CBCS SCHEME

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18MR34

Third Semester B.E. Degree Examination, June/July 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 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.

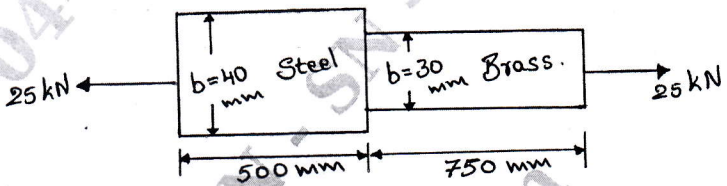

Fig.Q1(b) **(10 Marks)**

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.

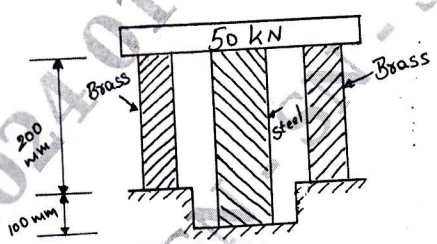

Fig.Q.2(b) **(10 Marks)**

Module-2

3 a. Derive expressions for normal stress and tangential stress in member subjected to direct stresses on two mutually perpendicular directions. **(10 Marks)**

b. A machine component is subjected to the stress as shown in Fig.Q3(b). Find the normal and shearing stresses on the section AB inclined at an angle of 60° with x – x axis. Also find the resultant stress on the section by Mohr's circle.

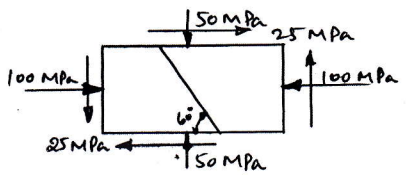

Fig.Q3(b) **(10 Marks)**

OR

4 a. Define Thin Cylinders. Derive expressions for circumferential stress and longitudinal stress. **(10 Marks)**

b. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand an internal fluid pressure of 8 N/mm^2. The maximum allowable stress in the section is not to exceed 35 N/mm^2. **(10 Marks)**

Module-3

5 a. Explain with sketches, different types of Beams and different types of load acting on a beam. **(10 Marks)**

b. A simply supported beam AB of span 8 meters carrying concentrated loads of 4kN, 10kN and 7kN at distances of 1.5m, 4m and 6m from the left support. Draw the SFD and BMD for the Fig.Q.5(b) **(10 Marks)**

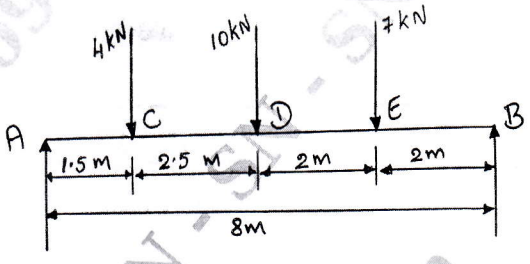

Fig.Q.5(b)

OR

6 a. Derive the relation between load, shear force and bending moment of a beam carrying udl of 'w' per meter length. **(08 Marks)**

b. A simply supported beam of length 10m, carries the uniformly distributed load and two point loads as shown in Fig.Q.6(b). Draw SFD and BMD for the beam. Also calculate the maximum BM. **(12 Marks)**

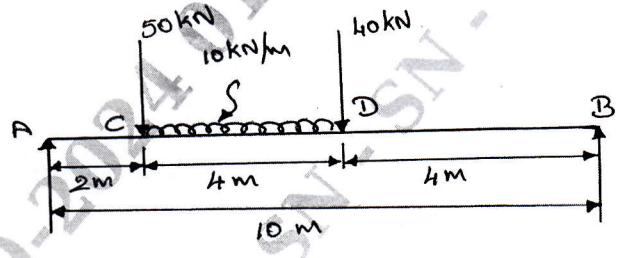

Fig.Q.6(b)

Module-4

7 a. Derive bending equation. What are the assumption made in pure bending? **(12 Marks)**

b. The T-section shown in Fig.Q7(b) is used as a simply supported beam over a span of 4m. It carries an uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section.

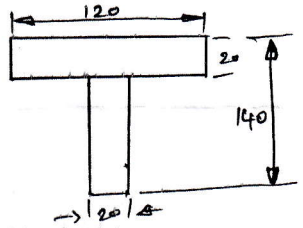

Fig.Q7(b) **(08 Marks)**

OR

8 a. Prove that $\tau_{max} = 1.5\ \tau_{avg}$ in rectangular cross-section. **(10 Marks)**

b. A beam of an I-section 200mm × 300mm has web thickness 10mm and flange thickness 10mm. It carries a shearing force of 10 kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

Module-5

9 a. Show that the strength of the hollow shaft is more than the strength of the solid shaft. **(10 Marks)**

b. A hollow shaft of diameter ratio 3/8 is required to transmit 600kW at 110r.p.m, the maximum toque being 20% greater than the mean. The shear stress is not to exceed 63MN/m^2 and the twist in a length of 3m not to exceed 1.4 degrees. Calculate the maximum external diameter satisfying these conditions. **(10 Marks)**

OR

10 a. Derive Euler's crippling load for a column when both of its ends are hinged or pinned. **(10 Marks)**

b. Design the section of a circular cast iron column that can safely carry a load of 1000kN. The length of the column is 6 metres. Rankine's constant is 1/1600 factor of safety is 3 one end of the column is fixed and the other end is free. Critical stress is 560MPa. **(10 Marks)**

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