CBCS SCHEME

USN | | | | | | | | | |

15ME/MA34

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

1 a. 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)**

b. 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 = 200GPa for steel, E = 70GPa for Aluminium and E = 100GPa for copper. All dimensions are in mm. **(08 Marks)**

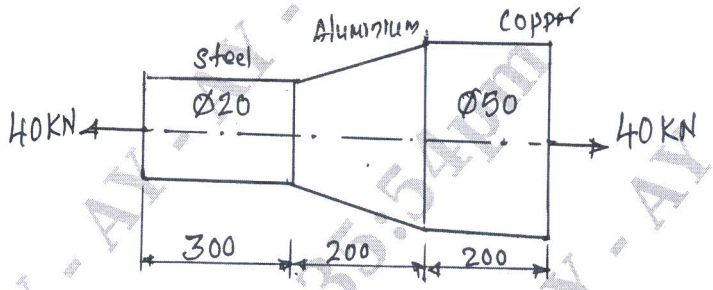

Fig.Q.1(b)

OR

2 a. Define:
i) Modulus of Elasticity
ii) Modulus of Rigidity
iii) Poisson's ratio
iv) Thermal stress. **(08 Marks)**

b. 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_{steel} = 200GPa, E_{copper} = 100GPa. Determine:
i) Load carried by each material
ii) Stresses developed on each material. **(08 Marks)**

Module-2

3 a. Define or explain:
i) Principal plane
ii) Principal stresses
iii) Plane of maximum shear
iv) Maximum shear stress. **(08 Marks)**

b. The state of stress at a point in a strained material is shown in Fig.Q.3(b). Determine:
   i) Principal stresses and their planes
   ii) Maximum shear stress and its planes. **(08 Marks)**

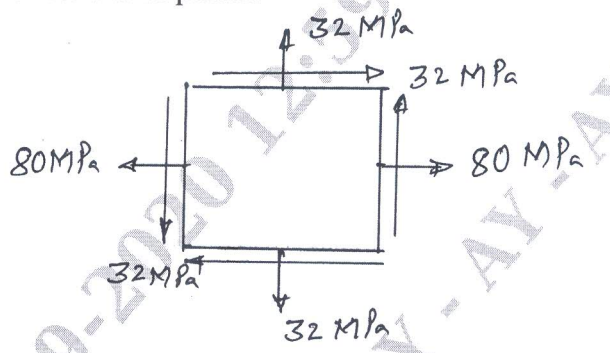

Fig.Q.3(b)

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:
   i) Shear force
   ii) Bending moment
   iii) 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)**

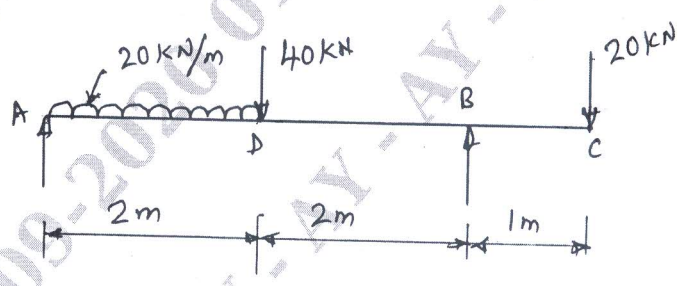

Fig.Q.5(b)

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 100mm × 10mm and a web of 180mm × 5mm. 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 = 80GPa. **(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 = 200GPa. **(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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