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06ME34

Third Semester B.E. Degree Examination, June/July 08
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions choosing at least two questions from each section.***
2. ***Assume suitable data wherever necessary.***

PART A

1 a. Define Hook's law, modulus of elasticity, elasticity and strain. **(04 Marks)**

b. Derive an expression for the total extension of the tapered circular bar cross section of diameter D and d, when it is subjected to an axial pull of load P. **(06 Marks)**

c. For the laboratory tested speciman the following data were obtained:

i) Diameter of the speciman = 25 mm
ii) Length of speciman = 300 mm
iii) Extension under the load of 15 KN = 0.045 mm
iv) Load at yield point = 127.65 KN
v) Maximum load = 208.60 KN
vi) Length of the speciman after failure = 375 mm
vii) Neck diameter = 17.75 mm

Determine : i) Young's modulus ii) Yield point stress iii) Ultimate stress iv) Percentage elongation v) Percentage reduction in area. **(10 Marks)**

2 a. Derive the relationship between Young's modulus and modulus of rigidity in the form of $E = \dfrac{9GK}{3K+G}$. **(06 Marks)**

b. Derive an expression for extension of the bar due to its self weight only having area 'A' and length 'L' suspended from its top. **(04 Marks)**

c. A 12 mm diameter steel rod passes centrally through a copper tube 48 mm external diameter and 36 mm internal diameter and 2.50 m long. The tube is closed at each end by 24 mm thick steel plates which are secured by nuts. The nuts are tightned until the copper tube is reduced in length by 0.508 mm. The whole assembly is then raised in temperature by 60°C. Calculate the stresses in copper and steel before and after raising the temperature, assuming the thickness of the plates remain to be unchanged.

Take $\alpha_S = 1.2 \times 10^{-5}$ per °C, $\alpha_C = 1.75 \times 10^{-5}$ per °C

$E_S = 2.1 \times 10^5$ N/mm², $E_C = 1.05 \times 10^5$ N/mm² **(10 Marks)**

3 a. What are principal stresses and principal planes? **(02 Marks)**

b. Explain procedure for construction of Mohr's circle with tensile, compressive and shear stresses acting on the component. **(06 Marks)**

c. The state of stress in two dimensionally stressed body is as shown in figure Q3 (c). Determine the principal planes, principal stresses, maximum shear stress and their planes. **(12 Marks)**

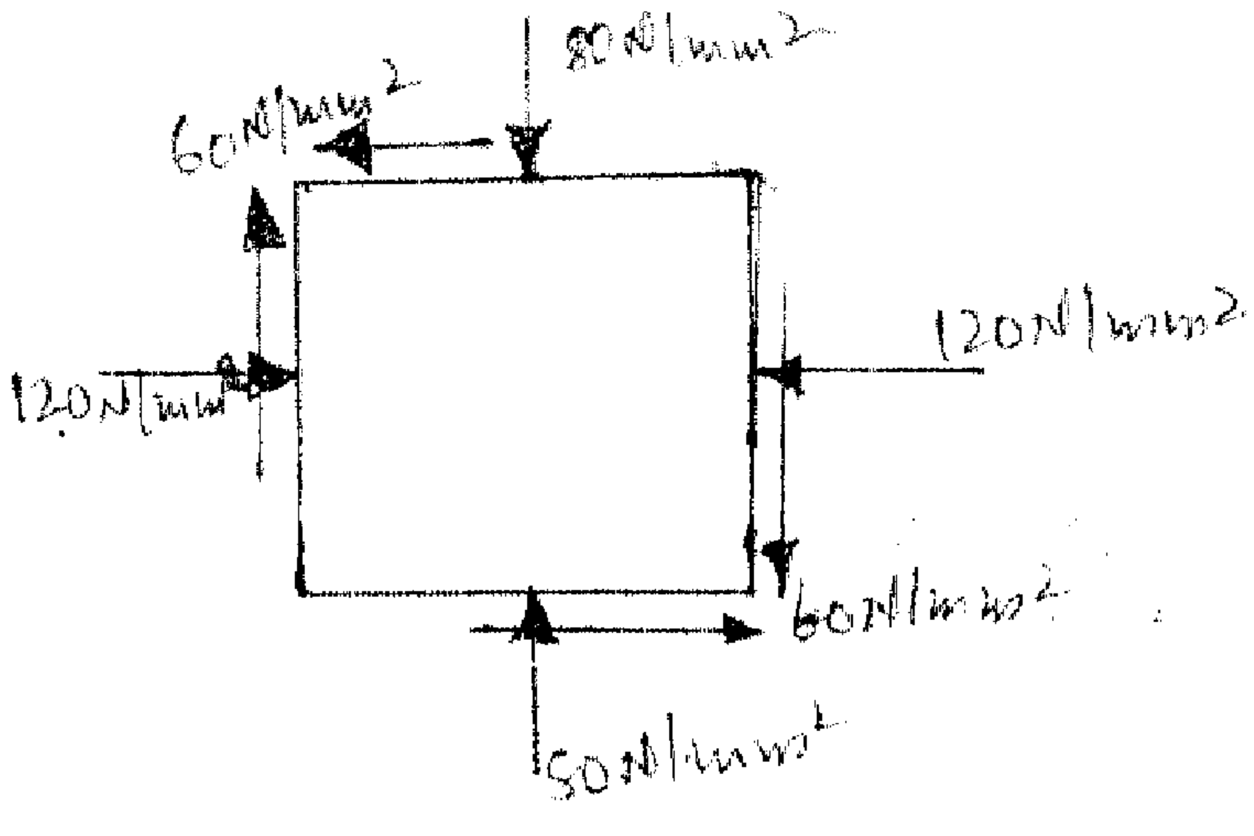

Fig. Q3 (c)

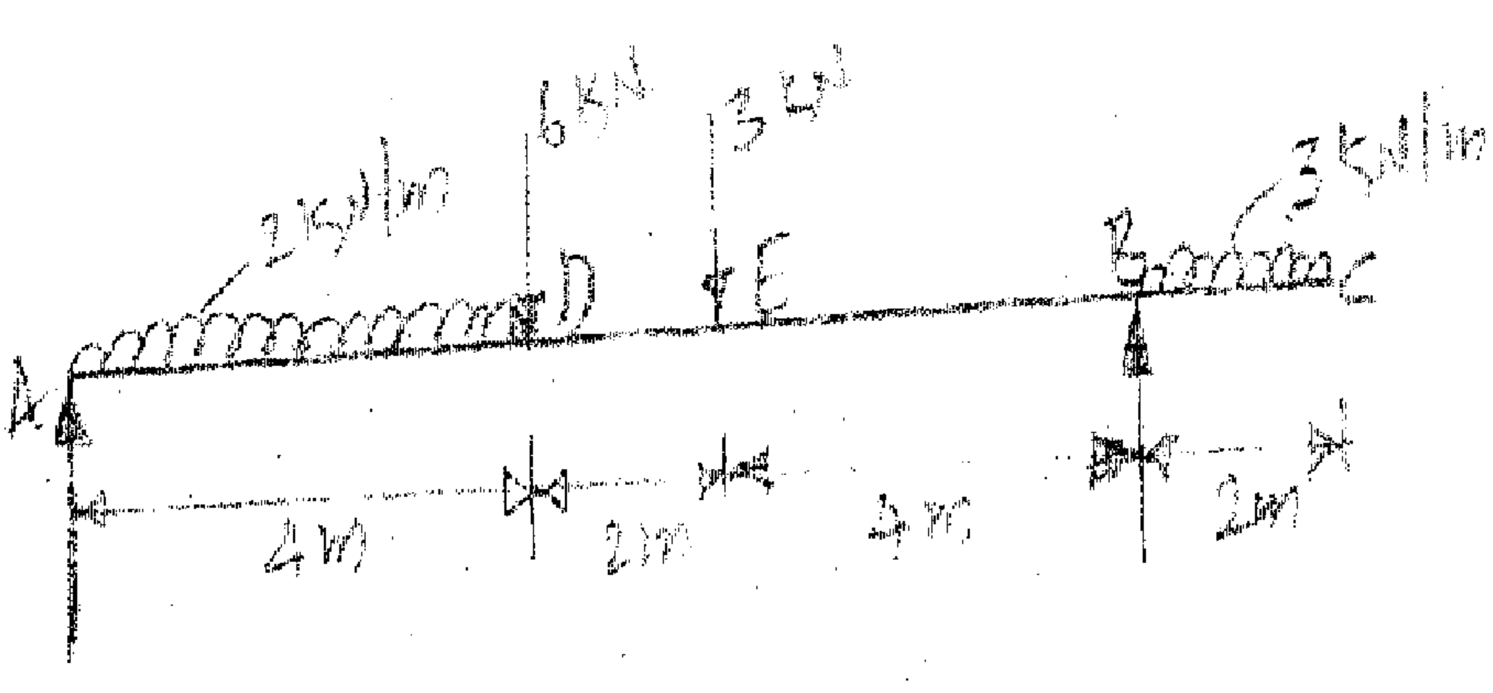

Fig. Q5 (b)

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)

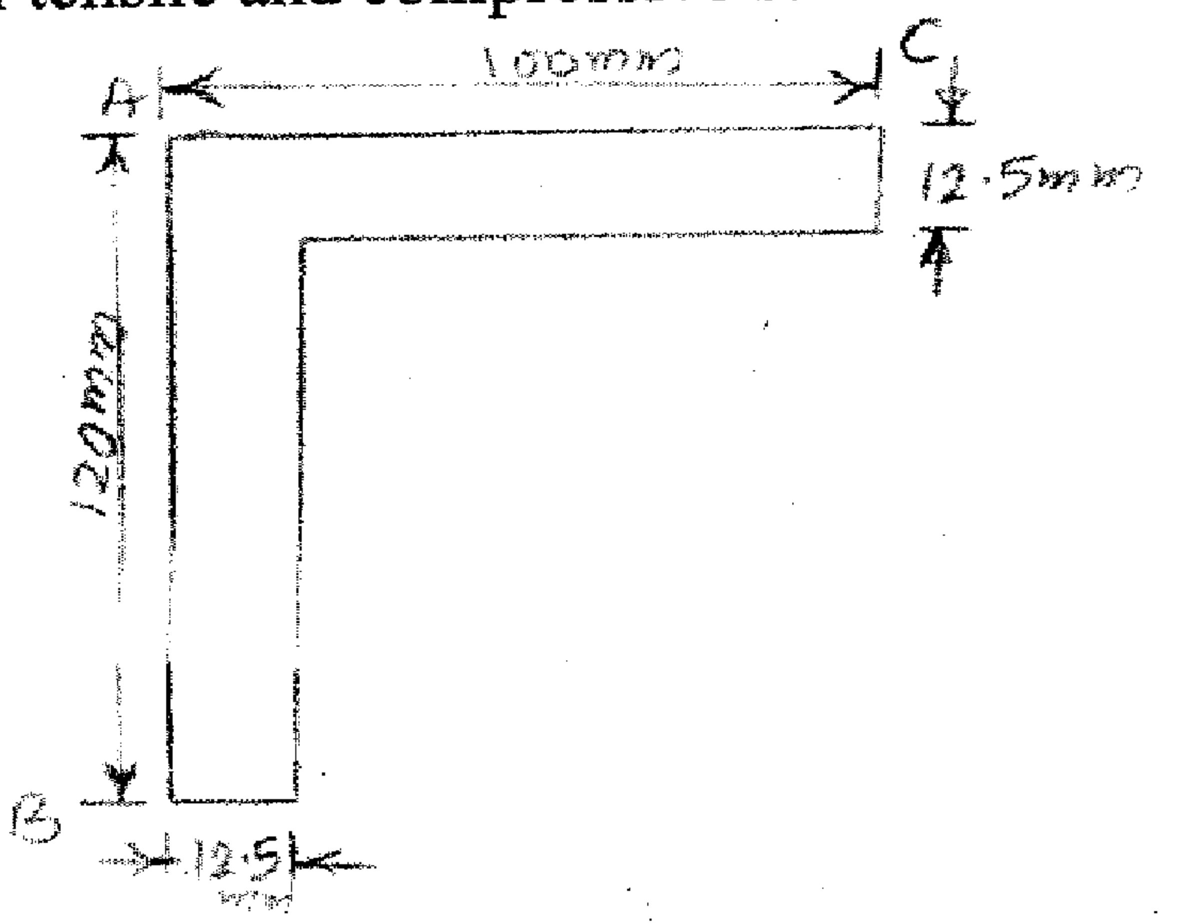

Fig. Q6 (c)

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)

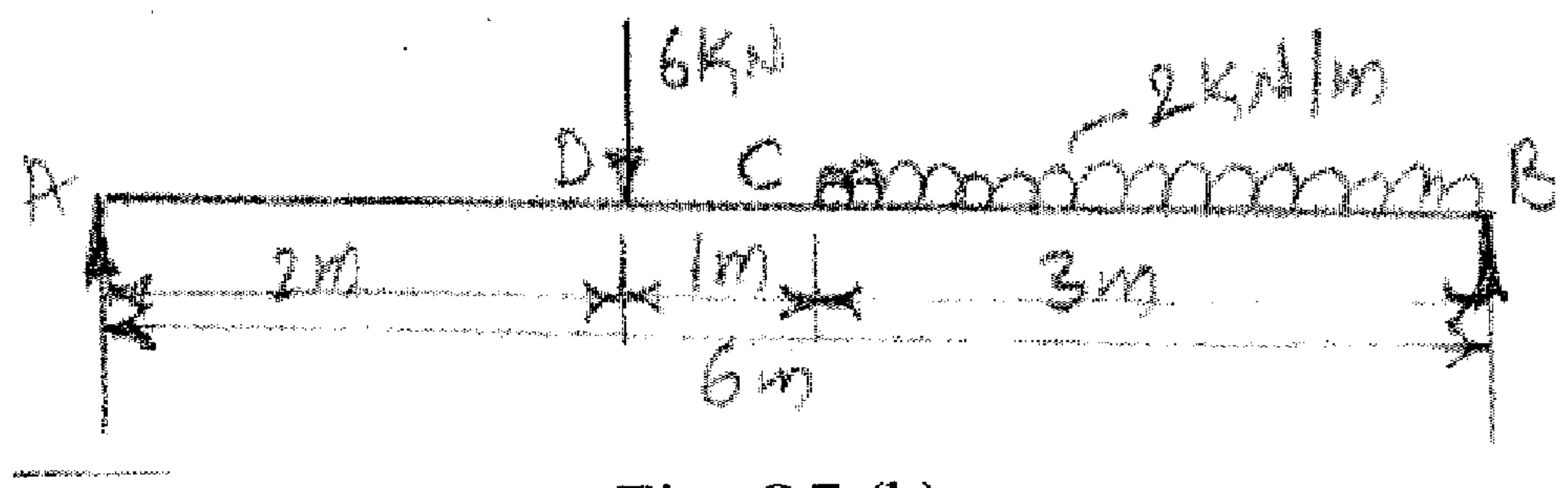

Fig. Q7 (b)

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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