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06ME34

Third Semester B.E. Degree Examination, June / July 2014
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Define i) Poisson's ratio ii) Bulk modulus iii) Factor of safety iv) Principle of super position. **(04 Marks)**

b. Distinguish between a ductile materials and a brittle material. Give one example each. Draw typical stress strain diagram for each of them indicating salient points on them. **(08 Marks)**

c. A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in fig.Q1(c). Calculate the force P_3 necessary for equilibrium, if P_1 = 120kN, P_2 = 220kN and P_4 = 160kN. Determine also the net change in the length of the member. Take E = 200GN/m^2. **(08 Marks)**

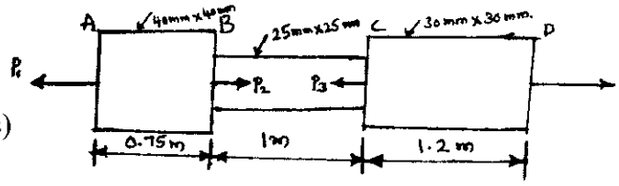


Fig.Q1(c)

2 a. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(10 Marks)**

b. A horizontal rigid bar AB weighing 200kN is hung by three vertical rods, each of 1m length and 500mm^2 in cross section as shown in fig.Q2(b). The central rod is of steel and the outer rods are of copper. If the temp rise is 40^{0}C. Estimate the load carried by each rod and how much the load will descend. Take E_s = 200GN/m^2 , E_c = 100GN/m^2 , $\alpha_s = 1.2 \times 10^{-5}/^0C$, $\alpha_c = 1.8 \times 10^{-5}/^0C$. **(10 Marks)**

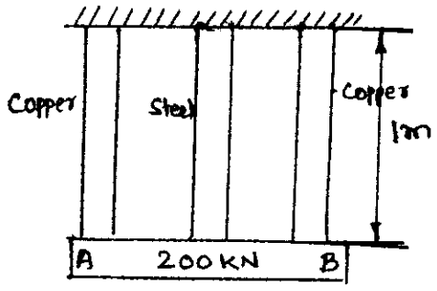


Fig.Q2(b)

3 a. Show that : i) Sum of normal stresses in any two mutually perpendicular direction is constant. ii) Principle planes are planes of maximum normal stress also. **(10 Marks)**

b. At a point in a strained material, there is tensile stress of 80N/mm^2 upon a horizontal plane and compressive stress of 40N/mm^2 upon a vertical plane. There is also a shear stress of 48N/mm^2 upon each of these planes. Determine the planes of maximum shear stress at the point. Determine also the resultant stress on the planes of maximum shear stress. **(10 Marks)**

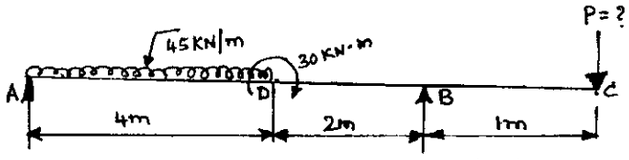
4 a. Derive the expression for circumferential and radial stresses in the wall of thick cylinder (Lame's equation). **(10 Marks)**

b. Determine the maximum and minimum hoop stress across the section of a pipe of 400mm internal diameter and 100mm thick, when the pipe contains a fluid at a pressure of $8N/mm^2$. Also sketch the radial pressure distribution and hoop stress distribution across the section. **(10 Marks)**

PART - B

5 For the beam AC shown in fig.Q5(a), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw SF and BM diagrams for the beam. Mark the salient points and their values on the diagram. Locate the point of contraflexure, if any. **(20 Marks)**

Fig.Q5



6 a. Prove that the ratio of depth of width of the strongest beam that can be cut from a circular log of diameter 'd' is 1.414. Hence calculate the depth and width of the strongest beam that can be cut of cylindrical log of wood whose diameter is 300mm. **(10 Marks)**

b. Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress. **(10 Marks)**

7 a. Prove that the slope and deflection of a simply supported beam of length L and carrying a uniformly distributed load of W per unit length over the entire length are given by

Slope at the supports $= \frac{WL^2}{24EI}$ and Deflection at centre $= \frac{5}{384}\frac{WL^3}{EI}$,

where W = Total load = W × L. **(10 Marks)**

b. A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is $7N/mm^2$ and central deflection is not to exceed 1cm. **(10 Marks)**

8 a. What are the assumptions made in Euler's theory? **(03 Marks)**

b. Derive an expression for Euler's buckling load for a column with its both ends are fixed. **(07 Marks)**

c. A solid circular shaft is to transmit 300kW at 100rpm. If the shear stress in not to exceed $80N/mm^2$. Find the diameter of the shaft. What percentage in saving in weight would be obtained, if this shaft is replaced by a hollow one, whose internal diameter is equal to 0.8 of the external diameter, the length, the material and the allowable maximum shear stress being the same? **(10 Marks)**

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