CBCS SCHEME

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15MN34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. Define the following: (i) Hooke's law (ii) Strength (iii) Toughness (iv) Poisson's ratio **(08 Marks)**

b. Explain stress-strain diagram for mild steel with salient features. **(08 Marks)**

OR

2 a. A copper rod. 25 mm in diameter is enclosed in steel tube 30 mm internal diameter and 35 mm external diameter. The ends are rigidly attached. The composite bar is 500 mm long and is subjected to an axial pull of 30 kN. Find the stress induced in the rod and the tube. Take E for steel = 2×10^5 N/mm^2 and E for copper as 1×10^5 N/mm^2. **(08 Marks)**

b. Derive an expression for the elongation of uniformly tapering circular bar subjected to axial load P. **(08 Marks)**

Module-2

3 a. Define the following: (i) Principal stresses (ii) Principal planes (iii) Shear modulus (iv) Young's modulus. **(08 Marks)**

b. A point in a strained material is subjected to the stresses as shown in Fig.Q3(b). Locate the principal stresses. Also determine the maximum shear stress. Use analytical approach.

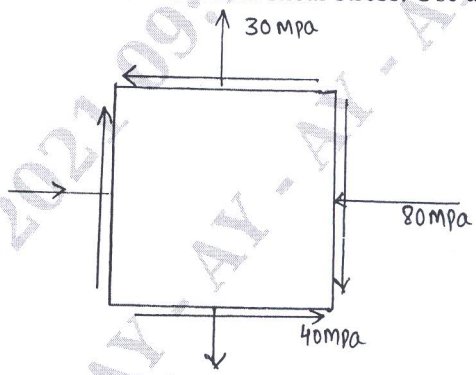

Fig.Q3(b) **(08 Marks)**

OR

4 a. A cylindrical shell has an external diameter of 500 mm and wall thickness 10 mm. the length of the cylinder is 1.7 m. Determine the increase in its internal diameter and length inside pressure is 1 N/mm^2. Given E = 210 GPa and Poisson's ratio = 0.3. **(08 Marks)**

b. A thin cylinder, 2m long and 200 mm in diameter with 10 mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000 mm^3 fluid in pumped in, find the longitudinal stress and circumferential stress developed. Also determine the changes in diameter and length, if E = 2×10^5 N/mm^2 and Poisson's ratio as 0.3. **(08 Marks)**

Module-3

5 a. Derive an expression for establishing relationship between shear force, bending moment and rate of loading. **(06 Marks)**

b. A cantilever 2m long is loaded with a uniformly distributed load of 10 kN/m run over a length 1.5m from the free end. It also carries a point load of 10 kN at a distance of 0.5m from the free end. Draw the shear force and bending moment diagram for the beams. **(10 Marks)**

OR

6 a. Explain various types of beams. **(06 Marks)**

b. Draw shear force diagram and bending moment diagram for the following beam shown in Fig.Q6(b).

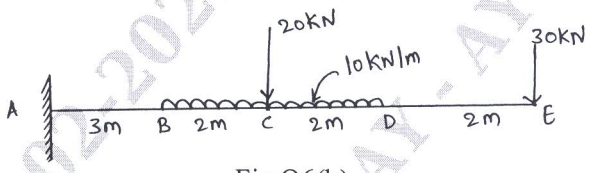

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notation. **(08 Marks)**

b. Derive an expression relating slope, deflection and radius of curvature in a beam from first principle in terms of E, I and M with usual notations. **(08 Marks)**

OR

8 a. The C/S of a beam is shown in Fig.Q8(a). If permissible stress is 150 N/mm^2. Find its moment of resistance. Compare it with equivalent section of the same area for a square section.

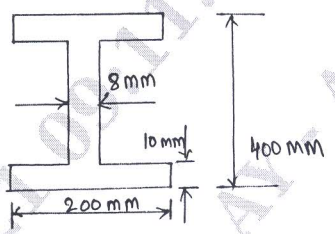

Fig.Q8(a) **(08 Marks)**

b. A I-section consists of Flanges 200 × 15 with web 10 mm thick. Total depth of the section is 50 mm. If the beam carries a UDL of 35 kN/m over a span of 8m, compute the bending and shear stress at centre and support respectively. **(08 Marks)**

Module-5

9 a. Derive an expression for torsional equation with usual notations. **(08 Marks)**

b. A solid circular shaft is required to transmit 80 kW at 160 rpm. The permissible shear stress in the shaft material is 60 N/mm^2. The maximum torque transmitted exceeds the mean torque by 20%. The angle of twist is not to exceed 1° in a length of 20 times the diameter of shaft. The value of rigidity modulus is 0.8×10^5 N/mm^2. Find the diameter of shaft. **(08 Marks)**

OR

10 a. Derive an expression for Euler's buckling load for column with both ends hinged. **(08 Marks)**

b. Find the Euler's critical load for a column 1.2 m long by rectangular C/S 90 mm wide, 60 mm depth with both end hinged modulus of elasticity os 200 GPa. Compare it with Rankine's critical load taking Rankine's constant $\sigma = 300$ MPa and $\alpha = \frac{1}{7500}$. **(08 Marks)**