JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, February/March - 2016

MECHANICS OF SOLIDS

(Common to ME, MCT, MMT, AE, AME, MSNT)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A [25 Marks]

1.a) Draw the stress strain diagram for any ductile material and indicate the salient points on it. [2]

b) Define the Hook's Law. Write the stress-strain relation for three dimensional stress system. [3]

c) Present the mathematical relationship between the loading, shear force and bending moment and explain the terms involved in it. [2]

d) Draw the shear force and bending moment diagram for a cantilever beam of length L and carrying a point load F at the free end. [3]

e) State the assumption made in deriving the bending equation. [2]

f) Derive the section modulus expression for a circular cross section. [3]

g) Explain which theories of failure are applicable to ductile materials. [2]

h) What is a state of pure shear? Represent it graphically. Draw the maximum normal stress planes on it. [3]

i) Draw the shear stress distribution due to torsion across a circular cross section. [2]

j) What is the relationship between the Hoop and longitudinal stresses in thin cylinders? [3]

PART- B [50 Marks]

2.a) The extension in a rectangular steel bar of length 400 mm and thickness 10 mm is found to be 0.21 mm. the bar tapers uniformly in width from 100 mm to 50 mm. if the Young's modulus is 200 GPa, determine the axial load on the bar.

b) A steel rod of 1metre long and 200 mm^2 cross-section is subjected to a tensile force of 120 kN in the direction of its length. Calculate the change in volume. Take Poisson's ratio = 0.3 and Young's modulus = 205 MPa. [5+5]

OR

3. Find the extension of the bar shown in Figure 1 under an axial load of 25 kN. Take Young's modulus = 200 MPa. [10]

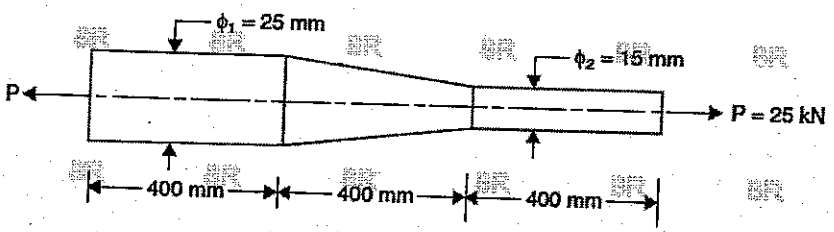

Figure 1

4. Draw the shear force and bending moment diagrams for the beam loaded and supported as shown in figure 2. [10]

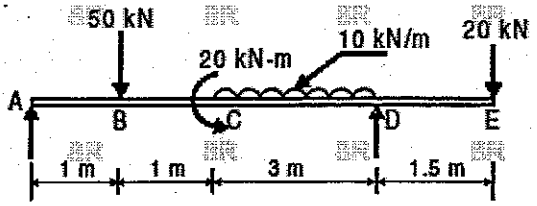

Figure 2

OR

5. A horizontal beam 10 m long carries a uniformly distributed load of 100 N/m over its entire span and in addition a concentrated load of 200 N at the left end. The beam is supported at two points 8 m apart, so chosen that each support carries half the total load. Draw the shear force and bending moment diagrams. [10]

6.a) Show that a square section is more efficient for a beam than a circular section of the same cross sectional area.

b) A timber beam is to be designed to carry a load of 6 kN/m over a simply supported span of 5 m. Permissible stress in bending is 10 MPa. Keeping the depth twice the width, design the beam. [5+5]

OR

7.a) A steel beam of I-section, 200 mm deep and 160 mm wide has 16 mm thick flanges and 10 mm thick web. The beam is subjected to a bending moment of 200 kN m at a critical section. Determine the maximum bending stress if the web of the beam is kept horizontal.

b) Show that maximum shear stress in a beam of rectangular section is 1.5 times the average shear stress. [5+5]

8. The state of stress in a two dimensionally stressed material is as shown in Figure 3. Determine the principal stresses, principal planes and the maximum shear stress. Determine normal and tangential stresses on plane AC. Draw the Mohr's Circle and represent the points on it. [10]

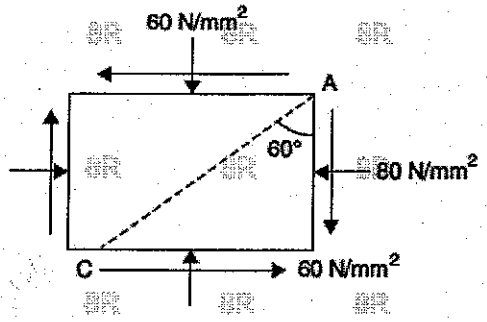

Figure 3

OR

9. The surface of a steel machine member is subjected to stresses of 100 MPa in X-direction, 20 MPa in Y-direction. What tensile strength is required to provide a factor of safety of 2.5 with respect to yielding (a) according to the maximum shear stress theory, (b) maximum principal stress theory and (c) according to the Distortion energy theory? [3+3+4]

10. A cylinder has an internal diameter of 230 mm, has walls 5 mm thick and is 1 m long. It is found to change in internal volume by 12×10^{-6} m3 when filled with a liquid at a pressure p. If Young's Modulus = 200 GPa and Poisson's Ratio = 0.25, and assuming rigid end plates, determine:
a) The values of hoop and longitudinal stresses;
b) The necessary change in pressure p to produce a further increase in internal volume of 15 %. The liquid may be assumed incompressible. [5+5]

OR

11.a) Design a suitable diameter for a circular shaft required to transmit 90 kW at 180 rpm. The shear stress in the shaft is not to exceed 70 MPa and the maximum torque exceeds the mean by 40%. Also find the angle of twist in a length of 2 metres. Take Modulus of rigidity = 90 GPa.

b) Compare the weights of equal lengths of hollow shaft and solid shaft to transmit a given torque for the same maximum shear stress. The material for both the shafts is same and inside diameter is 2/3 of outside diameter in case of hollow shaft. [5+5]

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