CBCS SCHEME

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18MT33

Third Semester B.E. Degree Examination, July/August 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. Derive an expression for the extension of a tapering bar whose diameter d, at one end tapers linearly to a diameter d_2 at the other end in a length L, under an axial pull P and the elastic modulus of its material is E. **(10 Marks)**

b. A round bar with stepped portion is subjected to the forces as shown in Fig.Q1(b). Determine the magnitude of force P, such that net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa and that of aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40 mm and 12.5 mm respectively.

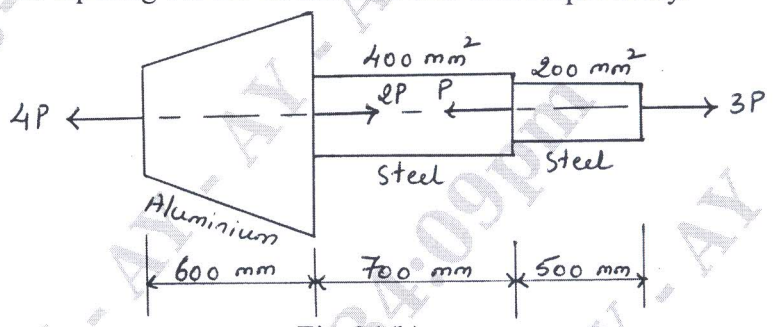

Fig.Q1(b) **(10 Marks)**

OR

2 a. Explain volumetric strain and obtain the expression for volumetric strain for a circular bar. **(10 Marks)**

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

Module-2

3 a. Derive an equation for normal and shear stresses on an inclined plane in a member subjected to general two dimensional stress system. **(12 Marks)**

b. A short cast iron pillar of 625 mm^2 cross-section carries an axial compressive load of 100 kN. Calculate normal and shear stress on a plane inclined at 30° to the axis of the pillar as shown in Fig.Q3(b).

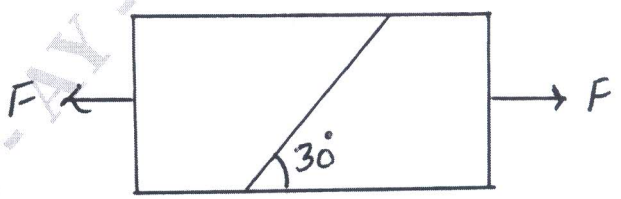

Fig.Q3(b) **(08 Marks)**

OR

4 At a certain point in a strained material the stress condition shown in Fig.Q4 exists. Find:
(i) Normal and shear stress on the inclined plane AB
(ii) Principal stresses and principal planes
(iii) Maximum shear stresses and their planes

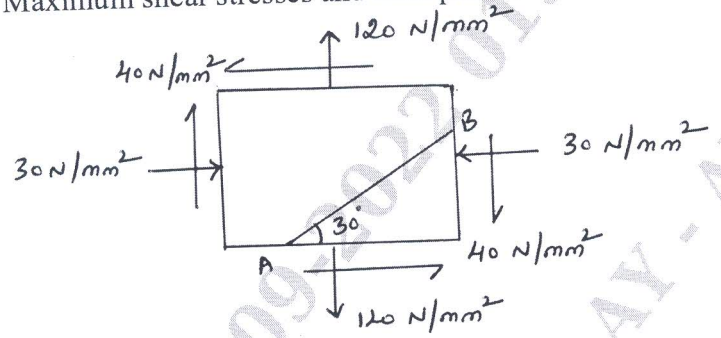

Fig.Q4 **(20 Marks)**

Module-3

5 a. Define: (i) Shear force (ii) Bending moment **(04 Marks)**
b. Derive an expression to establish a relationship between the intensity of load W, shear force F and bending moment M in the beam. **(08 Marks)**
c. Explain types of beams, loads and support. **(08 Marks)**

OR

6 Draw the SFD and BMD of the simply supported beam loaded as shown in Fig.Q6.

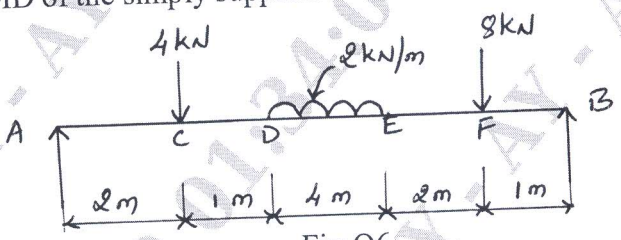

Fig.Q6 **(20 Marks)**

Module-4

7 a. Derive an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending. Also state the assumptions made in the theory of simple bending. **(12 Marks)**
b. The cross-section of a beam is shown in Fig.Q7(b). If permissible stress is 150 N/mm^2, find its moment of resistance.

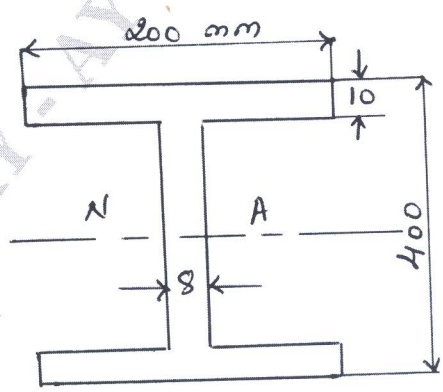

Fig.Q7(b) **(08 Marks)**

OR

8 a. Derive an expression for relation between slope, deflection and radius of curvature. **(10 Marks)**

b. Find the slope and deflection at the free end of the cantilever shown in Fig.Q8(b). $E = 200\ kN/mm^2$, $I = 40 \times 10^6\ mm^4$.

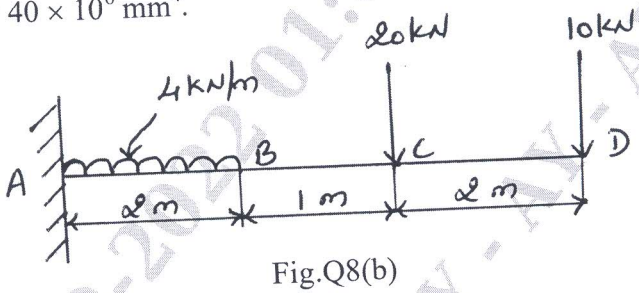

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Using the standard notations, derive the expression for torsional equation. Also state its assumptions. **(12 Marks)**

b. Determine the diameter of the solid shaft which will transmit 440 KW at 280 rpm, if maximum torsional shear stress is to be limited to $40\ N/mm^2$. Assume $G = 84\ kN/mm^2$. **(08 Marks)**

OR

10 a. Derive an expression for crippling load in a column when both of its ends are hinged or pinned. Also state its assumptions. **(12 Marks)**

b. Find the Euler's crippling load for a hollow cylindrical steel column of 40 mm external diameter and 4 mm thick. The length of the column is 2.5 m and is hinged at both ends. Also compute the Rankine's crippling load using constants 335 MPa and 1/7500. Take $E = 205\ GPa$. **(08 Marks)**

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