USN

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

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: (i) Stress (ii) Poisson's ratio (iii) Hook's law (iv) Factor of safety **(04 Marks)**

b. Explain stress-strain diagram for mild steel with salient features. **(06 Marks)**

c. A brass bar having cross section area of 900 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar if $E = 1 \times 10^5$ N/mm^2.

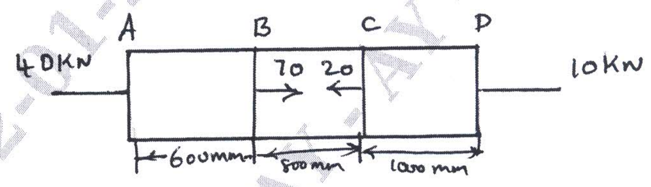

Fig.Q1(c) **(10 Marks)**

2 a. Define volumetric strain and obtain the expression for volumetric strain for circular bar. **(08 Marks)**

b. Derive an expression for establishing the relationship between Young's modulus and modulus of rigidity. **(10 Marks)**

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

3 a. Determine the expressions for normal and tangential stresses on a plane at θ to the plane of stress in x-direction in a general two-dimensional stress system and show that:

i) Sum of normal stresses in any two mutually perpendicular directions in constant.

ii) Principal planes are planes of maximum normal stresses also. **(12 Marks)**

b. The state of stress at a point in a strained material is shown in Fig.Q3(b). Determine:

i) The direction of the principal planes

ii) The magnitude of principal stresses

iii) The magnitude of maximum shear stress and its direction.

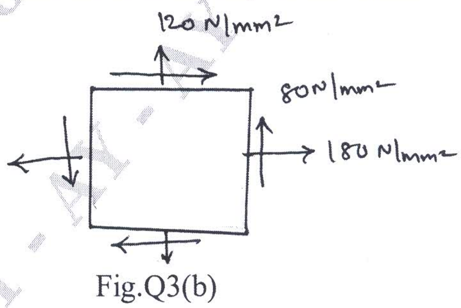

Fig.Q3(b) **(08 Marks)**

4 a. For a thin cylinder, if Hoop stress $f_1 = \frac{Pd}{2t}$ and longitudinal stress $f_2 = \frac{Pd}{4t}$, derive an expression for volumetric strain. **(10 Marks)**

b. A thick pipe of 300 mm outer diameter and 200 mm internal diameter is subjected to an internal pressure of 12 MPa. What minimum external pressure can be applied so that the tensile stress in the metal shall not exceed 16 MPa? **(10 Marks)**

PART – B

5 a. Classify beams (based on type of supports) and loads sketch them. (10 Marks)

b. Draw bending moment and shear force diagram for the overhanging beam shown in Fig.Q5(b). Clearly indicate the point of contra flexure.

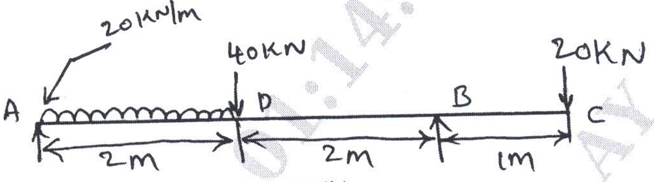

Fig.Q5(b) (10 Marks)

6 a. State the assumptions made in simple bending theory. (05 Marks)

b. A simply supported beam of span 5m has a cross section 150 mm × 250 mm. If the permissible stress is 10 N/mm^2, find:

i) Maximum intensity of uniformly distributed load it can carry.

ii) Maximum concentrated load P applied at 2m from one end it can carry. (15 Marks)

7 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$ with usual notations. (10 Marks)

b. Find the deflection at C in the beam loaded as shown in Fig.Q7(b). Takes EI = 10,000 kN-m^2.

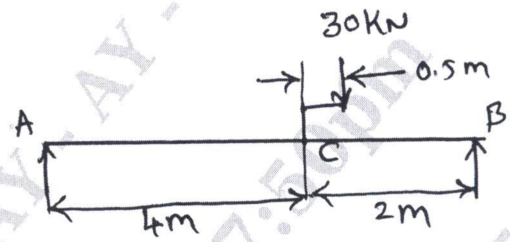

Fig.Q7(b) (10 Marks)

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

b. Determine the diameter of a solid shaft which will transmit 440 kW at 280 rpm. The angle of twist should not exceed one degree per metre length and the maximum torsional shear stress is to be limited to 40 N/mm^2. Assume h = 84 kN/mm^2. (10 Marks)

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