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10ME/AU34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanics of Material

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: i) Proof stress ii) Toughness iii) Creep iv) Young's modulus. **(04 Marks)**

b. Explain principle of super position. **(02 Marks)**

c. Mention the assumptions made in the theory of simple stress and strain and derive the equation $\delta L = \frac{PL}{AE}$. **(06 Marks)**

d. Derive an expression for the total extension of the tapered circular bar cross section of diameter d_1 and d_2, when it is subjected to an axial pull of load P. **(08 Marks)**

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

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(08 Marks)**

c. A bar of 20mm 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 Poission's ratio, elastic constants (E, G, K) and change in volume. **(10 Marks)**

3 a. What are principle stresses and principal planes? Explain their uses. **(06 Marks)**

b. At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa and 32 MPa, both tensile and there is a shear stress of 32MPa clock wise on the plane carrying 80MPa stresses across the planes as shown in Fig Q3(b). Determine:

i) Maximum and minimum normal stresses and locate their planes

ii) Maximum shear stress and specify it plane.

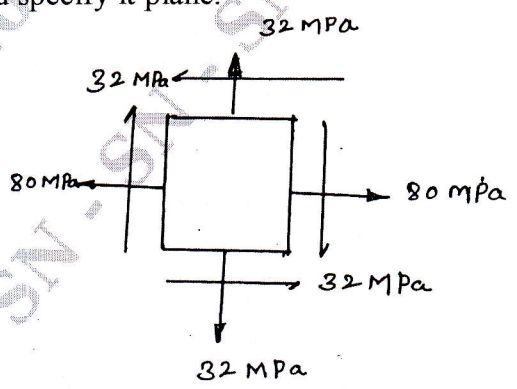

Fig Q3(b) **(14 Marks)**

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

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

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

PART – B

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

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

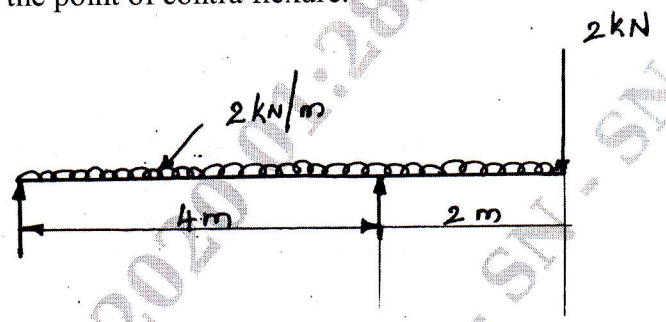

Fig Q5(b) **(14 Marks)**

6 a. 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)**

b. A cast iron beam is T section shown in Fig Q6(b) is used as a simply supported beam over a span of 4 meters. It carries an uniformly distributed load 8 kN/m^2 over its entire span. Determine the maximum tensile and compressive stresses.

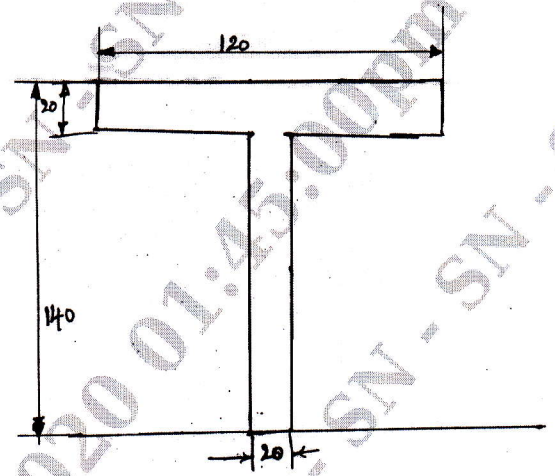

Fig Q6(b) **(10 Marks)**

7 a. Derive an expression with usual notations for the maximum deflection in simply supported beam subjected to point load at the mid span. **(10 Marks)**

b. A simply supported steel beam having uniform cross section is 14m span and is simply supported at its ends. It carries a concentrated load of 120kN and 80kN at two points 3m and 4.5m from the left and right end respectively. If the moment of inertia of the section is 160×10^7 mm^4 and E = 210 GPa, determine the deflection of the beam at load points. **(10 Marks)**

8 a. Derive torsional equation with usual notation. State the assumption in the theory of pure torsion. **(10 Marks)**

b. State the assumption made in the derivation of Euler's expression. Derive the Euler's expression for a column subjected to an axial compressive load. Consider both ends of the column as hinged. **(10 Marks)**