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06ME34

Third Semester B.E. Degree Examination, December 2010
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from Part – A and Part - B.***

PART – A

1 a. State Hooke's law. Sketch the typical stress – strain curve for aluminum. **(04 Marks)**

b. A stepped bar having circular sections of diameter 1.5D and D is shown in fig. Q1(b). If ρ and E are the density and Young's modulus of elasticity respectively, find the extension of the bar due to its own weight. **(08 Marks)**

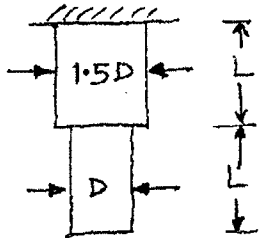


Fig. Q1(b)

c. A stepped bar of steel, held between two supports as shown in fig, Q1(c), is subjected to loads P_1 = 80kN and P_2 = 60kN. Find the reactions developed at the ends A and B.**(08 Marks)**

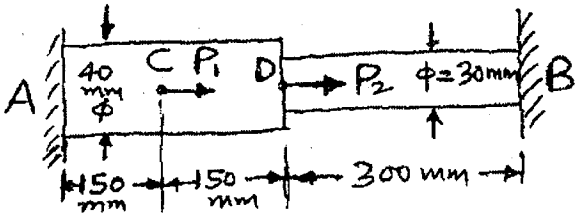


Fig. Q1(c)

2 a. Define Poisson's ratio. Using the relationship between Young's modulus of elasticity and bulk modulus, prove that the maximum value of Poisson's ratio is 0.5. **(06 Marks)**

b. AB is a rigid bar and has an hinged support at C as shown if fig. Q2(b). A steel and an aluminium bar support it at ends A and B respectively. The bars were stress free at room temperature. What are the stresses induced, when the temperature rises by 40^0C? **(14 Marks)**

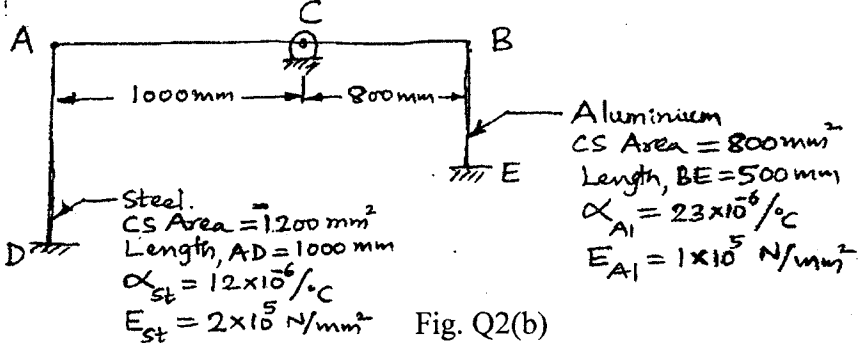
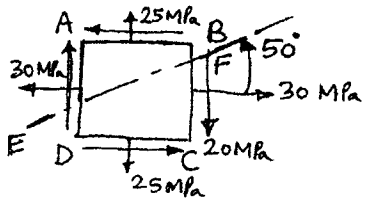


Fig. Q2(b)

3 a. Explain in brief 'plane stress'. **(04 Marks)**

b. The state of stress at a point is shown in fig. Q3(b). If the plane EF cuts the element, determine the normal and shear stresses on the plane and show them clearly on the portion of the element ABFE. **(08 Marks)**

Fig. Q3(b)



c. The state of stress at a point is expressed by principal stresses $\sigma_1 = 40$MPa and $\sigma_2 = 20$MPa. Draw Mohr's circle and determine any one plane on which the magnitude of normal stress is six times the magnitude of shear stress. **(08 Marks)**

4 a. A thin cylinder, 2m long and 200mm in diameter with 10mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000mm^3 fluid is pumped in, find the longitudinal and hoop stress developed. Also determine the changes in diameter and length if $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3. **(10 Marks)**

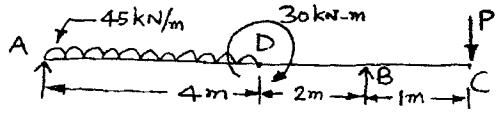
b. Derive the expressions for radial and hoop stresses (Lame's equations) for a thick cylinder. **(10 Marks)**

PART - B

5 a. Obtain the relationship between the shear force and the bending moment. **(05 Marks)**

b. For the beam shown in fig. Q5(b), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw the shear force and bending moment diagrams, indicating the values at the salient points. Locate the point of contraflexure. **(15 Marks)**

Fig. Q5(b)

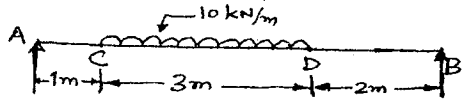


6 a. A cantilever beam of square section 200mm × 200mm, 2m long just fails in bending, when a load of 20kN is placed at its free end. A beam of the same material having a rectangular cross – section 150mm × 300mm, simply supported over a span of 3m is to be used under uniformly distributed load W n/m. What can be the maximum value of W? **(12 Marks)**

b. A cantilever beam of length 1m has a circular cross – section of diameter 300mm. Determine the concentrated load that can be applied at the free end to produce a maximum shear of 1.5N/mm^2. **(08 Marks)**

7 A beam AB shown in fig. Q7 is 6m long and has a flexural rigidity $EI = 9 \times 10^{13}$ N-mm^2. Determine i) slope at A ii) deflection at the mid span iii) maximum deflection and its location. **(20 Marks)**

Fig. Q7



8 a. State the assumptions made in pure torsion theory and derive $\frac{T}{I_p} = \frac{G\theta}{L}$, where,

T = Torsional moment ; I_p = Polar moment of inertia ; G = Modulus of rigidity ;
θ = Angle of twist ; L = Length of the shaft. **(10 Marks)**

b. Show the variation of Euler's critical load with slenderness ratio. Using the same, explain the limitations of Euler's theory. How the Rankine's formula overcomes these limitations? **(10 Marks)**

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