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10MT33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data if any may be suitably assumed.***

PART – A

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

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

c. The bar shown in Fig.Q1(c) is tested in universal testing machine. It is observed that at a load of 40 kN the total extension of the bar is 0.285 mm. Determine the Young's modulus of the material.

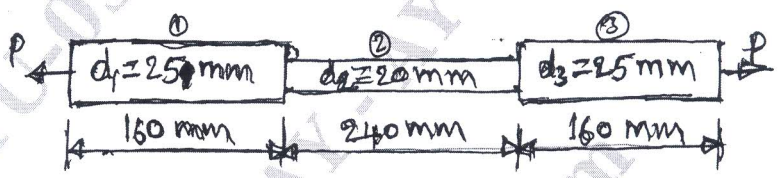

Fig.Q1(c) **(10 Marks)**

2 a. Explain volumetric strain and obtain the expression for volumetric strain for a circular bar. **(04 Marks)**

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(06 Marks)**

c. A compound bar is made of a central steel plate 60 mm wide and 10 mm thick to which copper plates 40 mm wide by 5 mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80°C, determine the stresses in each metal and the change in length. Take $E_s = 200$ GN/m^2, $E_c = 100$ GN/m^2, $\alpha_s = 12 \times 10^{-6}$/°C, $\alpha_c = 17 \times 10^{-6}$/°C. **(10 Marks)**

3 a. Explain: (i) Plane stress (ii) Principal strain. **(04 Marks)**

b. Derive an expression for an element subjected to uniaxial stress. **(06 Marks)**

c. The state of stress at a point in a strained material is shown in Fig.Q3(c). Determine:
i) The direction of the principal planes
ii) Magnitude of the principal stresses
iii) The magnitude of the maximum shear stress and its direction.

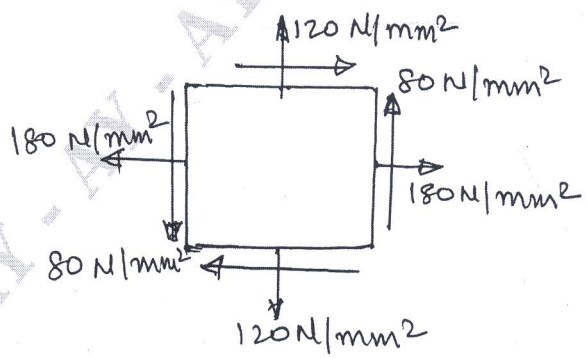

Fig.Q3(c) **(10 Marks)**

4 a. The bar with circular cross section as shown in Fig.Q4(a) is subjected to a load of 10 kN. Determine the strain energy stored in it. Take $E = 2.1 \times 10^5$ N/mm^2.

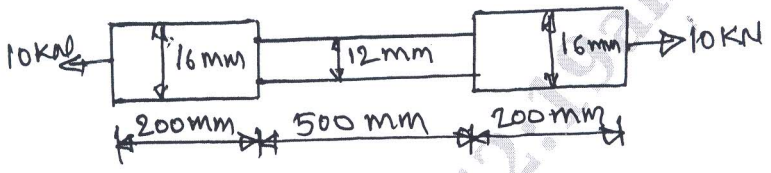

Fig.Q4(a) **(10 Marks)**

b. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure 80 N/mm^2. Find the maximum and minimum hoop stresses across the section. Also sketch the radial and hoop stress distribution across the section. **(10 Marks)**

PART – B

5 a. Derive expressions relating load, shear force and bending moment with used notations. **(05 Marks)**

b. A simply supported beam AB of 6 m span is loaded as shown in Fig.Q5(b). Draw the shear force and bending moment diagram.

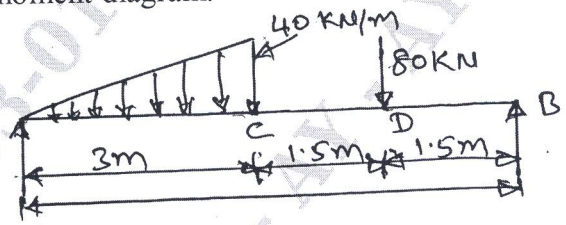

Fig.Q5(b) **(15 Marks)**

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

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

c. A cast iron beam has an I-section with top flange 80 mm × 40 mm, web 120 mm × 20 mm and bottom flange 160 mm × 40 mm. If tensile stress is not to exceed 30 N/mm^2 and compressive stress 90 N/mm^2, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6m if the larger flange is in tension. **(10 Marks)**

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

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

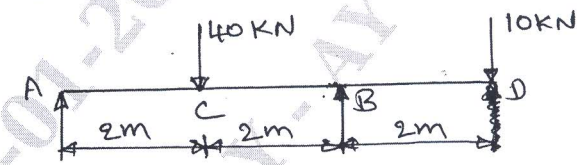

Fig.Q7(b) **(10 Marks)**

8 a. Derive an expression $\frac{T}{I_p} = \frac{q}{r} = \frac{G\theta}{\ell}$ with usual notations. **(10 Marks)**

b. A hollow cast iron whose outside diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formulae using factor of safety of 2.5. Find the ratio of Euler's to Rankine's load. Take $E = 1 \times 10^5$ 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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