CBCS SCHEME

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18CV32

Third Semester B.E. Degree Examination, June/July 2024
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. Define and explain four elastic constants. **(06 Marks)**

b. With neat sketch define the salient features of stress strain curve for tensile specimen. **(06 Marks)**

c. A bar of a rectangular section of 20mm × 30mm and a length of 500mm is subjected to axial compressive load of 60 kN. If E = 102 kN/mm^2 and Poisson's ratio = 0.34, determine the changes in the length and sides of bar. **(08 Marks)**

OR

2 a. Explain temperature stress induced in body and explain the parameters involved in the expression. **(10 Marks)**

b. A steel rod of 20mm diameter passes centrally through a copper tube of 50mm external diameter and 40mm internal diameter. The tube is closed at each end and the nuts are tightened on the projecting points of rod. If the temperature of the assembly is raised by 50°. Calculate the temperature stresses developed in copper and steel.
Take E_s = 200 GN/m^2 , E_c = 100 GN/m^2 and α_s 12×10^{-6} per °C and $\alpha_c = 18\times10^{-6}$ per °C. **(10 Marks)**

Module-2

3 a. Derive the expressions for normal and tangential stress on any arbitrary plane inclined at an angle θ with the plane containing σ_x . **(10 Marks)**

b. At a point in a strained material, the stresses acting are shown in Fig.Q3(b). Determine
i) Principal stresses and their plane
ii) Maximum shear stress and its plane
iii) Normal and shear stress on the inclined plane AB.

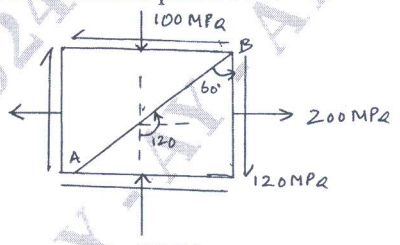

Fig.Q3(b) **(10 Marks)**

OR

4 a. Determine the expression for hoop stress in thin cylinder with the aid of neat sketch. **(06 Marks)**

b. A thick cylinder of internal diameter 200mm is subjected to an internal fluid pressure of 40 MPa. If the allowable stress in tension for the material is 120 MPa, find thickness of cylinder. **(14 Marks)**

Module-3

5 a. Derive the relationship between load intensity shear force and bending moment. **(05 Marks)**

b. Draw SFD and BMD for a cantilever beam of span length '*l*' carrying a point load 'W' at its free end. **(05 Marks)**

c. Draw SFD and BMD for a beam as shown in the Fig.Q5(c).

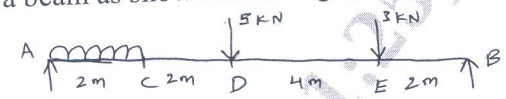

Fig.Q5(c) **(10 Marks)**

OR

6 a. Draw the shear force and bending moment diagram for beam shown in Fig.Q6(a) marking the salient points. Locate the point of contraflexure and point of maximum bending moment.

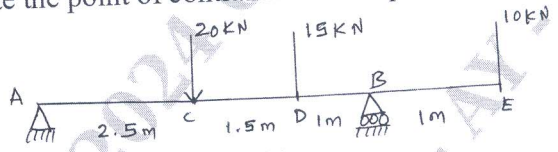

Fig.Q6(a) **(10 Marks)**

b. For the cantilever beam shown in Fig.Q6(b), obtain shear force and bending moment diagrams.

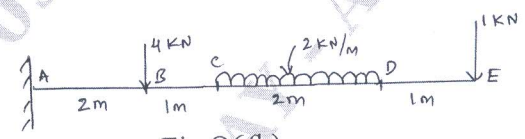

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Derive the expression $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ for pure bending. **(10 Marks)**

b. A rectangular beam 100mm wide and 250mm deep is subjected to a maximum shear force of 50 kN. Determine :

i) Average shear stress ii) Maximum shear stress

iii) Shear stress at a distance of 25mm above the neutral axies. **(10 Marks)**

OR

8 a. Derive the torsion equation with usual notations. **(10 Marks)**

b. A solid shaft is subjected to a maximum torque of 15 kN-m. Estimate a suitable diameter of the shaft. If the allowable shear stress and the twist are limited to 60 N/mm^2 and 1° respectively for a length of 20 times the diameter of shaft. Assume $G = 8\times10^4$ N/mm^2. **(10 Marks)**

Module-5

9 a. Derive the expression

$$EI \cdot \frac{d^2y}{dx^2} = M,$$ with usual notations. **(08 Marks)**

b. Determine the deflection under the loads for beam as shown in the Fig.Q9(b). Take $I = 1.85\times10^6$ mm^4 and $E = 2 \times 10^5$ N/mm^2.

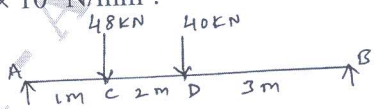

Fig.Q9(b) **(12 Marks)**

OR

10 a. Derive an expression for buckling load in a column subjected to an axial compressive load, when both ends of the column are hinged. **(08 Marks)**

b. Compare the crippling loads obtained by Euler's and Rankine's theory for an axially loaded hollow cylindrical cast column with external diameter and 20mm thick. The column is long and hinged at both ends. Given $\sigma_{failure}$ = 550 MPa, Rankine's constant "a" = 1/1600 and E = 80 GPa. **(12 Marks)**