

CBCS SCHEME

15ME/MA34

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Third Semester B.E. Degree Examination, Aug./Sept.2020 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- Derive an expression for the total extension of the tapered circular bar of diameter d_1 and d_2 , when it is subjected to an axial pull P . (08 Marks)
 - A stepped bar is subjected to an axial load is shown in Fig.Q.1(b). Determine the change in length of the bar. Take $E = 200\text{GPa}$ for steel, $E = 70\text{GPa}$ for Aluminium and $E = 100\text{GPa}$ for copper. All dimensions are in mm. (08 Marks)

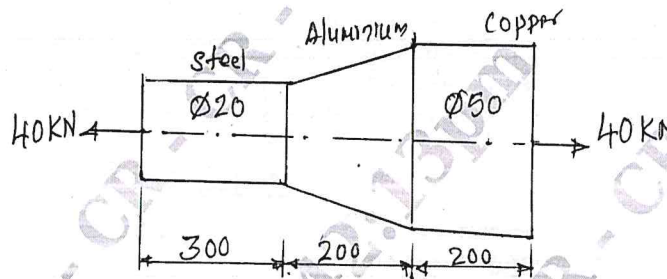


Fig.Q.1(b)

OR

- Define:
 - Modulus of Elasticity
 - Modulus of Rigidity
 - Poisson's ratio
 - Thermal stress. (08 Marks)
 - A steel rod of 20mm diameter and 300mm long is enclosed centrally inside a hollow copper tube of external diameter 30mm and internal diameter 25mm. The composite bar carries an axial load of 50kN. Take $E_{\text{steel}} = 200\text{GPa}$, $E_{\text{copper}} = 100\text{GPa}$. Determine:
 - Load carried by each material
 - Stresses developed on each material. (08 Marks)

Module-2

- Define or explain:
 - Principal plane
 - Principal stresses
 - Plane of maximum shear
 - Maximum shear stress. (08 Marks)

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(08 Marks)

- b. The state of stress at a point in a strained material is shown in Fig.Q.3(b). Determine:
- Principal stresses and their planes
 - Maximum shear stress and its planes.

(08 Marks)

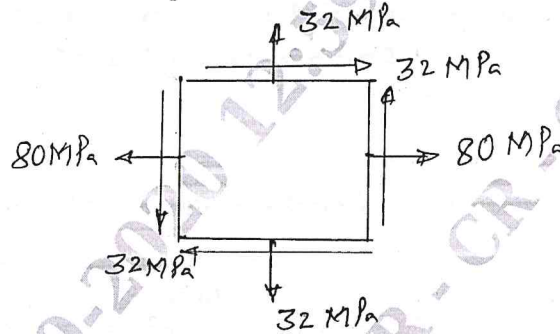


Fig.Q.3(b)

OR

- 4 a. Derive the expressions for circumferential and longitudinal stresses developed in thin cylinder subjected to internal pressure. (06 Marks)
- b. A thick cylinder of internal diameter 200mm and external diameter 300mm is subjected to an internal pressure 14N/mm^2 . Find the maximum hoop stress developed. Also plot the variation of hoop stress and radial pressure across the thickness of the cylinder. (10 Marks)

Module-3

- 5 a. Define:
- Shear force
 - Bending moment
 - Point of contra flexure.
- (06 Marks)
- b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q.5(b). (10 Marks)

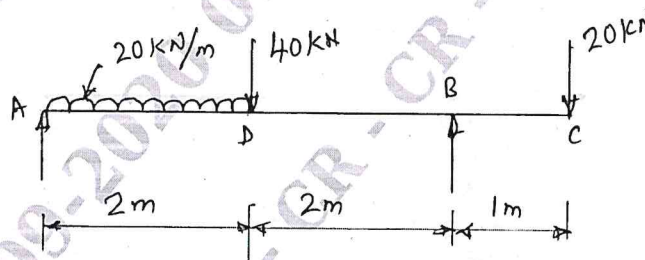


Fig.Q.5(b)

OR

- 6 a. Derive the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. (08 Marks)
- b. A beam of symmetric I-section consists of flanges of $100\text{mm} \times 10\text{mm}$ and a web of $180\text{mm} \times 5\text{mm}$. The beam is used as simply supported subjected to udl of 10kN/m . The beam is 10m long. Determine the maximum bending stress and sketch the variation along the depth of the section. (08 Marks)

Module-4

- 7 a. Derive the torsion equation with usual notations. (08 Marks)
b. Find the diameter of the shaft required to transmit 60kW at 150rpm, if the maximum torque is 25% more than the mean torque. The maximum permissible shear stress is 60MPa. Also find the angle of twist for a length of 4m. Take $G = 80\text{GPa}$. (08 Marks)

OR

- 8 a. Derive an expression for buckling load in a column subjected to an axial compressive load, when both ends are fixed. (08 Marks)
b. A hollow cast iron column whose outside diameter is 200mm and has a thickness of 20mm is 4.5m long and is fixed at both ends. Find the ratio of Euler's to Rankine's constants is 1/1600 and crushing strength as 550N/mm^2 . (08 Marks)

Module-5

- 9 a. Define:
i) Strain energy
ii) Proof resilience
iii) Modulus of resistance. (06 Marks)
b. State Castigliano's first and second theorems. (04 Marks)
c. Calculate the strain energy stored in a bar 2m long, 50mm wide and 40mm thick when it is subjected to an tensile load of 60kN. Take $E = 200\text{GPa}$. (06 Marks)

OR

- 10 a. Determine the strain energy stored in a cantilever beam of length L subjected to a point load P at its free end and hence find the deflection of its free end. (08 Marks)
b. Explain maximum principal stress theory and maximum shear stress theory. (08 Marks)

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