CBCS SCHEME

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15MN34

Third Semester B.E. Degree Examination, July/August 2022
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the terms: elasticity, elastic limit, Young's modulus and modulus of rigidity. **(04 Marks)**

b. Find an expression for the total elongation of a uniformly tapering rectangular bar when it is subjected to an axial load 'P' **(12 Marks)**

OR

2 a. An axial pull of 35 kN is acting on a bar consisting of three lengths as shown in Fig.Q2(a). If a Young's modulus = 2.1×10^5 N/mm^2, determine:
(i) Stresses in each section (ii) Total extension of the bar.

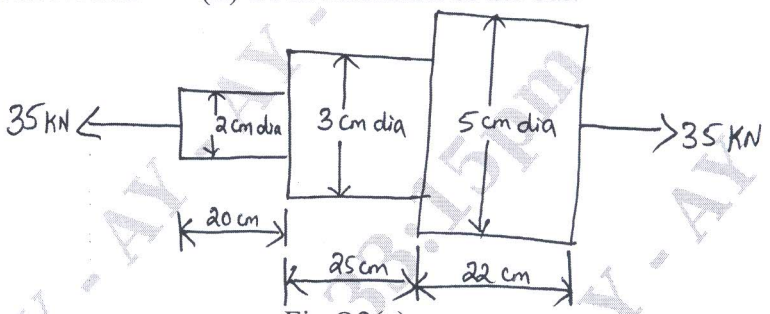

Fig.Q2(a) **(12 Marks)**

b. What is the procedure of finding thermal stresses in a composite bar? **(04 Marks)**

Module-2

3 a. Calculate the change in diameter, change in length and change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5m long when subjected to internal pressure of 3 N/mm^2. Take the value of $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio, $\mu = 0.3$. **(12 Marks)**

b. Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is 1.2×10^5 N/mm^2 and modulus of rigidity is 4.8×10^4 N/mm^2. **(04 Marks)**

OR

4 An element is subjected to the stresses shown in Fig.Q4. Using the Mohr's circle, determine:
a. Maximum and minimum stresses and orientations of their planes. **(12 Marks)**
b. Stress acting on a plane whose normal is at an angle of 35° with respect to x-axis. **(04 Marks)**

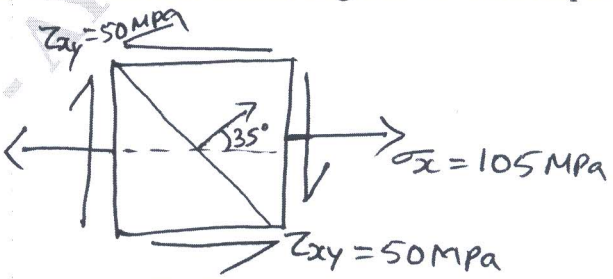

Fig.Q4

Module-3

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

b. Draw the S.F and B.M diagrams for a cantilever of length L carrying a uniformly distributed load of ω per m length over its entire length. **(12 Marks)**

OR

6 Draw the S.F. and B.M. diagrams for the beam which is loaded as shown in Fig.Q6. Determine the points of contraflexure within the span AB.

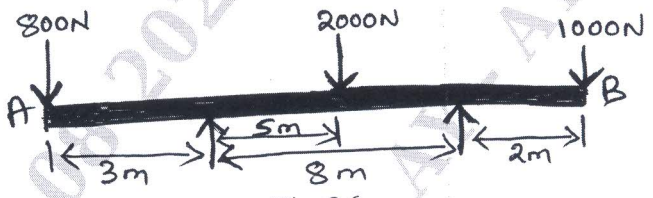

Fig.Q6 **(16 Marks)**

Module-4

7 a. A beam of uniform rectangular section 200 mm wide and 300 mm deep is simply supported at its ends. It carries a uniformly distributed load of 9 kN/m run over the entire span of 5m. If the value of E for the beam material is 1×10^4 N/mm^2. Find the slope at the supports and maximum deflection. **(08 Marks)**

b. Prove that relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ **(08 Marks)**

OR

8 a. A circular beam of 100 mm diameter is subjected to a shear force of 5 kN. Calculate average shear stress, maximum shear stress and shear stress at a distance of 40 mm from N.A. **(08 Marks)**

b. Derive an expression for the slope and deflection of a cantilever of length L, carrying a point load W at the free end by double integration method. **(08 Marks)**

Module-5

9 Derive the relation for a circular shaft when subjected to torsion as given below:

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$$ **(16 Marks)**

OR

10 A 2 meters long column has a square cross-section of side 40 mm. Taking the FOS as 4, determine the safe load for the end conditions:

(i) Both ends are hinged.
(ii) One end is fixed and other end is free.
(iii) Both ends are fixed.
(iv) One end is fixed and other end is hinged.

Take E = 210 GPa. **(16 Marks)**

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