CBCS SCHEME

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15ME34

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive an expression for the extension of uniformly tapering circular bar subjected to axial load. **(08 Marks)**

b. A stepped bar made up of steel and brass in subjected to a pull of 30 kN as shown in Fig.Q1(b). Determine the deformation of each material and stress in each material. Take E_S = 200 GPa, E_B = 100 GPa.

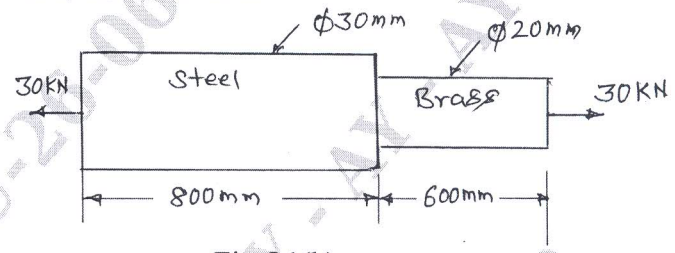

Fig.Q1(b) **(08 Marks)**

OR

2 a. Define: i) Young's modulus ii) Bulk modulus iii) Poisson's ratio iv) Thermal stress **(08 Marks)**

b. A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Determine: i) Lateral strain ii) Poisson's ratio iii) Elastic moduli E, G, K. **(08 Marks)**

Module-2

3 a. Define or explain (i) Principal plane (ii) Principal stress (iii) Plane of maximum shear (iv) Maximum shear stress. **(08 Marks)**

b. For a two dimensional stressed element shown in Fig.Q3(b), determine principal stresses, principal planes, maximum shear stress and maximum shear stress planes.

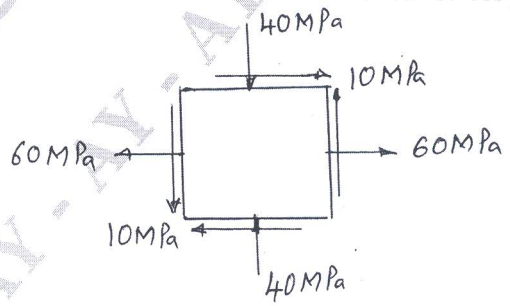

Fig.Q3(b) **(08 Marks)**

OR

4 a. Derive expressions for circumferential and longitudinal strains in thin cylinder. Hence show that volumetric strain $\epsilon_v = \frac{pd}{4tE}(5-4\mu)$ with usual notations. **(08 Marks)**

b. A thick cylinder of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 14 MPa. Determine the maximum hoop stress developed. Also sketch the variation of hoop stress and radial pressure across the thickness of the cylinder. **(08 Marks)**

Module-3

5 a. Derive an expression to establish a relationship between the intensity of load, shear force and bending moment. **(06 Marks)**

b. Draw SFD and BMD for the overhang beam shown in Fig.Q5(b). Indicate all the significant values.

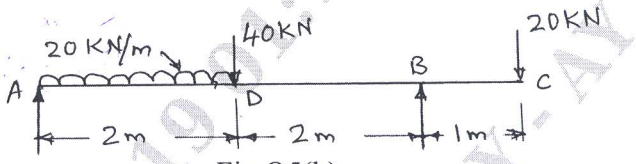

Fig.Q5(b) **(10 Marks)**

OR

6 a. Write bending equation and explain each notation with units. Also list the assumptions made in theory of simple bending. **(08 Marks)**

b. A cantilever beam of square section 200 mm × 200 mm, of length 2 m just fails in flexure when a load of 12 kN is placed at its free end. A beam of same material and having cross section 150 mm wide and 300 mm deep is simply supported over a span of 3m. Determine the minimum central point load required to break the beam. **(08 Marks)**

Module-4

7 a. Derive the torsion equation for a circular shaft with usual notations. **(08 Marks)**

b. A solid shaft is required to transmit 112.5 KW power at 150 rpm. The diameter of the shaft is 100 mm and length is 10 m long. Determine the maximum intensity of shear stress and the angle of twist. Take G = 82 GPa. **(08 Marks)**

OR

8 a. Derive an expression for Euler's critical load for a column whose both ends are hinged. **(08 Marks)**

b. A column of circular cross section of 50 mm diameter is 1.5 m long. One end of the column is fixed and other end is free. Determine the critical load using:

i) Euler's formula taking E = 120 GPa

ii) Rankines formula taking σ_c = 560 N/mm^2 and constant a = 1/1600. **(08 Marks)**

Module-5

9 a. State Castigliano's theorem I and II. **(04 Marks)**

b. Define strain energy and modulus of resilience. **(04 Marks)**

c. Calculate the strain energy stored in the bar shown in Fig.Q9(c) subjected to an axial force of 5 kN. Take E = 2 × 10^5 N/mm^2.

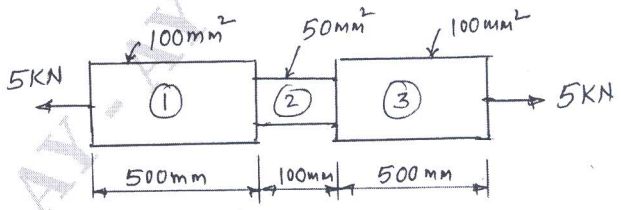

Fig.Q9(c) **(08 Marks)**

OR

10 a. Determine the deflection at the free end of a Cantilever beam of length L carrying a point load W at its free end. Use strain energy method. **(08 Marks)**

b. Explain: i) Maximum principal stress theory ii) Maximum shear stress theory. **(08 Marks)**