

# CBCS SCHEME

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18MN34

## Third Semester B.E. Degree Examination, Feb./Mar. 2022 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. Explain stress strain diagram for mild steel with salient features. (08 Marks)  
b. The following data refers to a mild steel specimen tested in laboratory.

Diameter of specimen	= 25 mm
Gauge length of specimen	= 200mm
Extension under a load of 20kN	= 0.04mm
Load at yield point	= 150kN
Maximum load	= 225 kN
Length of specimen after failure	= 275 mm
Neck diameter	= 18.25mm

Determine :

- Young's modulus
- Yield stress
- Ultimate stress
- Percentage elongation
- Percentage reduction in area
- Safe stress adopting a factor of safety 2.5.

(12 Marks)

OR

- 2 a. Derive an expression for stress and total elongation in a uniformly tapering circular bar subjected to an axial load P. (10 Marks)  
b. A brass bar having cross-sectional area  $300\text{mm}^2$  is subjected to axial forces as shown in Fig.Q2(b). Find the total elongation of the bar.  $E = 84\text{ GPa}$ .

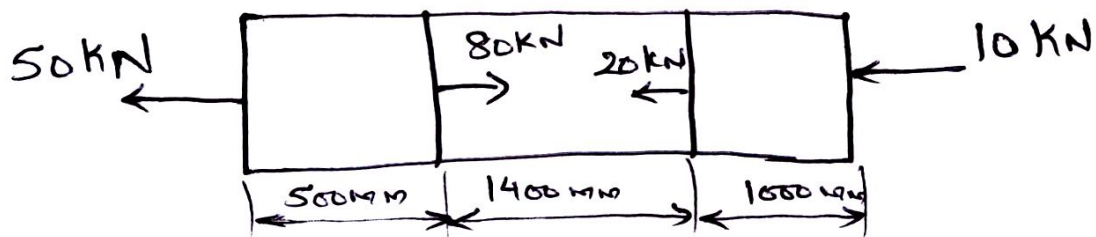


Fig.Q2(b)

(10 Marks)

**Module-2**

- 3 a. The state of stress at a point in a strained material is shown in Fig.Q3(a). Determine :
- Direction of principal planes
  - Magnitude of principal stress
  - Magnitude of maximum shear stress and its direction
  - Normal stress on maximum shear stress plane
  - Verify the answers by Mohr's circle method.

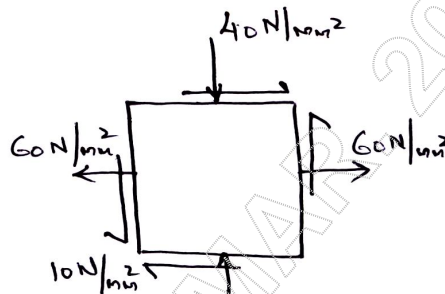


Fig.Q3(a)

(12 Marks)

- b. Establish relationship between the modulus of elasticity, modulus of rigidity and Bulk modulus. (08 Marks)

**OR**

- 4 a. Derive an expression for circumferential stress and longitudinal stress subjected to a pressure in a thin cylinder. (10 Marks)
- b. Calculate the maximum external to internal radius ratio for a thick cylinder with internal fluid pressure of 15MPa and maximum hoop stress is 60MPa. (10 Marks)

**Module-3**

- 5 a. Explain different types of Beam with sketch. (10 Marks)
- b. Draw the shear free and bending moment diagrams for a cantilever of length L carrying a point load W at the free end. (10 Marks)

**OR**

- 6 a. A simply supported beam of span 6m is subjected to a concentrated load of 25 kN acting at a distance of 2m from the left end. Also subjected to an uniformly distributed load of 10kN/m over the entire span. Draw the bending moment and shear force diagram. Indicating the maximum and minimum values. (10 Marks)
- b. Draw the shear force and bending moment diagram for the beam shown in Fig.Q6(b). Also calculate the maximum bending moment.

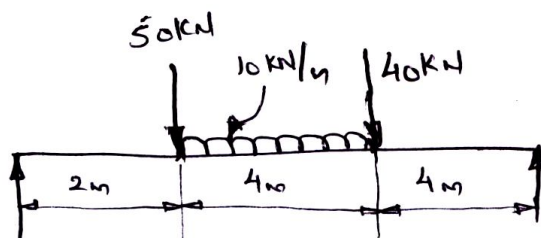


Fig.Q6(b)

(10 Marks)

**Module-4**

- 7 a. Prove that  $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$  with usual notation. (10 Marks)
- b. Determine the maximum tensile stress  $\sigma_t$  and maximum compressive stress  $\sigma_c$  due to the load  $P$  acting on the simple beam AB as shown in Fig.Q7(b). Find the value of  $b$  for which tensile and compressive stress will be largest. What are these values?

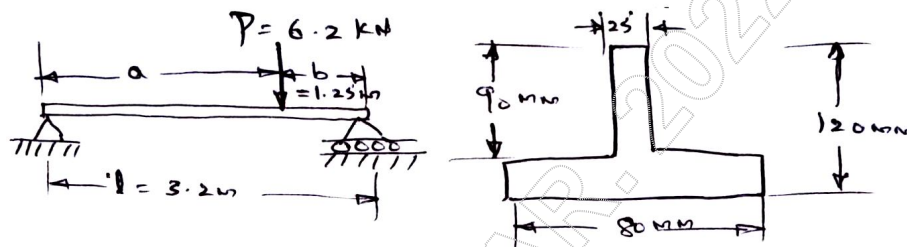


Fig.Q7(b)

(10 Marks)

OR

- 8 a. Derive expression  $EI \cdot \frac{d^2y}{dx^2} = m$  with usual notation. (10 Marks)
- b. A cantilever is subjected to the free as shown in Fig.Q8(b). Determine the deflection at the free end, taking  $E = 210 \text{ GPa}$  and  $I = 20 \times 10^{-4} \text{ m}^4$ .

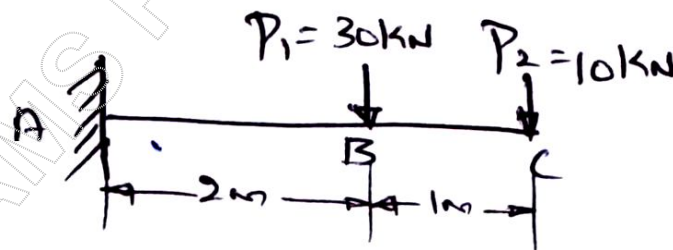


Fig.Q8(b)

(10 Marks)

**Module-5**

- 9 a. Derive torsional equation with usual notation. (10 Marks)
- b. A solid circular shaft is required to transmit 100KW at 180rpm. The permissible shear stress in the shaft is  $60 \text{ N/mm}^2$ . Find suitable diameter of the shaft. If the angle of twist is not to exceed  $1^\circ$  in a length of 3 meter. The value of modulus of rigidity is  $0.8 \times 10^5 \text{ N/mm}^2$ . (10 Marks)

OR

- 10 a. State assumptions made in Euler's column theory. (08 Marks)
- b. What is the limitation of Euler's theory? (06 Marks)
- c. Derive an expression for Euler's crippling load for a column when both ends are fixed. (06 Marks)

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