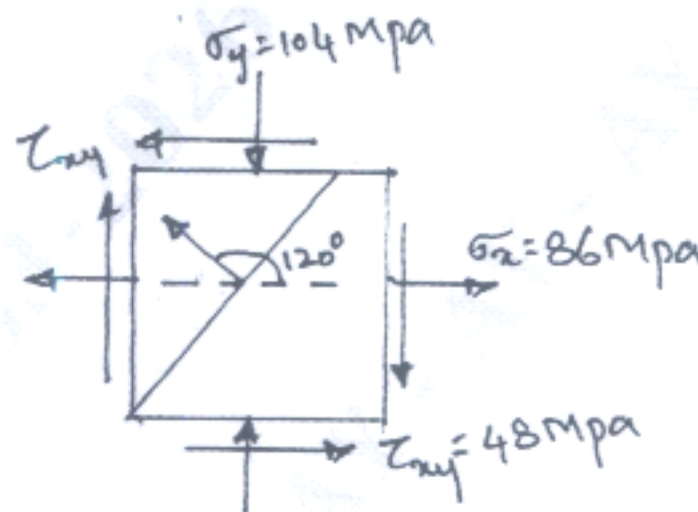


Fig Q4

Also, solve the problem using Mohr's Circle Method.

(20 Marks)

Module-3

- 5 Draw the SFD and BMD for the beam shown in Fig Q5. Locate point of contraflexure if any

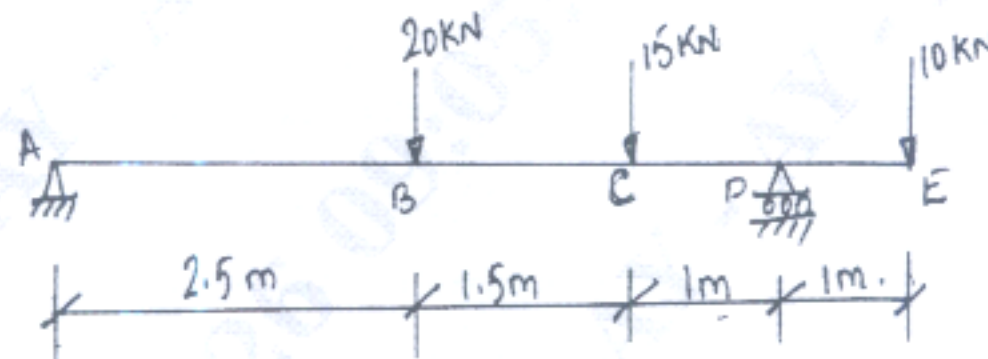


Fig Q5

(20 Marks)

OR

- 6 a. Derive the equation $\frac{M}{I} = \frac{\sigma_b}{Y} = \frac{E}{R}$ with usual notations. State the assumption in the derivation. (10 Marks)
- b. A circular bar of 120 mm diameter is used as a beam of span 4 m simply supported ends. It is subjected to a central concentrated load of 20 kN. Find the value of maximum bending stress induced and draw the bending stress diagram. (10 Marks)

Module-4

- 7 a. Derive an expression $EI \frac{d^2y}{dx^2} = M_x$, with usual notations. (10 Marks)
- b. For the loaded cantilever beam shown in Fig Q7(b). Determine Max. slope and Max. deflection. Take $E = 200 \text{ GPa}$. Cross section of the beam is hollow with external diameter 150 mm and thickness of metal 10 mm? Take $W = 4000 \text{ N}$.

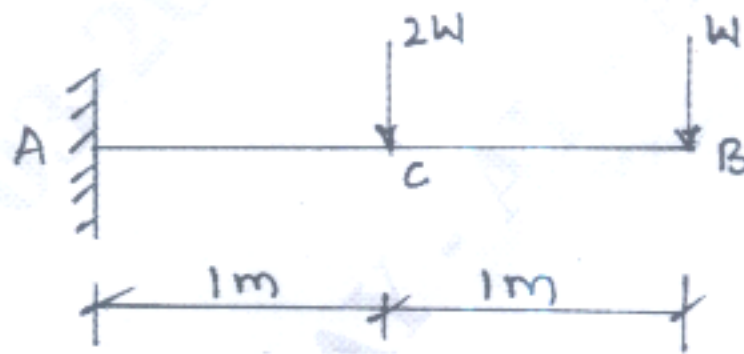


Fig 7(b)

(10 Marks)

OR

- 8 a. With usual notation derive torsion equation. (10 Marks)
- b. A solid shaft rotating at 500 rpm transmit 30 kW. Maximum torque is 20% more than the mean torque. Material of the shaft has allowable shear stress of 65 Mpa and modulus of rigidity 81 GPa. Angle of twist in the shaft should not exceed 1° in 1m length. Determine the diameter of shaft. (10 Marks)

Module-5

- 9 a. Derive an expression for Euler's long column for both ends hinged condition. (10 Marks)
- b. A hollow circular column is used to carry an automobile of mass 2000 Kg through a height of 3m. Material of the column has an yield stress of 330 MPa. Outer diameter of the column is 100 mm and thickness of wall is 5 mm. One end of the column is fixed and other end is free. Take $E = 200 \text{ GPa}$. Determine :
- Factor of safety
 - Ratio of crushing stress to yield point to crippling stress

(10 Marks)

OR

- 10 a. What is Strain Energy? Obtain an expression for strain energy due to shear stress. (10 Marks)
- b. Obtain Lames equation for thick cylinder subjected to internal pressure with usual notations. (10 Marks)
