USN

Third Semester B.E. Degree Examination, Aug./Sept.2020
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART – A

1 a. Define : (i) Hook's law (ii) Linear strain (iii) Poisson's ratio (iv) Elasticity **(04 Marks)**

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

c. A bar of 800 mm length is attached rigidly at A and B as shown in Fig.Q1(c). Forces of 30 kN and 60 kN act as shown on the bar. If E = 200 MPa, determine the reactions at the two ends. If the bar diameter is 25mm, find the stresses and change in length of each portion.

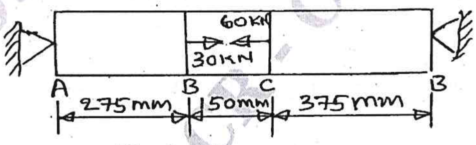

Fig.Q1(c) **(10 Marks)**

2 a. Define : (i) Volumetric strain (ii) Young's modulus (iii) Modulus of rigidity (iv) Bulk modulus **(04 Marks)**

b. Derive an expression for establishing the relationship between Young's modulus and modulus of rigidity. **(06 Marks)**

c. At room temperature the gap between bar A and B shown in Fig.Q2(c) is 0.25mm. What are the stresses induced in the bars, if temperature rise is 35°C. Given A_A = 1000 mm^2, A_B = 800 mm^2, $E_A = 2\times10^5$ N/mm^2, $E_B = 1\times10^5$ N/mm^2, $\alpha_A = 12\times10^{-4}$/°C, $\alpha_B = 23\times10^{-6}$/°C L_A = 400mm and L_B = 300mm.

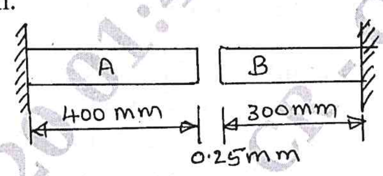

Fig.Q2(c) **(10 Marks)**

3 a. The direct stresses acting at a point in a strained material are shown in Fig.Q3(a). 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.

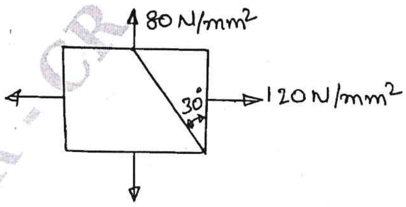

Fig.Q3(a) **(08 Marks)**

b. The state of stress at a point in a strained material is as shown in Fig.Q3(b). Determine (i) The direction of the principal planes (ii) The magnitude of principal stresses and (iii) The magnitude of the maximum shear stress and its direction indicating all the above planes by a sketch. [For diagram P.T.O.] **(12 Marks)**

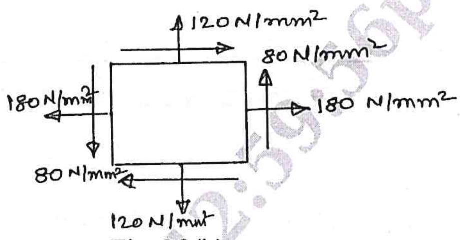

Fig.Q3(b)

4 a. Define (i) Strain energy (ii) Work (iii) State Castigliano's theorem. **(06 Marks)**

b. Derive an expression for longitudinal stress of a thin cylinder. **(04 Marks)**

c. A thick cylinder of internal diameter 160mm is subjected to an internal pressure 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2. Find the thickness required. **(10 Marks)**

PART – B

5 a. Explain the terms :
(i) Sagging bending moment (ii) Hogging bending moment (iii) Point of Contraflexure. **(05 Marks)**

b. What are the different types of load acting on a beam? Explain with sketches. **(05 Marks)**

c. The simply supported beam shown in Fig.Q5(c) carries two concentrated loads and a uniformly distributed load. Draw shear force and bending moment diagrams.

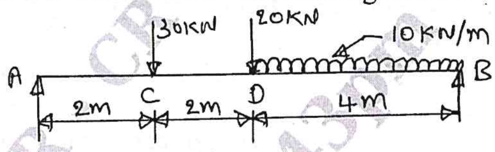

Fig.Q5(c) **(10 Marks)**

6 a. What are the assumptions made in simple theory of bending? **(04 Marks)**

b. Derive the expression for relationship between bending stress and radius of curvature. **(06 Marks)**

c. A cantilever has a length of 3m. Its cross-section is of T-section with flanges 100mm×20mm and web 200mm × 12mm, the flanges is in tension. What is the intensity of uniformly distributed load that can be applied if the maximum tensile stress is limited to 30 N/mm^2. Also compute the maximum compressive stress. **(10 Marks)**

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

b. Determine the deflection under the loads in the beam shown in Fig.Q7(b). Take flexural rigidity as EI throughout.

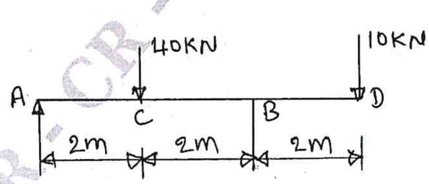

Fig.Q7(b) **(10 Marks)**

8 a. Prove that a hollow shaft is stronger and stiffer than solid shaft of the same material, length and weight. **(10 Marks)**

b. A hallow cast iron whose outside diameter is 200mm and has a thickness of 20mm is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formulae using a factor of safety of 2.5. Find the ratio of Euler's to Rankine's loads. Take $E = 1\times10^5$ N/mm^2 and Rankine's constant = 1/1600 for both ends pinned case and $\sigma_c = 550$ N/mm^2. **(10 Marks)**

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