CBCS SCHEME

USN | | | | | | | | | | |

18MR34

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. Draw a Stress-Strain curve for ductile material and explain salient points. **(10 Marks)**

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

OR

2 a. Determine the stress in different segments of a circular bar shown in Fig.Q2(a). Also compute the total elongation of the bar if E = 200 GPa.

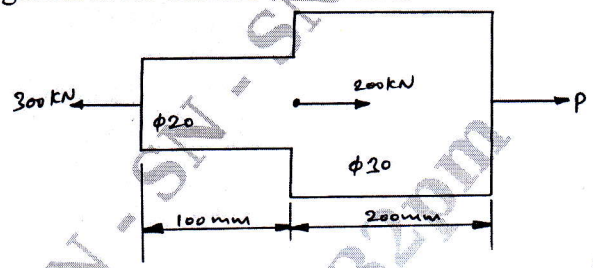

Fig.Q2(a) **(10 Marks)**

b. The composite bar shown in Fig.Q2(b) is 0.2mm short of distance between the rigid supports at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find stresses induced when temperature rise is 40°C.

Given $\alpha_s = 12 \times 10^{-6}$ per °C, $\alpha_c = 17.5 \times 10^{-6}$ per °C

$E_s = 2 \times 10^5$ N/mm^2, $E_c = 1.2 \times 10^5$ N/mm^2

AS : AC = 4 : 3

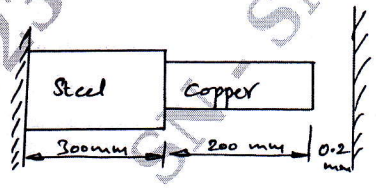

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Derive expressions for normal stress and tangential stress in member subjected to direct stresses on two mutually perpendicular directions. **(10 Marks)**

b. A machine component is subjected to the stress as shown in Fig.Q3(b). Find the normal and shearing stresses on the section AB inclined at an angle of 60° with x – x axis. Also find the resultant stress on the section by Mohr's circle.

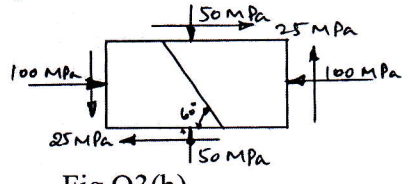

Fig.Q3(b) **(10 Marks)**

OR

4 a. Define Thin Cylinders. Derive expressions for circumferential stress and longitudinal stress. **(10 Marks)**

b. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand an internal fluid pressure of 8 N/mm^2. The maximum allowable stress in the section is not to exceed 35 N/mm^2. **(10 Marks)**

Module-3

5 a. Explain different types of beams and loads. **(06 Marks)**

b. Draw SFD and BMD for a simply supported beam loaded as shown in Fig.Q5(b).

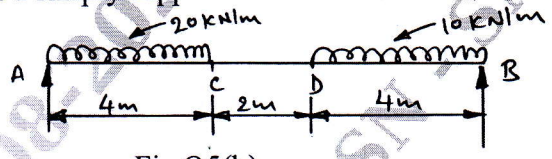

Fig.Q5(b) **(14 Marks)**

OR

6 a. Draw SFD and BMD for a simply supported beam of length 'l' with a point load 'W' at mid-point. **(08 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q6(b). Indicating the principal values.

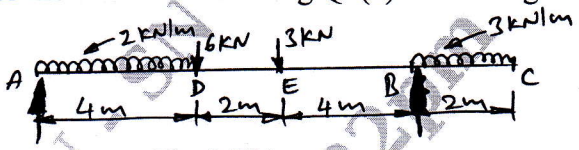

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Derive bending equation. What are the assumption made in pure bending? **(12 Marks)**

b. The T-section shown in Fig.Q7(b) is used as a simply supported beam over a span of 4m. It carries an uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section.

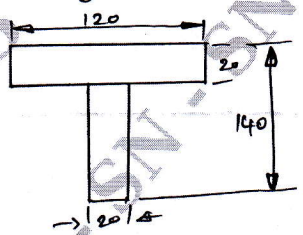

Fig.Q7(b) **(08 Marks)**

OR

8 a. Prove that $\tau_{max} = 1.5\ \tau_{avg}$ in rectangular cross-section. **(10 Marks)**

b. A beam of an I-section 200mm × 300mm has web thickness 10mm and flange thickness 10mm. It carries a shearing force of 10 kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

Module-5

9 a. Derive Torsion equation and list out assumptions made in torsion. **(12 Marks)**

b. Find the maximum torque that can be applied to a shaft of 300mm diameter. The permissible angle of twist is 1.5° in a length of 5m and the shear stress is not to exceed 42 N/mm^2. G = 84 GPa. **(08 Marks)**

OR

10 a. Derive the expression for Euler's crippling load for a column when one end of the column is fixed and other end is free. **(10 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using (i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = 1/1600$ (ii) Euler's formula, taking $E = 1.2\times10^5$ N/mm^2. **(10 Marks)**

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