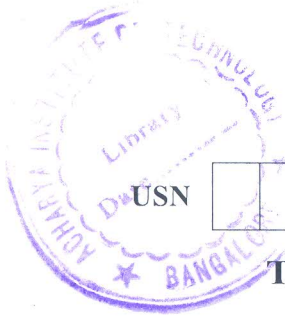


CBCS SCHEME



17ME34

Third Semester B.E. Degree Examination, July/August 2021

Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

- 1 a. Define the following:

(i) Elasticity	(ii) Ductility	(iii) Poisson's ratio
(iv) Shear stress	(v) Hooks law	

(10 Marks)
- b. Derive an expression for the extension of a tapering bar whose diameter D_1 at one end tapers linearly to a diameter D_2 in a length L , under an-axial pull 'P' and Young's modulus E .
(06 Marks)
- c. A bar having cross-sectional area 300 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar. Take $E = 84 \text{ GPa}$.

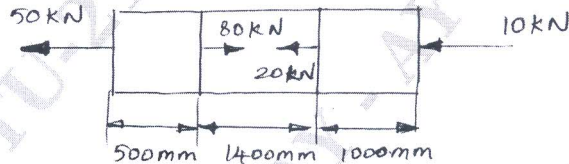


Fig.Q1(c)

(04 Marks)

- 2 a. Derive a relation between Young's modulus and Modulus of rigidity. (10 Marks)
- b. A copper bar of length 160 mm is placed on a rigid support in vertical position. Clearance between the upper support and top surface of the member is 0.1 mm as shown in the Fig.Q2(b). Determine:
 - (i) Increase in temperature required for the bar to touch the upper support.
 - (ii) Temperature rise required to induced compressive stress of 100 MPa.
 - (iii) Stress induced in the bar when its temperature is increased by 90°C and the upper support yields by 0.12 mm.
 - (iv) Stress induced in the bar when the temperature is increased by 30°C , assume that there is no clearance between upper support and top surface of the bar. Take $E_c = 120 \text{ GPa}$ and $\alpha_c = 18 \times 10^{-6}/^\circ\text{C}$.

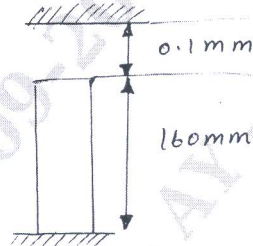


Fig.Q2(b)

(10 Marks)

- 3 a. Derive an expression for normal stress and shear stress acting on a inclined plane. (10 Marks)
- b. A point in a strained member is subjected to tensile stresses 100 MPa and 70 MPa along two mutually perpendicular directions. The point is also subjected to a shear stress 50 MPa such that shear force on vertical face give rise to anticlockwise couple. Determine:
 - (i) Stresses acting on a plane whose normal is at an angle of 120° with the reference to the 100 MPa stress plane.
 - (ii) Magnitude of principal stresses and maximum shear stresses
 - (iii) Orientations of the principal plane and maximum and minimum shear stress planes. Solve the problem using Mohr's circle method. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- 4 a. Derive an expression for Hoop stress and longitudinal stress for thin cylinder. (08 Marks)
 b. A thin cylindrical vessel of 1000 mm diameter and 3000 mm length has a metal wall of thickness 10 mm. It is subjected to an internal fluid pressure of 3 N/mm^2 . Find the circumferential and longitudinal stresses in the wall. Determine the change in the length, diameter and volume of the cylinder. Assume $E = 2.1 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.3. (12 Marks)
- 5 For the beam shown in the Fig.Q5, draw shear force and bending moment diagrams. Locate the point of contraflexure, if any.

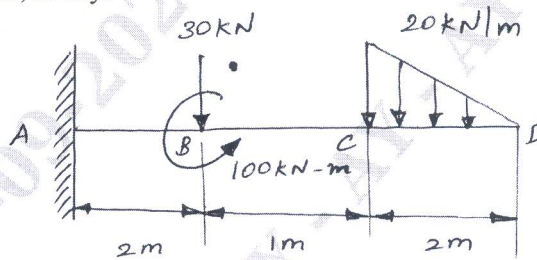


Fig.Q5

(20 Marks)

- 6 a. Derive the deflection equation, $EI \frac{d^2y}{dx^2} = M$. (06 Marks)
 b. A T section of flange $120 \times 12 \text{ mm}$ and overall depth is 200 mm with 12 mm web thickness is loaded, such that, at a section it has a moment of 20 kN-m and shear force of 120 kN. Sketch the bending and shear force distribution diagram. (14 Marks)
- 7 a. Derive an expression for torque and shear stress of a shaft. (08 Marks)
 b. A 2m long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When the torsional load on the shaft is 6 kN-m, determine:
 (i) Maximum shear stress induced
 (ii) Angle of twist
 (iii) Also draw the distribution of shear stress in the wall of the shaft. Take $G = 80 \text{ GPa}$. (12 Marks)
- 8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. (10 Marks)
 b. A 2m long column has a square cross-section of side 40 mm. Taking FOS = 4. Determine the safe load for the end conditions.
 (i) Both ends are hinged
 (ii) One end fixed and other end is free
 (iii) Both ends are fixed.
 Take $E = 210 \text{ GPa}$. (10 Marks)
- 9 a. Derive an expression for strain energy due to shear stresses. (10 Marks)
 b. Explain:
 (i) Maximum principal stress theory
 (ii) Maximum shear stress theory (10 Marks)
- 10 a. Derive an expression for the strain energy in bending and strain energy in torsion. (16 Marks)
 b. A solid circular shaft is 4 m long has a diameter of 80 mm. Find the torsional strain energy stored in it when it is subjected to a torque of 200 N-m. Take $G = 80 \text{ GPa}$. (04 Marks)
