CBCS SCHEME

18CV32

USN

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Strength 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. Derive the expression for extension of rectangular tapering bar subjected to an axial load P. **(07 Marks)**

b. Explain the terms :
(i) Modulus of Elasticity (ii) Modulus of Rigidity (iii) Poisson's Ratio. **(03 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in Fig.Q1(c). Determine the magnitude of force P, such that the net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa, E for Aluminium is 70 GPa. Large end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively.

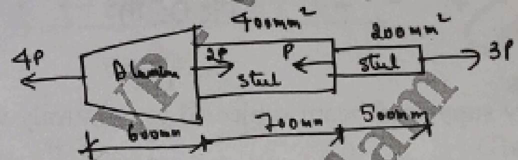

Fig.Q1(c) **(10 Marks)**

OR

2 a. Explain the St. Venant's Principle. **(04 Marks)**

b. A steel sleeve is slipped over a brass bolt and held in place by a nut. Compute the temperature rise required to stress the brass to 27.5 N/mm² in compression. Use the following data: $A_s = 500mm^2$, $A_b = 480\ mm^2$, $E_s = 19.6\times10^4\ N/mm^2$, $E_b = 8.82\times10^4\ N/mm^2$ $\alpha_s = 12\times10^{-6}$ cm/cm/°C, $\alpha_b = 19\times10^{-6}$ cm/cm/°C. **(08 Marks)**

c. Derive the relationship between the 3 elastic constants E, G, K. **(08 Marks)**

Module-2

3 a. Show that the planes of maximum shear stresses are inclined at 45° with the principal planes. **(06 Marks)**

b. The state of stress in a two-dimensionally stressed body is shown in Fig.Q3(b). Determine the principal planes, principal stresses, maximum shear stress and their planes.

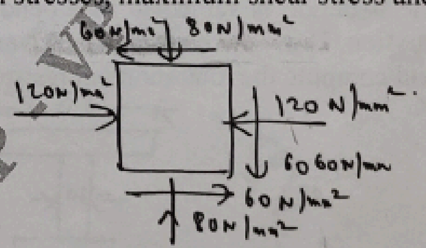

Fig.Q3(b) **(14 Marks)**

OR

4 a. Derive Lame's equation for radial and hoop stresses for thick cylinder subjected to internal and external fluid pressures. **(08 Marks)**

b. A thick cylindrical vessel is 250 mm in internal diameter and has 50mm thick walls. It is subjected to an internal pressure of 10 MPa due to the movement of fluid. Find the maximum hoop stress developed. Also calculate the radial and hoop stress at a point 20mm from the inside surface. **(08 Marks)**

c. A thin cylinder is 3m in length, 1m in diameter and has a metal thickness of 12mm in its walls. Determine the stresses (Hoop and Longitudinal) and strain along the length when subjected to an internal pressure of 1.5 MPa. Take E = 210 GPa, $\mu = 0.25$. **(04 Marks)**

Module-3

5 a. For a cantilever beam subjected to a UDL of intensity W/unit length throughout, plot the SFD and BMD. **(06 Marks)**

b. For the beam shown in Fig.Q5(b) construct the SFD and BMD indicating salient values. Find the point of contraflexure, if any.

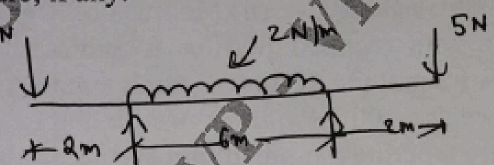

Fig.Q5(b) **(14 Marks)**

OR

6 a. For a simply supported beam subjected to uniformly varying load of W/unit length plot the SFD and BMD. **(08 Marks)**

b. For the beam shown in Fig.Q6(b), find the load 'P' to have equal reactions at A and C. Draw the Binding Moment and Shear Force diagram indicating values at significant points. Locate the point of contraflexure. **(12 Marks)**

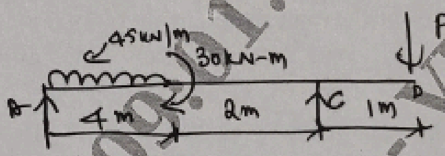

Fig.Q6(b)

Module-4

7 a. Define Section Modulus and Moment of Resistance. **(04 Marks)**

b. Derive the relationship between Bending Stresses and Radius of curvature

ie., $\frac{\sigma}{y} = \frac{E}{R}$ **(06 Marks)**

c. An unsymmetric I-section is subjected to a bending moment of 20 kN-m. The top flange being in compression. Draw the bending stress variation diagram across the section marking salient points and compute the total moment resisted by the top flange. Refer Fig.Q7(c).

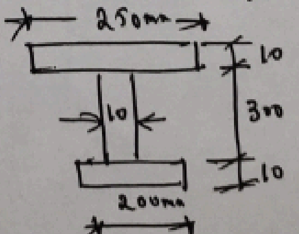

Fig.Q7(c) **(10 Marks)**

OR

8 a. Compare the weight of solid shaft to that of the hollow shaft of the same material, having the same length to transmit power at a given speed. Take inside diameter of hollow shaft as 0.5 times the outer diameter. **(10 Marks)**

c. Determine the diameter of the solid shaft which will transmit 440 kW at 280 rpm, if the maximum torsional shear stress is to be limited to 40 N/mm^2. Assume G = 84 kN/mm^2 and length of shaft is 1m with angle of twist of 1 degree. **(10 Marks)**

Module-5

9 a. For a simply supported beam subjected to an UDL of 'W' N/m determine the magnitude of maximum deflection using Double Integration method. **(10 Marks)**

b. An overhanging beam ABC is loaded as shown in Fig.Q9(b). Determine the slope and deflection at its free end C. Take $E = 2\times10^5$ N/mm^2 and $I = 5\times10^8$ mm^4.

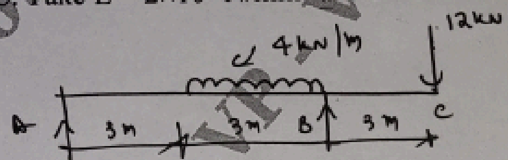

Fig.Q9(b) **(10 Marks)**

OR

10 a. Derive the Euler's equation for buckling load on a column with one end fixed and other end hinged. **(10 Marks)**

b. A hollow cast iron column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a FOS of 4. Calculate ratio of Euler's and Rankine's critical loads for cast iron,

take $\alpha = \frac{1}{1600}$, $\sigma_c = 550$ N/mm^3, $E = 8\times10^4$ N/mm^2. **(10 Marks)**

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