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10MT33

Third Semester B.E. Degree Examination, June/July 2019
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. Derive an expression for deformation of taper bar having rectangular cross section subjected to axial pull. **(08 Marks)**

b. Define the following :
   i) Normal stress
   ii) Shear stress
   iii) Young's modulus
   iv) Poisson's ratio. **(04 Marks)**

c. A brass bar having cross – sectional area 300mm^2 is subjected to axial forces as shown in Fig Q1(c). Find the total elongation of the bar. Take E as 84GPa.

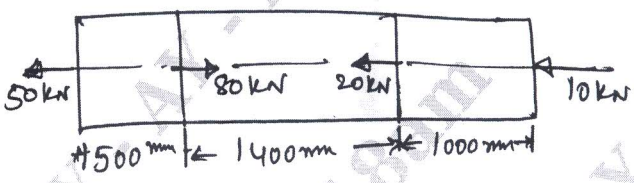

Fig Q1(c) **(08 Marks)**

2 a. Derive relation between Young's modulus and modulus of rigidity. $E = 2G(1 + \mu)$. **(10 Marks)**

b. A bar of 20m diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ration and elastic constants E, G, K. **(08 Marks)**

c. Define:
   i) Bulk modulus
   ii) Rigidity modulus. **(02 Marks)**

3 a. Define principal plane and principal stress. **(02 Marks)**

b. The state of stress at a point in strained material is as shown in Fig Q3(b). Determine :
   i) The direction of the principal planes
   ii) The magnitude of principal stresses
   iii) The magnitude of the maximum shear stress and its direction, Indicate all the above planes by a sketch.

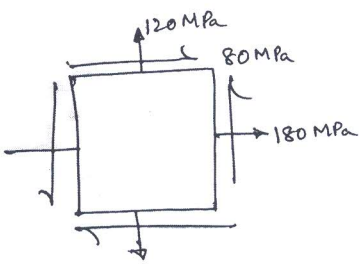

Fig Q3(b) **(12 Marks)**

c. The direct stresses acting at a point in a strained material are shown in Fig Q3(c). Find the normal, tangential and the resultant stresses on a plane 30° to the plane of major principal stress. Find the obliquity of the resultant stress also.

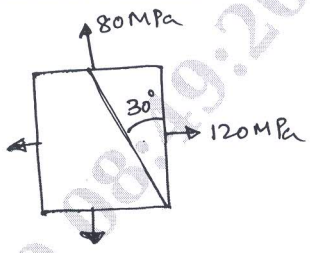

Fig Q3(c) **(06 Marks)**

4 a. Derive an expression for circumferential stress and longitudinal stress for thin cylinder subjected to internal pressure 'P'. **(10 Marks)**

b. Define : i) Strain energy ii) Resilience iii) Proof resilience. **(03 Marks)**

c. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure 80MPa. Find the maximum and minimum hoop stresses across the section, Also sketch the radial and hoop stress distribution across the section. **(07 Marks)**

PART – B

5 a. A simply supported beam with overhanging on its either supports is subjected to UDL of 10kN/m as shown in Fig Q5(a). Draw the SF and BM diagrams.

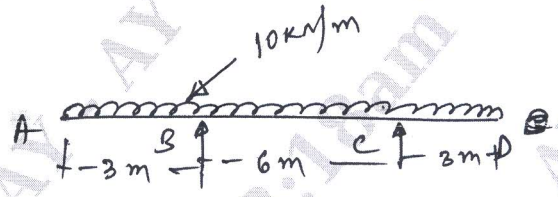

Fig Q5(a) **(14 Marks)**

b. A cantilever is subjected to point loads as shown in Fig Q5(b). Draw SFD and BMD.

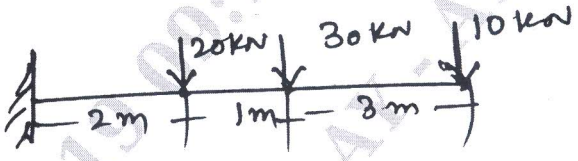

Fig Q5(b) **(06 Marks)**

6 a. Derive general equation for bending

$$\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$$

(12 Marks)

b. The T-section of a beam is as shown in Fig Q6(b). Determine maximum moment of resistance that the beam can support if yielding is to be avoid. **(08 Marks)**

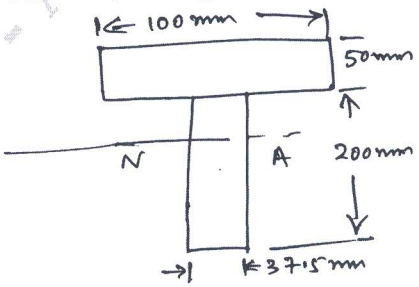

Fig Q6(b)

7 a. Derive deflection equation for bending

$$M = \frac{d^2y}{dx^2} EI.$$ **(10 Marks)**

b. Determine deflections and slope of the cantilever beam subjected to point load. **(10 Marks)**

8 a. Derive general equation for torsion

$$\left(\frac{T}{J}\right) = \left(\frac{G\theta}{L}\right) = \left(\frac{\tau}{R}\right)$$ **(12 Marks)**

b. Derive an expression for Euler's buckling load for both ends are hinged. **(08 Marks)**

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