CBCS SCHEME

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17AU34

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, choosing ONE full question from each module.

Module-1

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

b. Explain stress-strain relationship showing the salient points on the diagram. **(06 Marks)**

c. Derive an expression for the deformation of tapered bar of circular section, subjected to a tensile load. **(10 Marks)**

OR

2 a. The following data refer to a mild steel specimen tested in a laboratory.
Diameter of specimen = 25mm,
Gauge length of a specimen = 200mm
Extension under a load of 20kN = 0.04mm
Load at yield point = 150kN
Maximum load = 225kN
Length of specimen after failure = 275mm
Neck diameter = 18.25mm.
Determine:
i) Young's modulus
ii) Yield stress
iii) Ultimate stress
iv) Percentage elongation
v) Percentage of reduction in area
vi) Safe stress adopting a factor of safety of 2.5. **(06 Marks)**

b. Determine the magnitude of the load P necessary to produce zero net change in the length of the straight bar shown in Fig.Q.2(b) A = 400mm^2. **(06 Marks)**

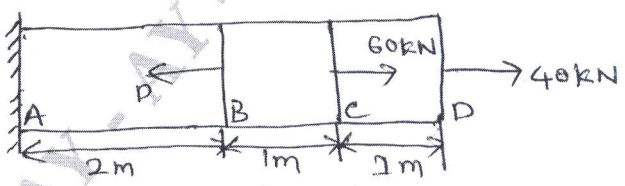

Fig.Q.2(b)

c. Derive a relation for volumetric strain due to three mutually perpendicular stresses or generalized Hooke's law. **(08 Marks)**

Module-2

3 a. Explain the concept of principal stresses and maximum shear stress with appropriate equations. **(06 Marks)**

b. Draw the Mohr's circle of the stress element shown below in Fig.Q.3(b). Determine the principle stresses and the maximum shear stresses. **(14 Marks)**

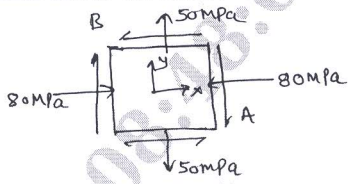

Fig.Q.3(b)

OR

4 a. Derive an expression for longitudinal and circumferential stress in thin cylinders. **(06 Marks)**

b. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3MPa. Determine:

i) Circumferential and longitudinal stress

ii) Circumferential, longitudinal and volumetric strain

iii) Change in the length, diameter and volume.

Find the maximum shearing stress in the shell. Assume Poisson's ratio as 0.3 and E = 210 GPa. **(08 Marks)**

c. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand a internal fluid pressure of $8N/mm^2$. The maximum allowable or permissible or hoop stress in the section is not to exceed $35N/mm^2$. **(06 Marks)**

Module-3

5 Draw shear force and bending moment diagram for the beam as shown in the Fig.Q.5 marking valves at salient points. Locate the point of contraflexure and point of maximum bending moment. Determine the valve of maximum bending moment. **(20 Marks)**

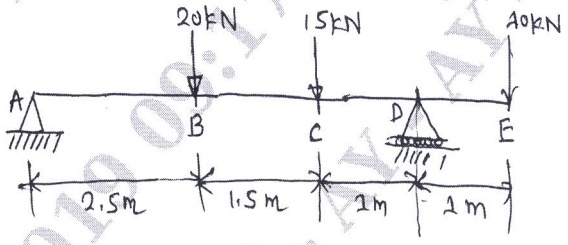

Fig.Q.5

OR

6 a. Derive relation between slope, deflection and radius of curvature of Euler Bernoulli equation for deflection or differential equation for deflection of curve. **(10 Marks)**

b. An unequal angle section shown in Fig.Q.6(b) is used as simply supported beam with span of 2m and uniformly distributed load of 10kN/m inclusively of its own weight determine the maximum tensile and compressive stress in section. **(10 Marks)**

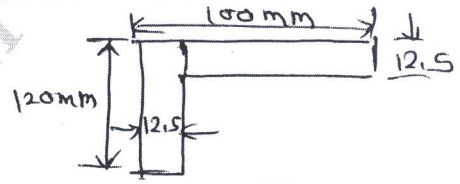

Fig.Q.6(b)

Module-4

7 a. Derive relation between torque and shear stress in a hallow circular shaft. **(08 Marks)**

b. A hallow circular steel shaft has to transmit 60kW at 210rpm such that the maximum shear stress does not exceed 60MN/m^2. If the ratio of internal to external diameter is equal to 3/4 and the value of rigidity modulus is 84GPa. Find the dimensions of the shaft and angle of twist in the length of 3m. **(12 Marks)**

OR

8 a. Derive an Euler's crippling load for a column. When one end of the column is fixed and other end hinged or pinned? **(10 Marks)**

b. A hollow circular section 2.8m long column is fixed at one end and hinged at the other end external diameter is 150mm and thickness of wall is 15mm Rankine constant = 1/1600 and σ_c = 550MPa. Compare the buckling loads obtained by using Euler's formula and Rankine formula. Also find the length of column for which both formulae gives the same load. Take E = 80GPa. **(10 Marks)**

Module-5

9 a. State and explain Castigliano's theorem. **(06 Marks)**

b. Determine the internal strain energy stored within an elastic bar subjected to a torque T. **(06 Marks)**

c. A cantilever beam AB supports a uniformly distributed load W per unit length as shown in Fig.Q.9(c). Determine the deflection and slope at by using Cantiglian's theorem. **(08 Marks)**

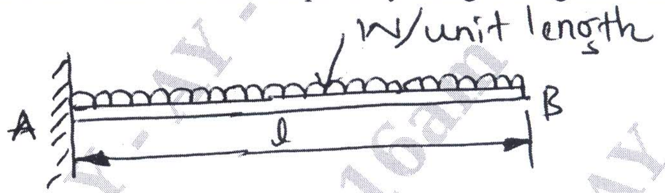

Fig.Q.9(c)

OR

10 a. Explain in detail Maximum principal stress theory. **(10 Marks)**

b. Explain in detail maximum shear stress theory. **(10 Marks)**

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