Code No: 153BE

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, August/September - 2022
MECHANICS OF SOLIDS
(Common to ME, MCT, MIE)

Time: 3 Hours **Max.Marks:75**

Answer any five questions
All questions carry equal marks
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1.a) Why is the shear modulus always smaller than the elastic modulus.
b) A 3 m steel rod of diameter 25 mm is placed inside a brass tube of the same length and inside and outside diameters of 25 mm and 35 mm respectively. What is the deformation of the rod and the tube when a force of 50 kN is applied on them through a rigid plate? Take Young's modulus steel and brass are 200 GPa and 100 GPa respectively. [3+12]

2.a) Derive the relation between Young's Modulus and Bulk Modulus.
b) A steel bar 50 mm × 50 mm in cross section and 100 mm length is acted upon by a tensile load of 200 kN along its longitudinal axis and 400 kN along the axes of the lateral surfaces. Determine change in the dimensions of the bar and the change in the volume. [6+9]

3.a) What is the importance of drawing shear force and bending moment diagrams?
b) Draw shear force and bending moment diagram of the beam shown in figure 1 for the given loading. [3+12]

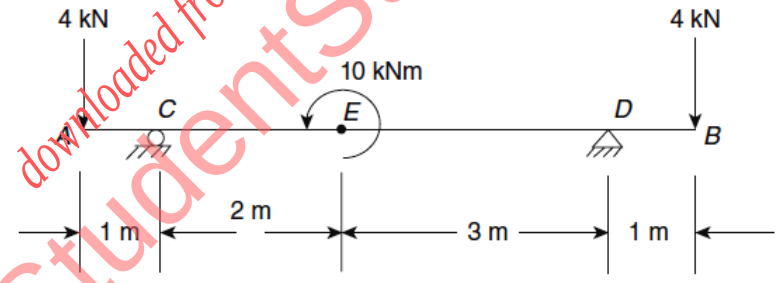

Figure 1

4.a) Derive the relation between bending moment and shear force in a beam.
b) A beam AB of length L, which is hinged at end A and roller supported at end B, carries a linearly variable load with zero intensity at A maximum intensity w per unit length at end B. Determine support reactions. Draw shear force and bending moment diagrams. [3+12]

5.a) Enumerate the assumptions considered in the theory of simple bending equation.
b) A 5 m cantilever beam of cross-section 150 mm × 300 mm weighing 50 kN/m carries an upward concentrated load of 30 kN at its free end. Determine bending stresses at sections 2 m and 5 m from the free end. [5+10]

6. The cross-section of a steel beam, shown in figure 2 is subjected to a shear force of 20 kN. Draw the shear stress distribution diagram. [15]

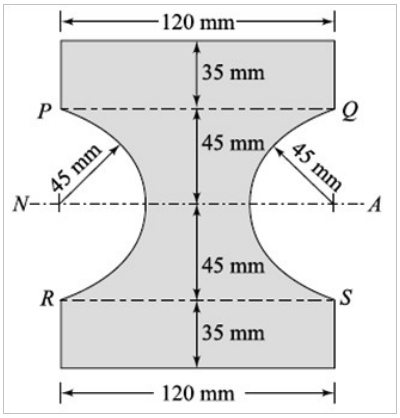

Figure 2

7.a) State and explain the distortion energy theory for the design of a shaft made of ductile materials.

b) An element in a structure is subjected to a tensile stress of 100 MPa accompanied by a shear stress of 40 MPa on the X-plane. Draw a Mohr's circle and find the principal stresses, the maximum shear stress and the directions of the corresponding planes. Compare the results with the analytical solution. [5+10]

8.a) A hollow steel propeller shaft, 9-m-long with 420 mm outer diameter and 300 mm inner diameter, transmits 8000 kW at 200 rpm. Calculate the maximum shear stress, and the angle of twist of the shaft. Use modulus of rigidity G = 80 GPa for steel.

b) Water in a water main of 1 m diameter is at a pressure head of 120 cm. The permissible stress on the shell material is 25 MPa. Find the thickness of the metal shell required for the water main. Take the unit weight of water as 9,810 kN/m^3. [8+7]

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