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10ME/AU34

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain stress-strain curve with salient points. **(06 Marks)**

b. Obtain an expression extension of a bar with continuously varying rectangular cross section. **(08 Marks)**

c. Determine the reactions at the two ends of the bar if the diameter is 25mm and modulus of elasticity is 200 GPa as shown in the Fig.Q.1(c). **(06 Marks)**

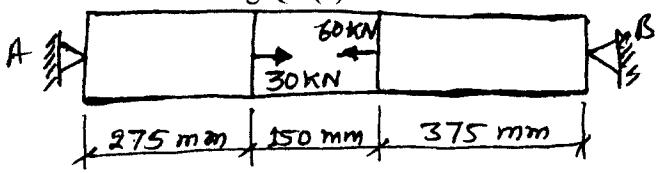

Fig.Q.1(c)

2 a. Derive an equation for volumetric strain for triaxial stress system. **(06 Marks)**

b. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide by 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is one meter. If the temperature is raised by 80°C, determine the stresses in each metal and the change in length. Take E_s = 200GPa, E_c = 100GPa, $\alpha_s = 12 \times 10^{-6}$/°C and $\alpha_c = 17 \times 10^{-6}$/°C. **(14 Marks)**

3 a. State of stress at a point in a strained material with tensile stress of 180 N/mm^2 in x-direction, tensile stress of 120 N/mm^2 in y-direction and shear stress of 80 N/mm^2. 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.

Indicate all the above planes by a sketch. **(10 Marks)**

b. The bi-axial stress system subjected to a tensile stress of 60 N/mm^2, compressive stress of 40N/mm^2 in x and y directions respectively and shear stress 10 N/mm^2. Determine using Mohr's circle principal stresses, maximum shear stress and its directions. **(10 Marks)**

4 a. A cylindrical shell is 3m long and is having one meter internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of shell if it is subjected to an internal fluid pressure of 1.5 N/mm^2. Take $E = 2 \times 10^5$Pa and Poissons ratio is 0.3. **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure of 14N/mm^2. Determine the maximum hoop stress developed in the cross section. What is the percentage of error if the maximum hoop stress is found from the equation for thin pipes? **(10 Marks)**

PART – B

5 a. Draw the shear force and bending moment diagrams for the cantilever beam shown in the Fig.Q.5(a). **(08 Marks)**

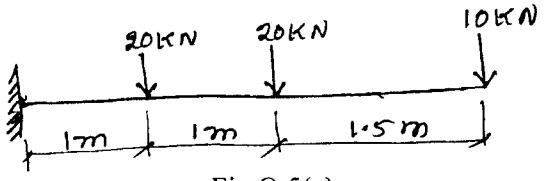

Fig.Q.5(a)

b. For the beam AC shown in the Fig.Q.5(b), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw shear force and bending moment diagrams and locate the point of contra flexure if any **(12 Marks)**

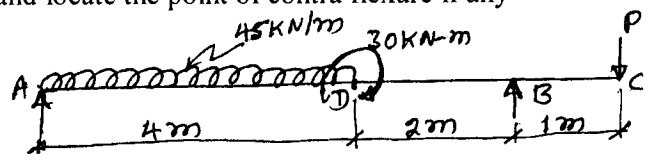

Fig.Q.5(b)

6 a. Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$. **(10 Marks)**

b. A simply supported beam of span 5m has a cross section 150mm × 250mm. If the permissible stress is 10N/mm^2, find: i) maximum intensity of uniformly distributed load it can carry; ii) maximum concentrated load P applied at 2m from an end it can carry. **(10 Marks)**

7 a. Derive deflection equation for a simply supported beam subjected to uniformly distributed load. **(10 Marks)**

b. Determine the deflection at points C, D and E in the beam shown in the Fig.Q.7(b). Take E = 200 kN/mm^2 and I = 60 × 10^6 mm^4. **(10 Marks)**

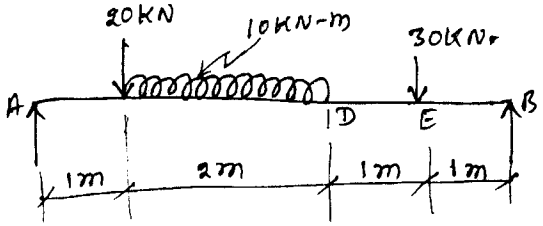

Fig.Q.7(b)

8 a. Derive Euler's equation of a column for both ends hinged. **(10 Marks)**

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

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