CBCS SCHEME

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17AU34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. Explain what are Mechanical Properties of a materials? **(04 Marks)**

b. A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in Fig.Q1(b).

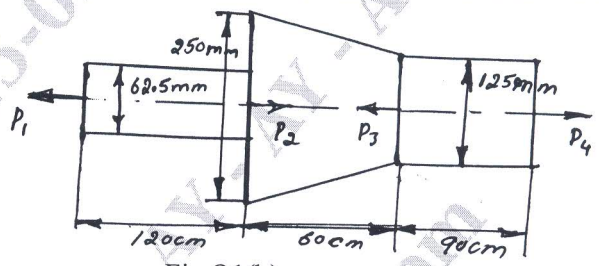

Fig.Q1(b)

Calculate the force P_2 necessary for equilibrium if P_1 = 45 kN, P_3 = 450 kN and P_4 = 130 kN. Determine total elongation of the member if E = 2.1×10^5 N/mm^2 and thickness is 10mm. **(08 Marks)**

c. A load of 2 MN is applied on a short concrete column 500mm × 500mm. The column is reinforced with four steel bars of 10mm diameter, one in each corner. Find the stresses in concrete and steel bars. Take E for steel as 2.1×10^5 N/mm^2 and for concrete as 1.4×10^4 N/mm^2. **(08 Marks)**

OR

2 a. Define four elastic constant and derive an expression for Young's modulus in terms of bulk modulus and Poisson's ratio. **(08 Marks)**

b. Define Thermal Stress and explain mathematically. **(04 Marks)**

c. A metallic bar 300mm × 100mm × 40mm is subjected to a force of 5 kN (tensile), 6 kN (tensile) and 4 kN (tensile) along x, y and z direction respectively. Determine the change in volume of block, volumetric strain. Take E = 2×10^5 N/mm^2 and μ = 0.25. Refer Fig.Q2(c) for coordinate directions.

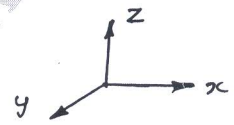

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. Define : (i) Principal Stress (ii) Principal Strain **(04 Marks)**

b. A machine component is subjected to the stress as shown is Fig.Q3(b). Find the normal and shear stresses on the section AB inclined at an angle 45°. Also find the resultant stress on the section. Verify the above results by drawing Mohr's circle.

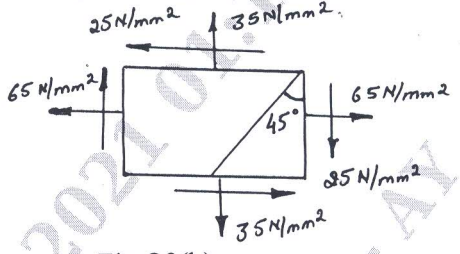

Fig.Q3(b) **(16 Marks)**

OR

4 a. With assumptions made, derive an expression for circumferential and longitudinal stress for thin cylinder. **(10 Marks)**

b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum, mean and minimum hoop stresses across the section. Also sketch radial and hoop stresses distribution across the section. **(10 Marks)**

Module-3

5 a. What are the different types of beams? Explain briefly with sketches. **(06 Marks)**

b. A beam shown in Fig.Q5(b), draw shear force and bending moments and also locate and calculate the maximum bending moment. **(14 Marks)**

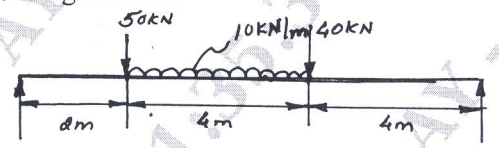

Fig.Q5(b)

OR

6 a. With assumptions made, derive an expression for Bending Stress. **(10 Marks)**

b. A rectangular beam 200mm deep and 300mm wide is simply supported over a span of 8 m. What uniformly distributed load per meter the beam may carry, if the bending stress is not to exceed 120 N/mm^2. **(06 Marks)**

c. Write a note on Deflection of beams. **(04 Marks)**

Module-4

7 a. Derive an expression for shear stress produced in a circular shaft subjected to torsion. Clearly explain assumptions. **(12 Marks)**

b. Determine the diameter of a solid shaft which will transmit 300 kW at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 1° in a shaft length of 2m. Take modulus of rigidity 1×10^5 N/mm^2. **(08 Marks)**

OR

8 a. Derive an expression for crippling load when one end of the column is fixed and other end is free. **(12 Marks)**

b. Write a note on:
(i) Crippling Stress in terms of effective length and radius of Gyration.
(ii) Limitation of Euler's formula
(iii) Slenderness Ratio
(08 Marks)

Module-5

9 a. Define the following :
(i) Resilience (ii) Proof Resilience (iii) Modulus of Resilience (iv) Strain Energy.
(08 Marks)

b. The maximum stress produced by a pull in a bar of length 1m is 150 N/mm^2. The area of cross-section and length are shown in Fig.Q9(b). Calculate the strain energy stored in bar is $E = 2 \times 10^5$ N/mm^2.

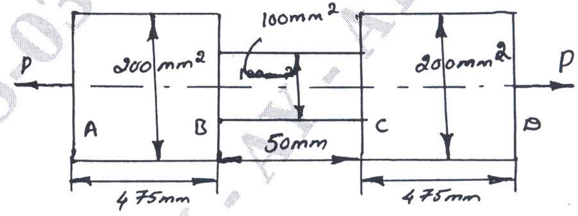

Fig.Q9(b)
(06 Marks)

c. Derive an expression for Strain Energy due to Shear stress.
(06 Marks)

OR

10 a. What do you mean by Theories of Failure? Name some important theories of failure and explain any two.
(08 Marks)

b. Determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN using
(i) Maximum Principal Stress Theory
(ii) Maximum Shear Stress Theory
Give the Elastic limit in tension = 225 N/mm^2. Factor of safety = 3.
(12 Marks)

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