CBCS SCHEME

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18IP/IM32

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. Derive an expression for elongation of uniformly tapering rectangular section. **(08 Marks)**

b. A steel bar of 1.5m length and uniform section of 500mm^2 is suspended vertically and loaded as shown in Fig.Q.1(b). Taking E = 2×10^5N/mm^2. Determine the total elongation of the bar neglecting the self weight of the bar. **(08 Marks)**

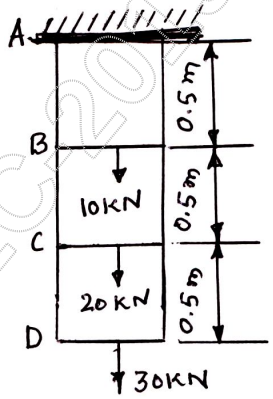

Fig.Q.1(b)

c. A material has modulus of rigidity equal to 0.4×10^5N/mm^2 and bulk modulus equal to 0.75×10^5N/mm^2. Find its Young modulus and Poisson's Ratio. **(04 Marks)**

OR

2 a. What do you mean by temperature stresses? Explain. **(04 Marks)**

b. A 500mm long bar has rectangular cross-section 20mm × 40mm. This bar is subjected to
   i) 40kN tensile force on 20mm × 40mm faces
   ii) 200kN compressive force on 20mm × 500mm faces
   iii) 300kN tensile force on 40mm × 500mm faces.
   Find the change in volume if E = 2×10^5N/mm^2 and $\mu = 0.3$. **(08 Marks)**

c. A steel rail is 12.6m long and is laid at a temperature of 24°C. The maximum temperature expected is 44°C.
   i) Estimate the minimum gap between two rails to be left so that temperature stresses do not develop.
   ii) Calculate the thermal stresses developed in the rails if • No expansion joint is provided • If a 2mm gap is provided for expansion. **(08 Marks)**

Module-2

3 a. What do you mean by principal planes and principal stresses? **(04 Marks)**

b. A plane element is subjected to stresses as shown in Fig.Q.3(b). Determine principal stresses, maximum shear stress and their planes. Sketch the planes determined. **(10 Marks)**

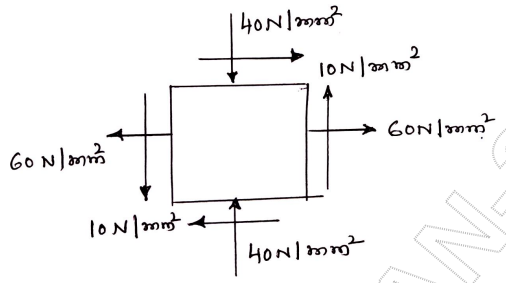

Fig.Q.3(b)

c. A thick cylinder of internal diameter 160mm is subjected to an internal pressure 40N/mm^2. If the allowable stress in the material is 120N/mm^2. Find the thickness required. **(06 Marks)**

OR

4 a. What are the assumptions made in the theory of pure torsion? Prove that $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{l}$. **(10 Marks)**

b. A hollow circular section 4m long column is fixed at both ends and carry an axial load of 500kN. The inner diameter of the column is 0.8 times the external diameter. Take $\alpha = \frac{1}{1600}$, σ_c = 550MPa and factor of safety = 2.5. Design the section of the hollow cast iron column. **(10 Marks)**

Module-3

5 a. Derive a relationship between load intensity, shear force and bending moment. **(06 Marks)**

b. Draw shear force and bending moment diagrams for the simply supported beam shown in Fig.Q.5(b). Indicating values at salient point. **(14 Marks)**

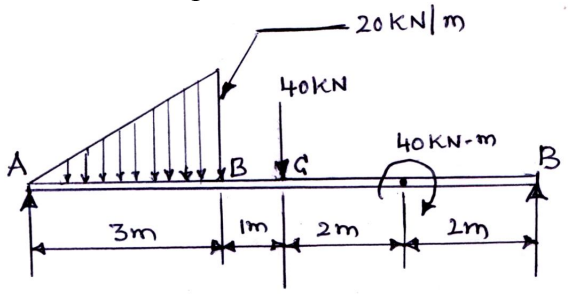

Fig.Q.5(b)

OR

6 a. Name the different type of beams and loads with sketches. **(06 Marks)**

b. Draw the Shearforce and beding moment diagrams for the beam shown in Fig.Q.6(b). **(14 Marks)**

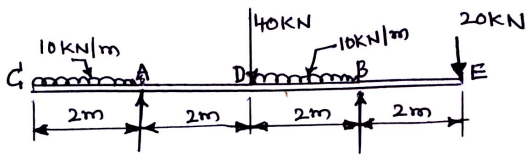

Fig.Q.6(b)

Module-4

7 a. Derive a relation between bending moment and radius of curvature. **(06 Marks)**

b. A cast iron beam has an I-section with top flange 80mm × 40mm, web 120mm × 20mm and bottom flange 160mm × 40mm. If tensile stress is not to exceed 30N/mm^2 and compressive stress 90N/mm^2. What is the maximum uniformly distributed load the beam can carry over a simply supported span of 6m if the larger flange is in tension? **(14 Marks)**

OR

8 a. Derive a relationship between Bending stresses and Radius of curvature. **(06 Marks)**

b. The cross-section of a beam is as shown in Fig.Q.8(b). If permissible stress is 150N/mm^2. Find its moment of resistance. Compare it with equivalent section of same area but i) Square section ii) Rectangular section with depth twice the width iii) Circular section. **(14 Marks)**

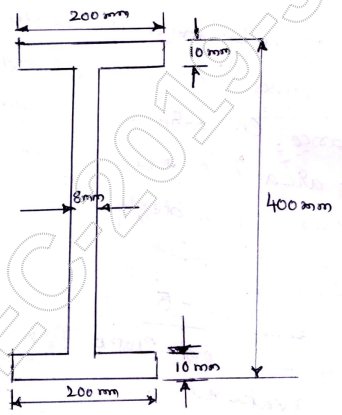

Fig.Q.8(b)

Module-5

9 a. Derive a relation between slope, deflection and radius of curvature. **(10 Marks)**

b. Find the slope and deflection at the free end of the cantilever shown in Fig.Q9(b). Take E = 200kN/mm^2, I = 40 × 10^{6}mm^4. **(10 Marks)**

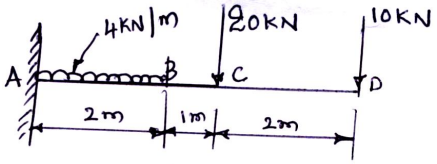

Fig.Q9(b)

OR

10 a. A simply supported beam of span L is subjected to equal loads W/2 at each of 1/3rd span points. Find the expressions for deflection under the load and at midspan. **(10 Marks)**

b. An over hanging beam ABC, supported at A and B is loaded as shown in Fig.Q.10(b). Determine the deflection at free end C and the maximum deflection between A and B. Take E = 200kN/mm^2 and I = 45 × 10^{6}mm^4. **(10 Marks)**

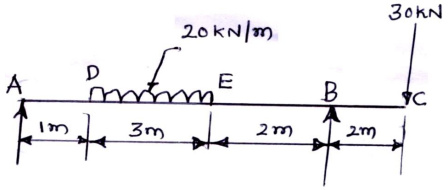

Fig.Q.10(b)

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