CBCS SCHEME

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17MN34

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. Explain any five mechanical properties of materials. **(10 Marks)**

b. The tensile test was conducted on a mild steel bar. The following data was obtained from the test.

Diameter of steel bar = 16 mm
Load at proportionality limit = 72 kN
Load at failure = 80 kN
Diameter of rod at failure = 12 mm
Extension at a load of 60 kN = 0.115 mm
Gauge length of bar = 80 mm
Final gauge length of bar = 104 mm
Determine: (i) Young's modulus (ii) Proportionality limit
(iii) True breaking stress (iv) Percentage elongation **(10 Marks)**

2 a. Derive an expression for extension of uniformly tapering rectangular bar subjected to axial load P. **(10 Marks)**

b. Determine the magnitude of the load P necessary to produce zero net change in the length of the straight bar shown in Fig.Q2(b). Take area = 400 mm^2.

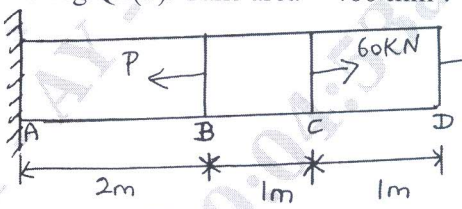

Fig.Q2(b) **(10 Marks)**

3 a. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(10 Marks)**

b. A plane element is subject to stresses as shown in Fig.Q3(b). Determine principal stresses, maximum shear stress, their planes and normal stress on maximum shear plane.

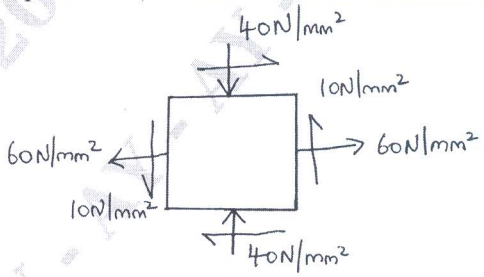

Fig.Q3(b) **(10 Marks)**

4 a. Derive an expression for circumferential stress and longitudinal stress subjected to internal pressure in a thin cylinder. **(10 Marks)**

b. A 1.2 m long thin cylindrical pressure vessel of 500 mm inner diameter and 14 mm wall thickness undergoes a volume change of 5×10^4 mm^3, when it s subjected to an internal pressure p. Taking E = 210 GPa and Poisson's ratio = 0.3. Determine: (i) Internal pressure (ii) Hoop stress. **(10 Marks)**

5 a. Define shear force and bending moment. **(04 Marks)**

b. Draw shear force and bending moment diagrams for the beam shown in Fig.Q5(b). Locate point of contra flexure.

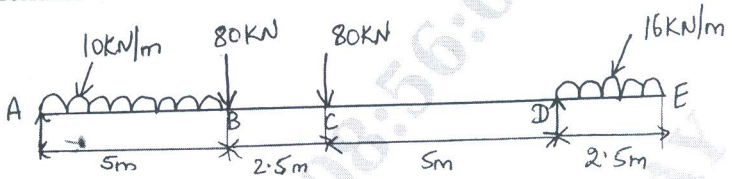

Fig.Q5(b) **(16 Marks)**

6 Draw SFD and BMD for the beam shown in Fig.Q6. Locate maximum bending moment and point of contraflexure.

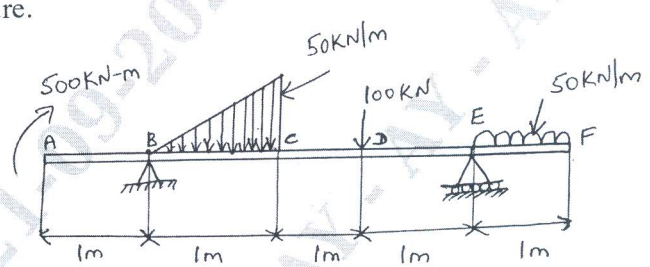

Fig.Q6 **(20 Marks)**

7 a. Derive an expression for shear stress distribution across a rectangular section. **(10 Marks)**

b. A simply supported beam carrying udl of w KN/m is subjected to a maximum bending stress of 45 MPa and maximum shear stress of 4.5 MPa. The beam has rectangular cross-section of width 50 mm and depth 100 mm. Determine:

(i) Length of beam

(ii) Maximum intensity of uniformly distributed load it can carry. **(10 Marks)**

8 a. Derive the deflection equation for the beam in the standard form $EI\frac{d^2y}{dx^2} = M$. **(10 Marks)**

b. A beam of length 5 m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9 kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is 7 N/mm^2 and central deflection is not to exceed 1 cm. Take E for beam material as 1×10^4 N/mm^2. **(10 Marks)**

9 a. Derive torsional equation with usual notations. **(10 Marks)**

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

10 a. Derive an expression for Euler's buckling load for a column when both ends are fixed. **(10 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor safety as 3, calculate the safe load using:

(i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = \frac{1}{1600}$.

(ii) Euler's formula, taking $E = 1.2 \times 10^5$ N/mm^2 **(10 Marks)**

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