CBCS SCHEME

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18MN34

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

Time: 3 hrs. Max. Marks:100

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

1 a. Explain with a neat sketch, stress-train diagram of Mild steel, cast iron and non-ferrous metals by indicating its salient points. **(10 Marks)**

b. A vertical circular steel bar of length 3ℓ fixed at both of its ends is loaded at intermediate sections by forces W and 2W as shown in Fig.Q1(b). Determine the end reactions if W = 1.5KN.

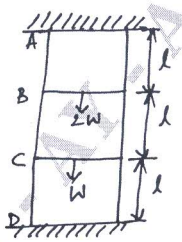

Fig.Q1(b) **(10 Marks)**

2 a. Derive an expression for deformation of Tapering rectangular section bar. **(10 Marks)**

b. A composite bar made up of Aluminium and steel is held between two supports as shown in Fig.Q2(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 $160mm^2$ and that of aluminium bar is $240mm^2$. $E_A = 0.7 \times 10^5 N/mm^2$, $E_S = 2 \times 10^5 N/mm^2$, $\alpha_A = 24 \times 10^{-6}/°C$ and $\alpha_S = 12 \times 10^{-6}/°C$.

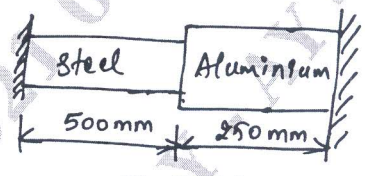

Fig.Q2(b) **(10 Marks)**

3 a. A point in a strained material is subjected to a tensile stress of $500N/mm^2$ and $300N/mm^2$ in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliquity on a plane making an angle of 30° with the axis of the second stress. Also find the maximum shear stress. **(10 Marks)**

b. A point is subjected to a tensile stress of $60N/mm^2$ and a compressive stress of $40N/mm^2$, acting on two mutually perpendicular planes and a shear stress of $10N/mm^2$ as shown in Fig.Q3(b). Determine the principal as well as maximum shear stress by Mohr's circle method.

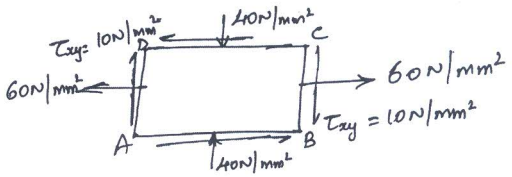

Fig.Q3(b) **(10 Marks)**

4 a. Define modulus of rigidity and its relation with Young's modulus. **(10 Marks)**

b. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3MPa. Determine : i) circumferential and longitudinal stress ii) circumferential, longitudinal and volumetric strain iii) change in length, diameter and volume. Assume 1/m = 0.3 and E = 120GPa. **(10 Marks)**

5 Draw the SFD and BMD of the simply supported beam loaded as shown in Fig.Q5.

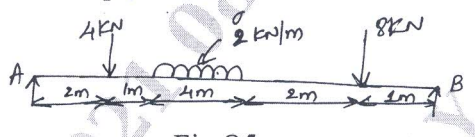

Fig.Q5 **(20 Marks)**

6 Draw the SFD and BMD for an overhanging beam shown in Fig.Q6 and locate the points of contra flexure.

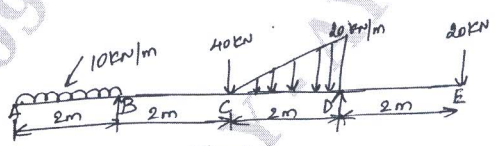

Fig.Q6 **(20 Marks)**

7 a. Derive an expression for maximum slope and deflection for a cantilever beam subjected to UDL. **(10 Marks)**

b. A cantilever of square section 200mm × 200mm, 2 meter long just fails in flexure when a load of 12kN is placed at its free end. A beam of same material and having a rectangular c/s 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(10 Marks)**

8 a. Derive Bernoulli – Euler bending equation or general bending equation and state assumptions. **(10 Marks)**

b. A beam AB of 4m span is simply supported at the ends and is loaded as shown in Fig.Q8(b). Determine : i) Deflection at C ii) Maximum deflection and iii) Slope at end A.

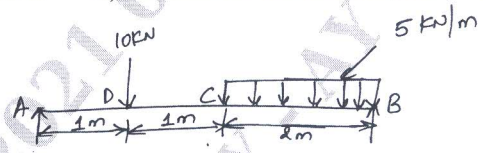

Fig.Q8(b) **(10 Marks)**

9 a. Derive the relation between torque and shear stress in a solid circular shaft. **(10 Marks)**

b. A solid circular shaft is required to transmit 80KW at 160rpm. The permissible shear stress in the shaft material is 60N/mm^2. The maximum torque transmitted exceeds the mean torque by 20%. The angle of twist is not to exceed 1° in a length of 20 times the diameter of shaft. The value of rigidity modulus is 0.8×10^5N/mm^2. Find the diameter of shaft. **(10 Marks)**

10 a. Derive an expression for Euler's crippling load for a column when both ends are fixed. **(10 Marks)**

b. A hollow CI circular section column is 7.5m long and is pinned at its both ends. The inner diameter of the column is 160mm and the thickness of the wall is 20mm. Find the safe load by Rankine's formula, using a factor of safety is 5. Also find the slenderness ratio and ratio of Euler's and Rankine's critical loads. For cast iron take $\sigma_C = 550$N/mm^2, $\alpha = 1/1600$ and $E = 8 \times 10^4$N/mm^2. **(10 Marks)**

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