CBCS SCHEME

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15MN34

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

1 a. Explain with a neat sketch, stress-strain diagram of mild steel indicating its salient points. **(06 Marks)**

b. A round bar with stepped portion is subjected to the forces as shown in Fig.Q1(b). Determine the magnitude of force P, such that net deformation in the bar does not exceed 1mm. E_{steel} = 200GPa and E_{Al} = 70GPa. Big end diameter and small end diameter of tapering bar are 40mm and 12.5mm respectively.

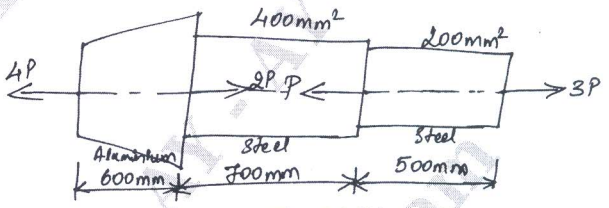

Fig.Q1(b) **(10 Marks)**

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

b. A bar, 20mm diameter and fixed at A, is stretched with a force of 10kN to bring to support B and fixed it. Temperature = 27°C and length AB = 2m. Determine the temperature at which the stress will become zero. Also determine the stress in the bar if the temperature rises to : i) 40°C ii) 50°C, E = 200GPa and $\alpha = 12 \times 10^{-6}$/°C. **(08 Marks)**

3 a. At a point in a loaded elastic member, there are normal stresses of 60MPa and 40MPa both tensile respectively, at right angles to each other with positive shearing stress of 20MPa. Draw the Mohr's circle diagram and find :
i) Principal stresses and their planes
ii) Maximum shear stress and its planes. **(12 Marks)**

b. Define principal stress and planes. **(04 Marks)**

4 a. Derive relation between Young's moudlus (E), modulus of rigidity (G) and bulk modulus (K). **(08 Marks)**

b. Derive an expression for volumetric strain in case of a thin cylindrical shell of internal diameter 'd' subjected to internal pressure 'P'. **(08 Marks)**

5 Find the reactions at the fixed end and draw the shear force and bending moment diagram for the cantilever beam shown in Fig.Q5.

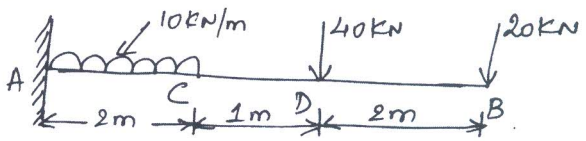

Fig.Q5 **(16 Marks)**

6 a. Derive an expression for maximum slope and deflection for a cantilever beam subjected to UDL. **(08 Marks)**

b. Derive Bernoulli-Euler bending equation and state its assumptions. **(08 Marks)**

7 a. The cross-section of a beam is as shown in Fig.Q7(a). If permissible stress is $150N/mm^2$. Find its moment of resistance. Compare it with equivalent section of the same area for a square section.

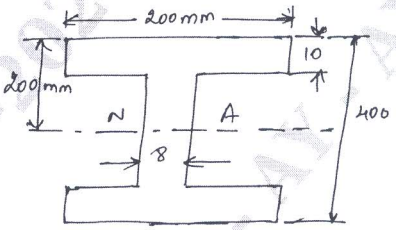

Fig.Q7(a) **(08 Marks)**

b. A cantilever beam of square section 200mm × 200mm 2m long just fails in bending, when a load of 20kN is placed at its free end. A beam of same material having a rectangular c/s 150mm × 300mm, simply supported over a span of 3m is to be used under a uniformly distributed load w N/m. what can be the maximum value of w? **(08 Marks)**

8 a. Derive an deflection equation of a simply supported beam with a point load at centre. **(08 Marks)**

b. With an example, explain the method used for the beams subjected to a set of concentrated loads and UDL. **(08 Marks)**

9 a. Derive an expression for relation between torque and shear stress in a hollow circular shaft. **(08 Marks)**

b. A solid shaft rotating at 1000rpm transmits 50KW maximum torque is 20% more than mean torque. Material of the shaft has the allowable shear stress of 50MPa and modulus of rigidity 80GPA. Angle of twist in the shaft should not exceed 1° in one metre length. Determine the diameter of the shaft. **(08 Marks)**

10 a. Find the Euler's crippling load for a hollow cylindrical steel column of 40mm external diameter and 4mm thick. The length of the column is 2.5m and is hinged at both ends. Also compute the Rankine's crippling load using constants 335MPa and 1/7500. Take E = 205GPa. **(08 Marks)**

b. Derive the expression for Euler's critical load for a long column with both ends fixed. **(08 Marks)**

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