CBCS SCHEME

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17AU34

Third Semester B.E. Degree Examination, June/July 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. Define : i) Stress ii) Strain iii) True stress iv) Hookes law v)Poisson's ratio vi) Rigidity modulus **(08 Marks)**

b. The following data refer to a MS specimen tested in laboratory. Diameter of specimen=25mm, Gauge length of specimen = 200mm, Extension under a load of 20kN=0.04mm load at yield point=150kN, Maximum load = 225 kN Length of specimen after failure = 275mm; Neck dia=18.25mm Determine:
i) Young's modulus ii) Yield stress iii) Ultimate stress
iv) Percentage elongation v) Percentage reduction in area
vi) Safe stress adopting a FOS=2.5 **(12 Marks)**

OR

2 a. A bar of 20mm diameter is subjected to a pull of 50kN. The measured extension on gauge length of 250mm is 0.12mm and change in diameter is 0.00375mm. Determine i) Young's modulus ii) Poisson's ratio iii) Bulk modulus iv) Modulus of Rigidity **(08 Marks)**

b. A composite bar madeup of Aluminium & steel is held between two supports as shown in Fig.Q.2(b). The bars are stress free at temperature 42°C. What will be the stresses in the two bars with the temperature drops to 24°C if i) The supports are Unyielding ii)The supports come nearer to each other by 0.1mm. The cross-sectional area of steel bar is 160mm² and that of aluminium bar is 240mm², $E_A = 0.7\times10^5$ N/mm², $E_s=2\times10^5$ N/mm², $\alpha_A=24\times10^{-6}$ per °c and $\alpha_s=12\times10^{-6}$ per °c.

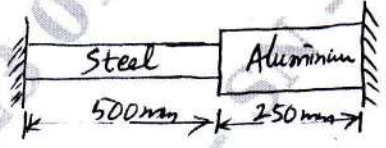

Fig.Q.2(b)

(12 Marks)

Module-2

3 a. The state of stress in two dimensionally stressed body is shown in fig.3a. Determine the principal stresses, Principle planes, maximum shear stress & theirs planes. **(14 Marks)**

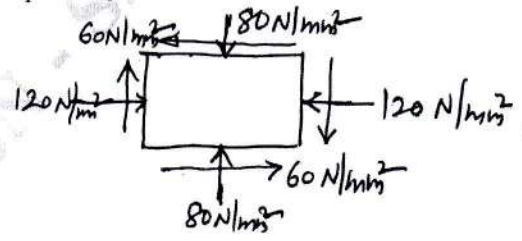

Fig.Q.3(a)

b. Draw the Mohr's circle and compare the results of Q.No.3(a). **(06 Marks)**

OR

4 a. Derive expression for circumferential stress and longitudinal stress for a thin cylindrical vessel subjected to internal pressure: **(08 Marks)**

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

Module-3

5 a. State the different types of loads acting on beams. **(05 Marks)**

b. A beam 25m long is supported at A & B and is loaded as shown in Fig.Q.5(b). Draw the SFD & BMD for the beam computing SF & BM at A, E, D, B & C. find the position and magnitude of the max. bending moment. Also, determine the point of contra flexure. **(15 Marks)**

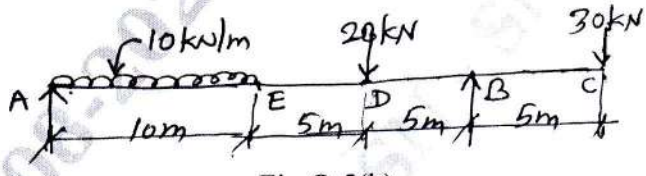

Fig.Q.5(b)

OR

6 a. State the assumptions made in theory of pure bending and write the bending equation with usual notations. **(08 Marks)**

b. The T-section shown in Fig.Q.6(b) is used as a simply supported beam over a span of 4m. It carries an UDL of 8kN/m over its entire span. Calculate the maximum tensile & compressive stresses occurring in the section. **(12 Marks)**

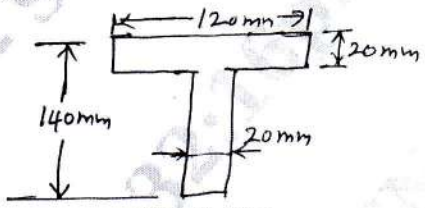

Fig.Q.6(b)

Module-4

7 a. State the assumptions made in theory of pure torsion & write the torsion equation with usual rotations. **(08 Marks)**

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm. Find the dia of shaft, if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal dia is 0.6 times its external dia, the length, material & maximum shear stress being same. **(12 Marks)**

OR

8 a. Derive an expression for Euler's load for a column with both of its end hinged. **(10 Marks)**

b. Determine the crippling load for a T Section of dimensions 100mm×20mm and length of column 12m with both ends fixed. Take E=210GPa. **(10 Marks)**

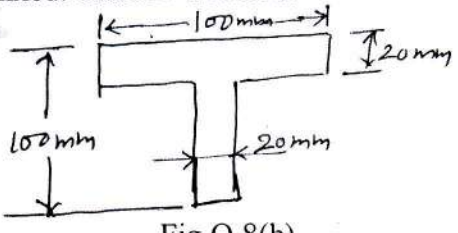

Fig.Q.8(b)

Module-5

9 a. Derive expression for strain energy stored in a body when an axial load is applied with an impact. **(10 Marks)**

b. A hollow circular shaft 2m long is required to transmit 1000 kW power, when running at a speed of 300rpm. If the outer dia is 150mm and the inner dia is 120mm, find the maximum shear stress and strain energy stored in the shaft. Take G=80 GPa **(10 Marks)**

OR

10 a. Explain in brief:
i) Maximum principal stress theory.
ii) Maximum shear stress theory. **(10 Marks)**

b. A bolt is subjected to an axial pull of 10kN together with a transverse shear load of 5 kN. Determine the diameter of the bolt by using
i) Maximum principal stress theory.
ii) Maximum shear stress theory.
Take FOS = 3 & permissible tensile stress = $300 N/mm^2$. **(10 Marks)**

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