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06ME34

Third Semester B.E. Degree Examination, June-July 2009
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting at least Two questions from each part.*

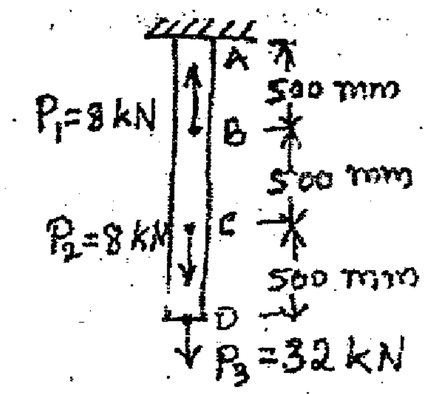
PART – A

1 a. Define the following terms:
i) Elastic limit; ii) True stress; iii) Factor of safety; iv) Poisson's ration. **(04 Marks)**

b. Prove that the extension of uniform bar due to self weight is half of the extension when the load equal to its self weight is applied at the end of the suspended bar. **(08 Marks)**

c. A prismatic bar ABCD is subjected to loads P_1, P_2 and P_3 as shown in the Fig.1(c). The bar is made of steel with modulus of elasticity E = 200 GPa and cross sectional area A = 225 mm^2. Determine the deflection 'δ' at the lower end of the bar due to applied loads. **(08 Marks)**

Fig.1(c).

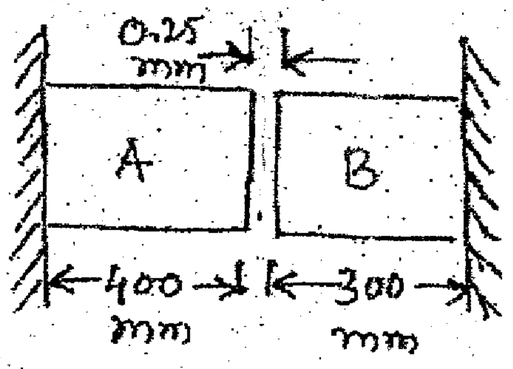


2 a. Establish a relationship between the modulus of elasticity and the modulus of rigidity. **(10 Marks)**

b. At room temperature the gap between bar A and bar B shown in Fig.2(b) is 0.25mm. What are the stresses induced in the bars, if the temperature rise is 35^0C?

Given $A_a = 1000\ mm^2$ $A_b = 800\ mm^2$
$E_a = 2 \times 10^5\ N/mm^2$ $E_b = 1 \times 10^5\ N/mm^2$
$\alpha_a = 12 \times 10^{-6}\ /^0C$ $\alpha_b = 23 \times 10^{-6}\ /^0C$
$L_a = 400$ mm $L_b = 300$ mm **(10 Marks)**

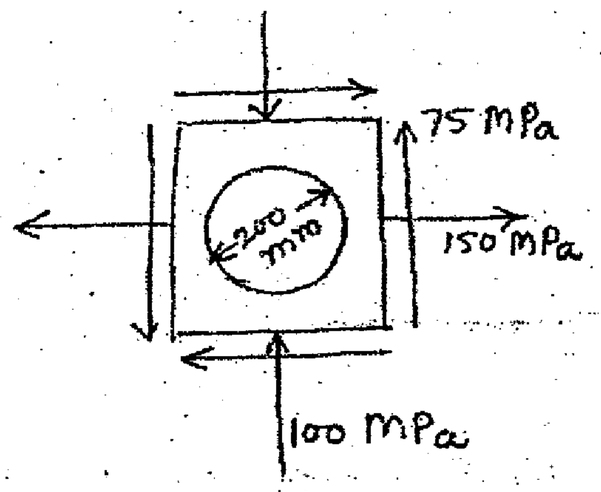
Fig.2(b).



3 a. Construct the Mohr's circle for a point in the machine member subjected to pure shear of 50 MPa. Determine the maximum and the minimum stresses induced and orientation of their planes. **(08 Marks)**

b. A point in a machine is subjected to stresses as shown in Fig.3(b). A circle of diameter 200 mm on the member is converted in to ellipse after the application of stresses. Determine major and minor axes of the ellipse and their orientations. Take $E = 2 \times 10^5$ MPa and the Poisson's ratio, $\mu = 0.3$. **(12 Marks)**

Fig.3(b).



4 a. What are the differences between thin and thick cylinder? **(02 Marks)**

b. Derive Lamme's equation for thick cylinder. **(08 Marks)**

c. A thin cylindrical shell 1.2 m in diameter and 3 m long has a metal wall thickness of 12 mm. It is subjected to an internal fluid pressure of 3.2 MPa. Find the circumferential and longitudinal stress in the wall. Determine change in length, diameter and volume of the cylinder. Assume E = 210 GPa and $\mu = 0.3$ **(10 Marks)**

PART B

5 a. Define shear force, bending moment, point of contraflexture and beam. **(04 Marks)**

b. Draw shear force and bending moment diagram for beam shown in figure Q 5 (b), indicating the principal values. **(16 Marks)**

6 a. Prove that maximum shear stress in a rectangular section of width b and depth d is equal to 1.5 times of its average shear stress. **(06 Marks)**

b. Explain neutral axis and modulus of section as applied to beam. **(04 Marks)**

c. An unequal angle section shown in figure Q6 (c) is used as a simply supported beam over a span of 2 m and uniformly distributed load of 10 kN/m, inclusive of its own weight. Determine the maximum tensile and compressive stresses in the section. **(10 Marks)**

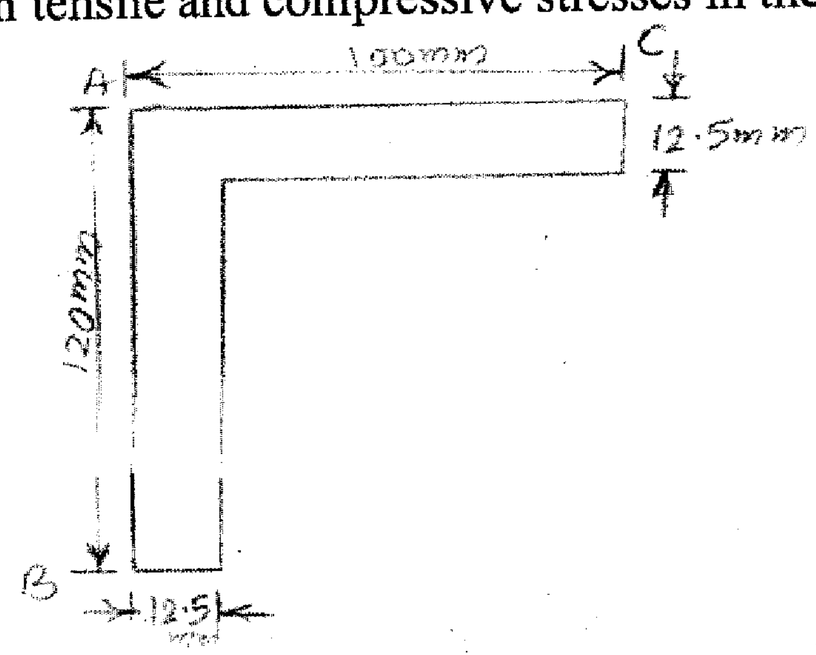


Fig. Q6 (c)

7 a. For simply supported beam with uniformly distributed load over whole length show that the maximum deflection is equal to $\frac{-5}{384}\frac{WL^4}{EI}$. **(05 Marks)**

b. A beam AB of span 6 m is simply supported at the ends and is loaded as shown in figure Q7 (b). Determine i) deflection at C ii) maximum deflection and iii) slope at the end A. Take $E = 2 \times 10^5$ N/mm^2, $I = 2 \times 10^7$ mm^4. **(15 Marks)**

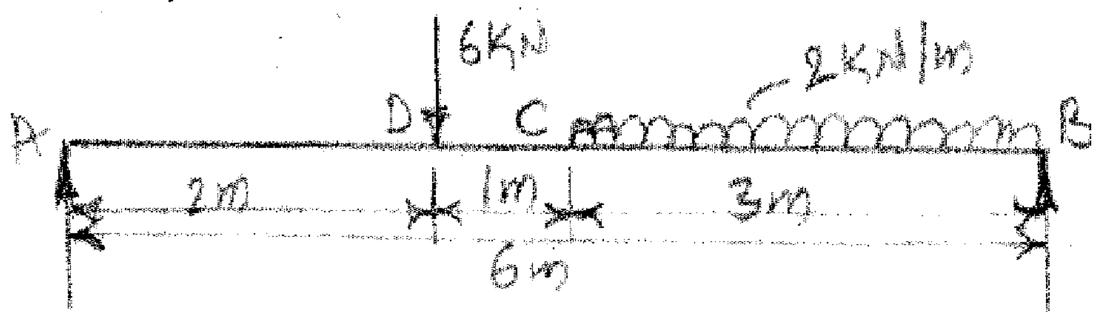


Fig. Q7 (b)

8 a. Derive the torsion formula, in the standard form $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$ and list all the assumptions made while deriving the same. **(08 Marks)**

b. A hollow column of C.I. whose outside diameter is 200 mm, has thickness of 20 mm. It is 4.5 m long and is fixed at both the ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate slenderness ratio and the ratio of Euler's and Rankine's critical loads. Take $\sigma_C = 550$ N/mm^2, $\alpha = \frac{1}{1600}$ and $E = 8 \times 10^4$ N/mm^2. **(12 Marks)**

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