CBCS SCHEME

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18MR34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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. A solid light alloy bar of 40 mm in diameter is used as a tie. If the permissible tensile strength in the material is 320 MN/m^2, determine the capacity of the bar. If a hollow steel bar with internal diameter of 20 mm is used instead of solid alloy bar, determine its external diameter. For steel hollow bar the permissible stress is 150 MN/m^2. **(06 Marks)**

b. Derive an expression for stress and total elongation in a uniformly tapering circular bar. **(08 Marks)**

c. A brass rod 1.5 m long and 20 mm diameter was found to deform 1.9 mm under a tensile load of 40 kN. Calculate the modulus of elasticity of the rod. **(06 Marks)**

OR

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

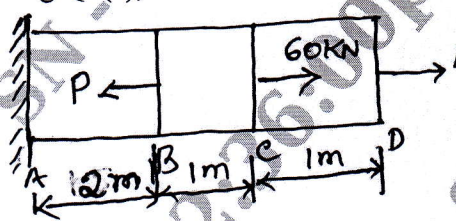

Fig.Q2(a) **(10 Marks)**

b. Derive a relation between modulus of elasticity and bulk modulus. **(10 Marks)**

Module-2

3 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(10 Marks)**

b. A point in a plate grider is subjected to a horizontal tensile stress of 100 N/mm^2 and vertical shear stress of 60 N/mm^2. Find the magnitude of principal stresses and its location. **(10 Marks)**

OR

4 a. A thin cylinder of internal diameter 2m contains a fluid at an internal pressure of 3 N/mm^2. Determine the maximum thickness of the cylinder if:
(i) Longitudinal stress is not to exceed 30 N/mm^2
(ii) Circumferential stress is not to exceed 40 N/mm^2 **(08 Marks)**

b. A thick cylinder of 500 mm inner diameter is subjected to an internal pressure of 9 MPa. Taking allowable stress for the material of the cylinder as 40 MPa, determine the wall thickness of the cylinder. **(12 Marks)**

Module-3

5 a. Explain the sign convention for shear force and bending moment. **(06 Marks)**

b. A cantilever beam carries UDL and point loads as shown in Fig.Q5(b). Find the reactions at the fixed end and draw the SFD and BMD.

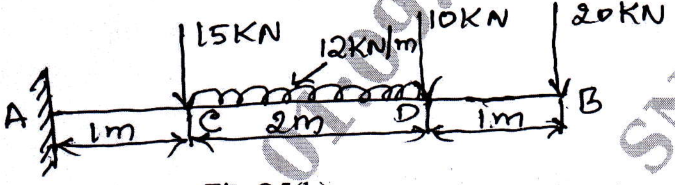

Fig.Q5(b) **(14 Marks)**

OR

6 a. Sketch and explain the types of loads acting on beams. **(04 Marks)**

b. Draw shear force and bending moment diagrams for the beam shown in Fig.Q6(b). Locate point of contraflexure.

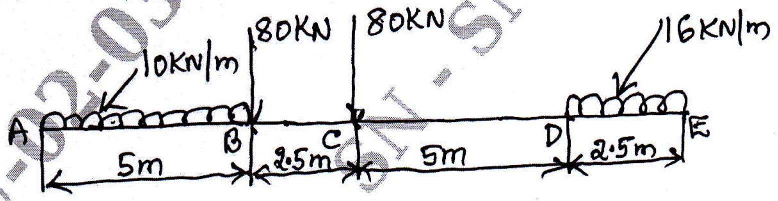

Fig.Q6(b) **(16 Marks)**

Module-4

7 a. State the assumptions in pure bending. **(08 Marks)**

b. A cantilever has a length of 3m. Its cross section is of T-section with flange 100 mm × 20 mm and web 200 mm × 12 mm, the flange is in tension. What is the intensity of UDL that can be applied if the maximum tensile stress is limited to 30 N/mm^2? Also compute the maximum compressive stress. **(12 Marks)**

OR

8 a. Derive an expression for Euler-Bernoulli equation for deflection of beams, $M = EI\frac{d^2y}{dx^2}$. **(10 Marks)**

b. A simply supported beam 100 mm × 200 mm carries a central concentrated load W. The permissible stress in bending and shear are 15 N/mm^2 and 1.2 N/mm^2 respectively. Determine the safe load W if the span of the beam is 3m. **(10 Marks)**

Module-5

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

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$$

(12 Marks)

b. A solid shaft of 120 mm diameter is required to transmit 200 KW at 100 rpm. If the angle of twist is not to exceed 2°, find the length of the shaft. Take G = 90 GPa. **(08 Marks)**

OR

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

b. A solid round bar of 60 mm diameter and 2.5 m is used as a strut. Find the safe compressive load for the strut if (i) both ends are hinged (ii) both ends are fixed. Take E = 2 × 10^5 N/mm^2 and factor of safety = 3. **(10 Marks)**

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