CBCS SCHEME

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18MR34

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 the extension of uniformly tapering circular bar subjected to axial load. **(10 Marks)**

b. A stepped bar made up of steel and brass is subjected to a pull of 25kN as shown in Fig.Q1(b). Determine the deformation of each material and stress in each material. Take, $E_S = 200GPa$, $E_B = 100GPa$. Thickness = 20cm. **(10 Marks)**

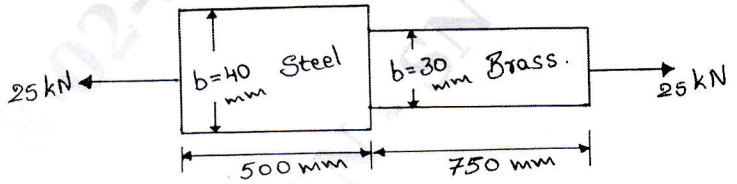

Fig.Q1(b)

OR

2 a. Derive the volumetric strain of a cylinder bar subjected t o an axial load (P). **(10 Marks)**

b. A steel rod of cross sectional are $1600mm^2$ and two brass rods each of cross sectional area of $1000mm^2$ together support a load of 50kN as shown in Fig.Q.2(b). Find the stresses in the rod E for steel = 2×10^5 N/mm^2, E for brass = 1×10^5N/mm^2 **(10 Marks)**

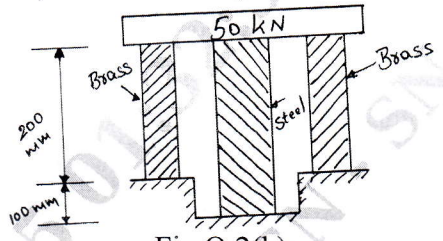

Fig.Q.2(b)

Module-2

3 a. Explain the construction procedures for Mohr's diagram. **(10 Marks)**

b. A Tension member is formed by connecting two wooden scartting each 75mm×150mm at their ends which are at an angle of 60° as shown in Fig.Q3(b). The member is subjected to a pull F. Find the safe value of F if the permissible normal and shear stress in the glue are 105N/mm^2 and 1N/mm^2 respectively. **(10 Marks)**

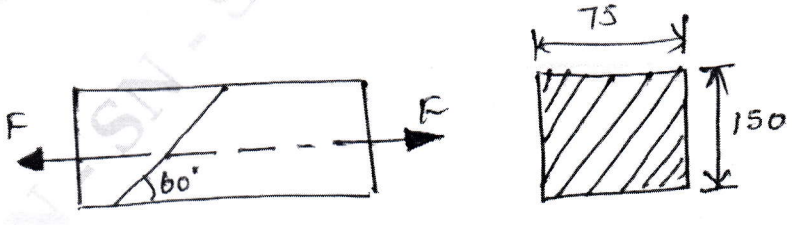

Fig.Q3(b)

OR

4 a. A thin cylinder shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to internal fluid pressure of 3Mpa. Determine,
   i) Circumferential and longitudinal stress.
   ii) Circumferential longitudinal and volumetric strain.
   iii) Change in length, diameter and volume, also find the max shear stress in the shell.
   iv) Assume Poisson's ratio as 0.3 and E=210Gpa. **(10 Marks)**

   b. Determine an expression for stress due to Impact load. **(10 Marks)**

Module-3

5 a. Explain different types of beams and loads. **(06 Marks)**

   b. Draw SFD and BMD for a simply supported beam loaded as shown in Fig.Q5(b).

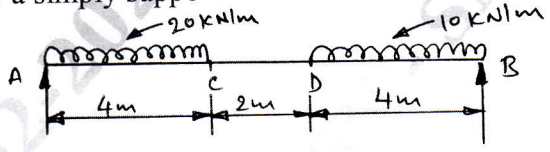

Fig.Q5(b) **(14 Marks)**

OR

6 a. Draw SFD and BMD for a simply supported beam of length '*l*' with a point load 'W' at mid-point. **(08 Marks)**

   b. Draw SFD and BMD for the beam shown in Fig.Q6(b). Indicating the principal values.

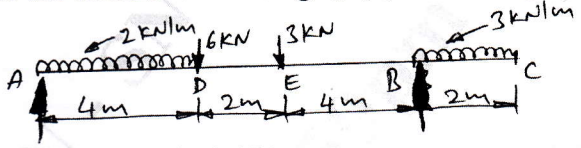

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Write the assumptions in simple bending and derive the relationship between bending stress and radius of curvature. **(10 Marks)**

   b. A square beam 20mm × 20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40mm wide, 60mm deep and 3m long? **(10 Marks)**

OR

8 a. Derive an expression for shear stress distribution across a rectangular section. **(10 Marks)**

   b. Draw shear stress distribution for an I-shaped section of a beam as shown in Fig.Q.8(b). The shear force on this section is 200kN. **(10 Marks)**

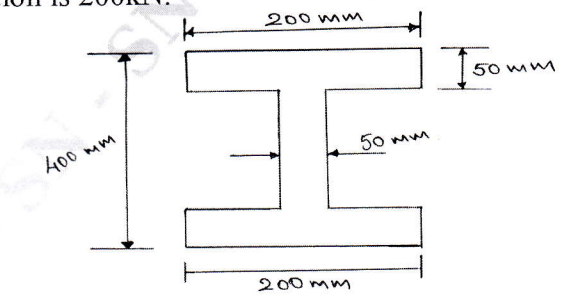

Fig.Q.8(b)

Module-5

9 a. Derive shear stress and torque relations in a hollow circular shaft. **(10 Marks)**

b. Determine the diameter of the solid shaft which will transmit 440kW at 280rpm. If maximum torsional sheer stress is to be limited to $40N/mm^2$. Assume G = 84 KN/mm^2. **(10 Marks)**

OR

10 a. Determine the Euler's crippling load for a column when one end is free and other end in hinged. **(10 Marks)**

b. Find the Euler's crippling load for a hallow. Cylindrical steel column of 40mm external diameter and 4mm thick. The length of the column is 2.5mm and is hinged at both ends also compute the Rankine's crippling load using constant 335Mpa and 1/7500. Take $\in$= 250GPa. **(10 Marks)**

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