CBCS SCHEME

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18AE/AS33

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 analysis of uniformly tapering rectangular bar. **(06 Marks)**

b. With neat sketch, explain stress – strain relation for mild steel. **(06 Marks)**

c. A steel bar ABCD of varying sections is subjected to the axial forces as shown in Fig Q1(c), Find the value of 'P' necessary for equilibrium. If E = 210kN/mm^2 determine : i) Stress in various segment ii) Total Elongation of bar iii) Total strain in the bar

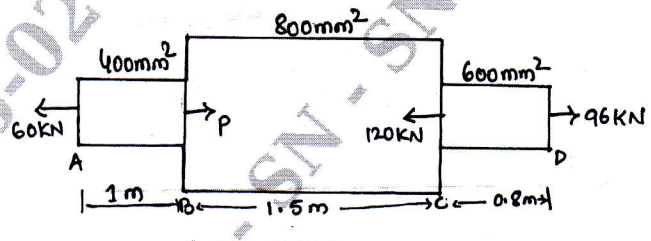

Fig Q1(c) **(08 Marks)**

OR

2 a. Derive an expression for analysis of uniformly tapering section due to self weight. **(06 Marks)**

b. A reinforced short concrete column 250mm × 250mm in section is reinforced with 8 steel bars. The total area of the steel bar is 1608.5mm^2. The column carries a load of 270kN. If the modular ratio is 18, find the stress in concrete and steel. If the stress in concrete shall not exceed 4N/mm^2, find the area of steel required so that the column may support a load of 400kN. **(07 Marks)**

c. Derive an expression for volumetric strain due to three mutually perpendicular stresses. **(07 Marks)**

Module-2

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

b. Draw the shear force and bending moment diagram for a overhanging beam shown in Fig Q3(b) and locate the point of contra-flexure.

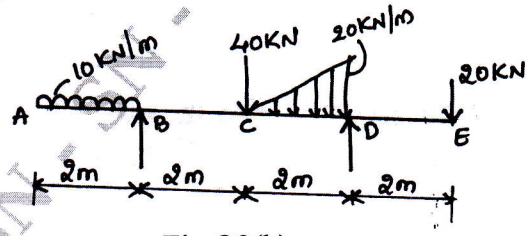

Fig Q3(b) **(14 Marks)**

OR

4 a. Derive an expression to establish a relationship between Bending stress and radius of curvature. **(10 Marks)**

b. A beam of an I-section consists of 180mm × 15mm flanges and a web of 280mm depth × 15mm thickness. It is subjected to a bending moment of 120kN-m and a shear force of 60kN. Sketch the bending and shear stress distribution along the depth of the section. **(10 Marks)**

Module-3

5 a. Find the expression for the slope and deflection of a cantilever of length 'L' carrying UDL over the whole length. **(08 Marks)**

b. A beam AB of 4m span is simply supported at the ends and loaded as shown in Fig Q5(b), determine, i) Deflection at mid span ii) Maximum deflection iii) Slope at end 'A' Take : $E = 2 \times 10^5 N/mm^2$, $I = 1000cm^4$.

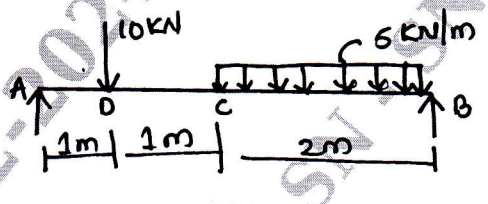

Fig Q5(b) **(12 Marks)**

OR

6 a. State the assumption made in pure torsion theory and drive torsional equation $\frac{T}{J_p} = \frac{\tau}{R} = \frac{G\theta}{\ell}$. **(10 Marks)**

b. A solid circular shaft has to transmit a power of 1000kW at 120rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed $80N/mm^2$. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(10 Marks)**

Module-4

7 a. State and derive Maxwell's reciprocal theorem. **(10 Marks)**

b. State and explain Castigliano's I and II theorem. **(10 Marks)**

OR

8 a. Define principles of virtual work for a rigid body and state the difference between principles of virtual work and principle of complementary virtual work. **(10 Marks)**

b. Explain the principle of virtual work for a particle and write the statements. **(10 Marks)**

Module-5

9 a. With suitable sketches, explain different stages of ductile fracture. **(10 Marks)**

b. Mention the factor that affects the creep characteristics of metals and explain creep curve for three stages. **(10 Marks)**

OR

10 a. Explain with suitable sketches stages involved in fatigue failure. **(08 Marks)**

b. Compare ductile and brittle fracture characteristics and derive and expression for stress relaxation. **(12 Marks)**

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