CBCS SCHEME

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15AU34

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. State Hooke's Law. **(02 Marks)**

b. A metallic bar 250mm × 80mm × 30mm is subjected to force of 20kN , 30kN and 15kN along x , y , z direction and all are tensile. Determine the change in volume of the block. Take $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.25. **(10 Marks)**

c. Determine an expression for shortening / extension of bar. **(04 Marks)**

OR

2 a. Derive an expression for deformation of tapering bar (Circular cross section). **(08 Marks)**

b. A steel rod of 20mm diameter is enclosed centrally in a hollow copper tube of external diameter 40mm and internal diameter 25mm. The composite bar is then subjected to an axial pull of 50kN through rigid cover plates. If the length of each bar is equal to 200mm, determine i) Stress in the rod and tube ii) Load carried by each bar. $E_{steel} = 2 \times 10^5$ N/mm^2 and $E_{copper} = 1 \times 10^5$ N/mm^2. **(08 Marks)**

Module-2

3 a. A point in a plate grinder is subjected to a horizontal tensile stress of 100N/mm^2 and vertical shear stress of 60 N/mm^2. Find the magnitude of principal stresses and its location. **(08 Marks)**

b. Write down step by step procedure to construct Mohr's circle. **(08 Marks)**

OR

4 a. A thin cylindrical shell in 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to internal fluid pressure of 3MPa. Determine :
i) Circumferential and longitudinal stress.
ii) Circumferential, longitudinal and volumetric strain.
iii) Change in length , diameter , volume. **(12 Marks)**

b. State Lame's theory. **(04 Marks)**

Module-3

5 Draw the SFD and BMD for the structure shown in Fig. Q5 and find point of contra flexure. **(16 Marks)**

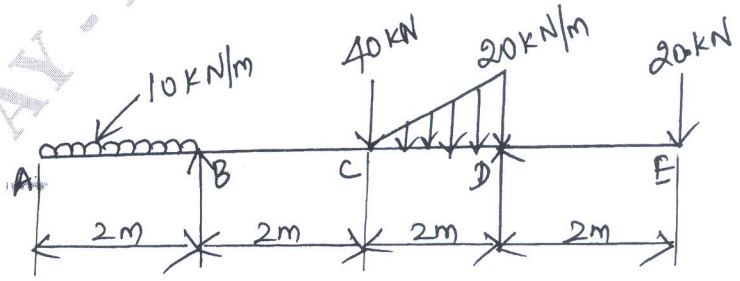

Fig. Q5

OR

6 a. Write down the assumptions in pure bending. **(08 Marks)**

b. A cast iron pipe has 300mm bore and 10mm metal thickness and is supported at its ends 10m apart. If the weight of cast iron is 70kN/m^3 and that of water is 9.8 kN/m^3. Determine the stress in the metal. **(08 Marks)**

Module-4

7 a. A solid shaft is subjected to a maximum torque of 25kN/m. Find a suitable diameter of a solid shaft. If the allowable shear stress and the twist are limited to 80N/mm^2 and 1° respectively for a length of 20 times the diameter of the shaft. **(08 Marks)**

b. Derive the expression for torsional equation. **(08 Marks)**

OR

8 a. Derive an expression for Euler's crippling load for column when both of its ends are hinged or pinned. **(08 Marks)**

b. A solid round bar of 60mm diameter and 2.5m is used as a strut. Find the safe compressive load for strut if i) Both ends are hinged ii) Both ends are fixed.
Take $E = 2 \times 10^5$ N/mm^2 ; Factor of safety = 3. **(08 Marks)**

Module-5

9 a. Define Strain Energy , Resilience , Proof resilience and Modulus of resilience. **(08 Marks)**

b. A load of 200N falls through a height of 25mm to a collar rigidly attached to the lower end of a vertical bar 2m long and of 300mm^2 cross – sectional area. The upper end of the vertical bar is fixed. E = 200GPa.
i) Maximum instantaneous stress induced in the vertical bar.
ii) Strain energy stored in vertical rod. **(08 Marks)**

OR

10 a. Explain Maximum Shear Stress theory and State the need of theories of failure. **(08 Marks)**

b. A machine element is subjected to the following $\sigma_x = 60$MPa , $\sigma_y = 45$ MPa , $\tau_{xy} = 30$ MPa. Find factor of safety, if its made of C_{45} steel, having yield stress 353 MPa using following theories i) Maximum Principal Stress theory ii) Maximum Shear Stress theory. **(08 Marks)**

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