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10ME/AU/PM/TL34

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

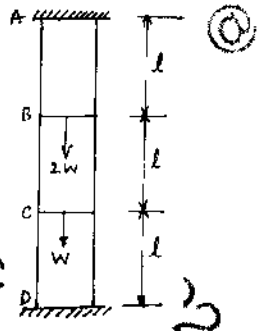
Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define: i) True stress ii) Factor of safety iii) Poisson's ratio iv) Principle of superposition **(04 Marks)**

b. A bar of uniform thickness 't' tapers uniformly from a width of b_1 at one end to b_2 at other end, in a length of 'L'. Find the expression for the change in length of the bar when subjected to an axial force P. **(08 Marks)**

c. 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.Q2(c). Determine the end reactions if W = 1.5 kN. **(08 Marks)**



2 a. Define: i) Volumetric strain, ii) Bulk modulus. **(02 Marks)**

b. A bar of rectangular cross section shown in Fig.Q2(b) is subjected to stresses σ_x, σ_y and σ_z in x, y and z directions respectively. Show that if sum of these stresses is zero, there is no change in volume of the bar.

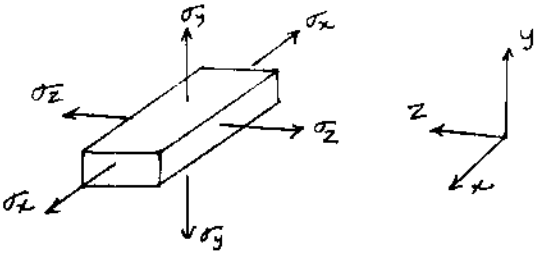


Fig.Q2(b) **(09 Marks)**

c. Rails are laid such that there is no stress in them at 24°C. If the rails are 32 m long, determine:

i) The stress in the rails at 80°C, when there is no allowance for expansion

ii) The stress in the rails at 80°C, when there is an expansion allowance of 8 mm per rail.

iii) The expansion allowance for no stress in the rails at 80°C.

Coefficient of linear expansion $\alpha = 11 \times 10^{-6}/°C$ and Young's modulus E = 205 GPa. **(09 Marks)**

3 a. Derive the expressions for normal and tangential stress on a plane inclined at 'θ' to the plane of stress in x-direction in a general two dimensional stress system and show that sum of normal stress in any two mutually perpendicular directions is constant. **(12 Marks)**

3 b. The state of stress in a two dimensionally stressed body is shown in Fig.Q3(b). Determine graphically (by drawing Mohr's circle), the principal stresses, principal planes, maximum shear stress and its planes. **(08 Marks)**

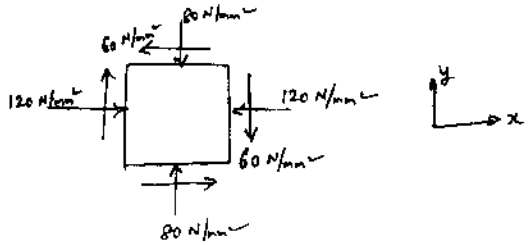


Fig.Q3(b)

4 a. A beam of length ℓ is simply supported at its ends. The beam carries a uniformly distributed load of w per unit run over the whole span. Find the strain energy stored by the beam. **(06 Marks)**

b. A water main 80 cm diameter contains water at a pressure head of 100 m. If the weight density of water is 9810 N/m^3, find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2. **(06 Marks)**

c. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum and minimum hoop stress across the section. Also, sketch the radial pressure distribution and hoop stress distribution across the section. **(08 Marks)**

PART – B

5 a. Define a beam. Explain with simple sketches, different types of beams. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.Q5(b). Locate the point of contra flexure. **(14 Marks)**

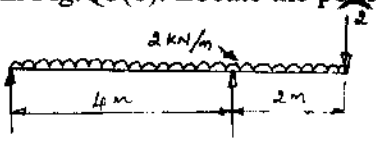


Fig.Q5(b)

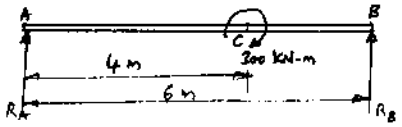


Fig.Q7(b)

6 a. State the assumptions made in the theory of simple bending. **(02 Marks)**

b. A simply supported cast iron square beam of 800 mm length and 15 mm × 15 mm in section fails on applying a load of 360 N at the mid span. Find the maximum uniformly distributed load that can be applied safely to a 40 mm wide, 75 mm deep and 1.6 m long cantilever made of the same material. **(08 Marks)**

c. Show that the shear stress across the rectangular section varies parabolically. Also show that the maximum shear stress is 1.5 times the average shear stress. Sketch the shear stress variation across the section. **(10 Marks)**

7 a. A cantilever 120 mm wide and 200 mm deep is 2.5 m long. What is the uniformly distribution load which the beam can carry in order to a deflection of 5 mm at the free end? Take E = 200 GN/m^2. **(04 Marks)**

b. A horizontal beam AB is simply supported at A and B, 6 m apart. The beam is subjected to a clockwise couple of 300 kN-m at a distance of 4 m from the left end as shown in Fig.Q7(b). If E = 2 × 10^5 N/mm^2 and I = 2 × 10^8 mm^4, determine: i) The deflection at the point where the couple is acting; ii)The maximum deflection. **(16 Marks)**

8 a. Derive torsion equation with usual notations. State the assumptions in the theory of pure torsion. **(10 Marks)**

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

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