CBCS SCHEME

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17AU34

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 Stress – strain diagram for mild steel depicting all the salient points in it. **(06 Marks)**

b. A circular bar of metal has a diameter 'd_1' at one end which tapers uniformly to diameter 'd_2' at the other end. Find the elongation of the bar under an axial tensile load 'P'. The length of bar is L. **(06 Marks)**

c. A steel tube 30mm in internal diameter and 40mm is external diameter contains a copper rod of 20mm in diameter. The tube is 500mm long and is closed by rigid washers that are fastened by nuts threaded on the copper rod. The nuts are tightened until the compressive load on tube is 30kN, what are the stresses on tube and rod? Find the increase in these stresses when the nut is further tightened by one quarter of a turn. There are 4 thread per 10mm. Take $E_s = 200$ GPa , $E_b = 100$ GPa. **(08 Marks)**

OR

2 a. A steel bar is sandwiched between 2 copper bars of same area and same length , with their ends rigidly connected. The temperature of the assembly is maintained at 30^0C on raising temperature to 150^0C, it was found that length of the unit increased by 5mm. Determine the original length and stress in bars. Take $E_s = 200$GPa , $E_c = 100$GPa , $\alpha_s = 12 \times 10^{-6} / {}^0$C , $\alpha_c = 17 \times 10^{-6}/{}^0$C. **(12 Marks)**

b. With usual notations establish relation between Young's modulus , rigidity modulus and bulk modulus. **(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. **(16 Marks)**

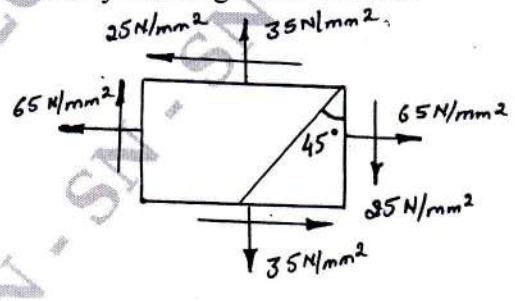

Fig. Q3(b)

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. Explain different types of beams and loads. **(05 Marks)**

b. Draw SFD and BMD for beam shown in Fig. Q5 (b).

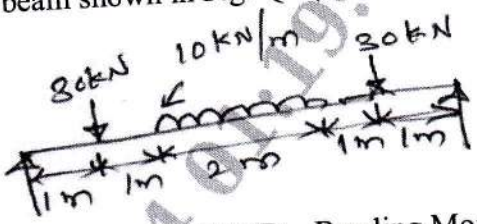

Fig. Q5(b)

SFD – Shear Force Diagram ; BMD – Bending Moment Diagram. **(15 Marks)**

OR

6 a. Prove the relation $\frac{M}{I}=\frac{\sigma}{Y}=\frac{\in}{R}$ with usual notations. **(10 Marks)**

b. A 2 m long beam with rectangular section (100 mm × 50 mm) is simply supported at its ends and is subjected to a point load of 10 kN at its midspan. Show the bending stress distribution along the depth under maximum bending moment. **(10 Marks)**

Module-4

7 a. Write the assumptions made in torsion theory and derive torsion equation for circular shaft. **(10 Marks)**

b. Show that hollow shaft is stronger and rigid than solid shaft of same material, length and weight. **(10 Marks)**

OR

8 a. Derive expression for Euler's critical load for column with both ends fixed. **(10 Marks)**

b. A T – section shown in fig. Q8(b) below is used as a strut of 3m length with one end fixed and other end free. Find crippling load if E = 150 GPa. **(10 Marks)**

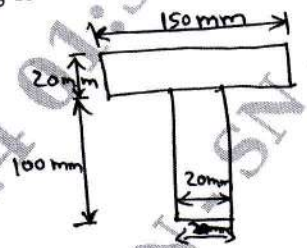

Fig.Q8(b)

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 $E = 2\times10^5$ N/mm^2. **(06 Marks)**

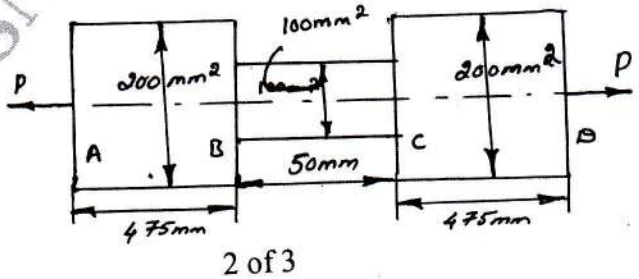

Fig.Q9(b)

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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