CBCS SCHEME

USN | | | | | | | | | | 18MT33

Third Semester B.E. Degree Examination, June/July 2025
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) Hook's Law
ii) Poisson's ratio
iii) Young's Modulus
iv) Principle of Super Position. **(04 Marks)**

b. Derive an Expression for deformation of Uniformly Tapering Circular bar. **(08 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in Fig.Q.1(c). Determine the magnitude of force P, such that net deformation in the bar does not exceed 1mm. E for steel is 200GPa and that of aluminium is 70GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. **(08 Marks)**

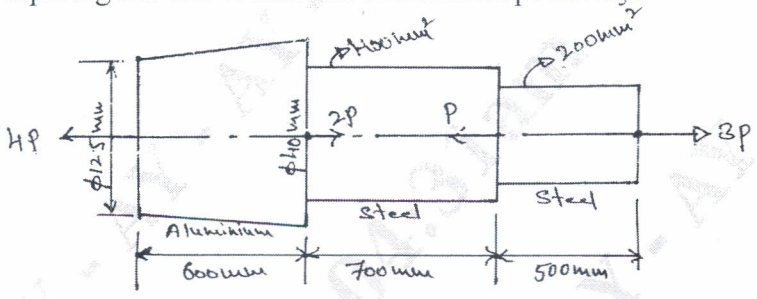

Fig. Q1(c)

OR

2 a. Derive an expression for relation between E, G and μ as $E = 2G(1 + \mu)$. **(08 Marks)**

b. Define Elastic constants. **(04 Marks)**

c. A steel rod of cross-sectional area 1600mm^2 and two brass rods each of cross-sectional area of 1000mm^2 together support a load of 50kN as shown in Fig.Q.2(c). Find the stresses in the rods. E for steel = 2×10^5 N/mm^2, E for brass = 1×10^5 N/mm^2. **(08 Marks)**

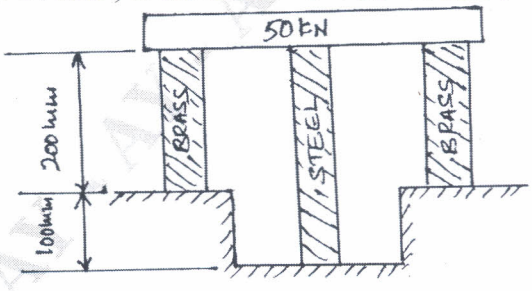

Fig. Q2(c)

Module-2

3 a. An element of unit thickness is subjected to the mutually perpendicular stresses δx and δy and shear stress τxy as shown in Fig Q3(a). Determine equation for normal stress on arbitrary plane and shear stress an arbitrary plane. **(10 Marks)**

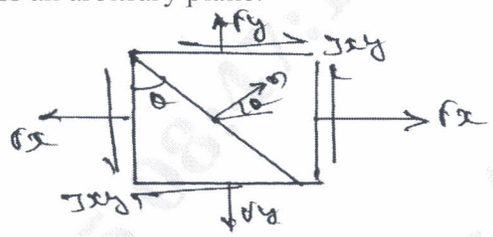

Fig. Q3(a)

b. An element is subjected to stresses as shown in Fig Q3(b). Determine :
   i) Principal stress and their directions
   ii) Normal and tangential stress on plane AC. **(10 Marks)**

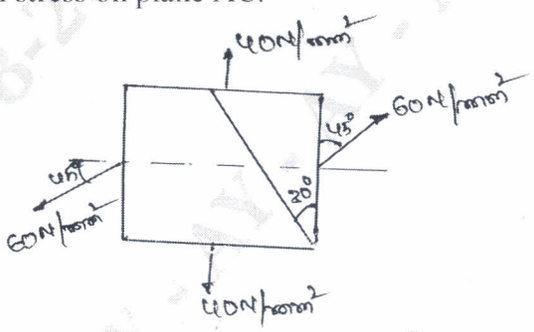

Fig. Q3(b)

OR

4 The state of stress at a point in a stained material is shown in Fig Q4. Determine :
   i) Direction of principal planes
   ii) Magnitude of principal stresses
   iii) Magnitude of maximum shear stress and its direction
   iv) Normal stress on maximum shear stress plane
   v) Verify the answers by Mohr's circle method. **(20 Marks)**

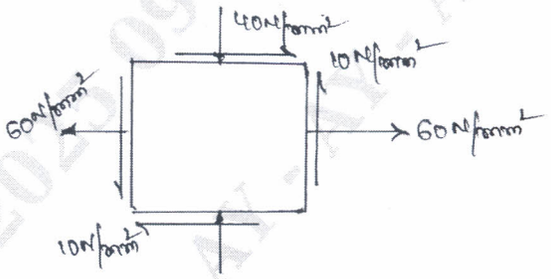

Fig. Q4

Module-3

5 a. Explain Sagging and Hagging moment. **(06 Marks)**

b. Draw the shear force and bending moment diagram for a simply supported beam subjected to the loads as shown in Fig.Q.5(b) also find the location of point of contraflexure. **(14 Marks)**

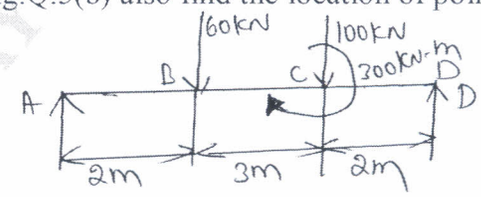

Fig. Q5(b)

OR

6 a. Define Beam. Explain the types of beams. **(06 Marks)**

b. Draw the shear force and bending moment diagram for the beam shown in Fig.Q.6(b). Find the location of point of contraflexture and magnitude of maximum bending moment. **(14 Marks)**

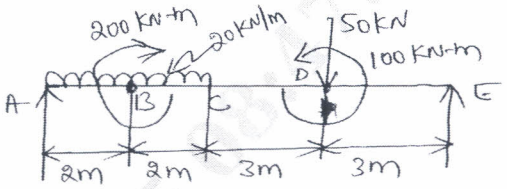

Fig. Q6(b)

Module-4

7 a. With assumptions derive bending moment equation $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$. **(10 Marks)**

b. An 'I' section has flanges of width 'b' and over all depth 2b. The flanges and the web are of uniform thickness t. Find the ratio of maximum shear stress intensity to the mean shear stress intensity. **(10 Marks)**

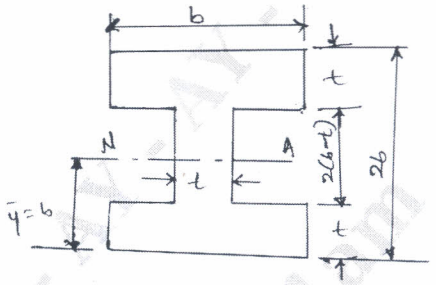

Fig. Q7(b)

OR

8 a. Derive Euler Bernouli equation for deflection. **(10 Marks)**

b. Derive an expression for maximum deflection in a cantilever beam subjected to a point load at free end. **(10 Marks)**

Module-5

9 a. Write the assumptions and derive the expression for torsion of equation for a circular shaft. **(10 Marks)**

b. A solid circular shaft has to transmit power of 1000kW at 120rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed 80N/mm^2. The maximum torque is 1.25 times of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hallow one whose internal diameter is 0.6 times of its external diameter, the length, material and maximum shear stress are being same. **(10 Marks)**

OR

10 a. Derive an equation for critical load of column one end is free and other end is fixed and subjected to buckling load "P". **(10 Marks)**

b. A hallow column (circular) is used to carry an automobile of mass 2000kg through a height of 3m. Material of column has yield stress of 300 MPa. Outer diameter of column is 100mm and thickness of the wall is 5mm. One end of the column is fixed and other end is free. Taking E = 200GPa, determine : i) FOS ii) Ratio of crushing stress at yield point to crippling stress. **(10 Marks)**

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