Roll No. | | | | | | | | | | | | | Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(AE) (2011 Onwards) (Sem.–3)

MECHANICS OF MATERIALS

Subject Code : BTAE-301

Paper ID : [A1112]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1 Answer briefly :

a. Draw a stress stain diagram for ductile material and define important points of the diagram.

b. Write any four assumptions for driving bending moment equation.

c. A thin cylindrical shell of diameter D wall thickness t is subjected to internal pressure p. If E and μ are Young's modulus and Poisson's ratio of the material, what will be the volumetric strain in the shell?

d. What do you understand by shear flow? Draw the shear distribution over vertical axis of a circular cross sectioned beam.

e. What is the condition of free expansion?

f. Draw the graphical representation of distortion energy theory for plane stress state.

g. Differentiate between short, intermediate/medium and long columns.

h. Write the equation for strain energy stored in the beam under the action of axial force, torsion and bending moment simultaneously.

i. For a simply supported beam loaded with point load at the mid-span, what will be maximum deflection in the beam and where will it occur?

j. Define section modulus and how does it influence bending moment.

SECTION-B

Q2. A uniform bar of length L, cross-sectional area A, and mass density ρ is suspended vertically from one end.

a. Show that the elongation of the bar is $\delta = \rho g L^2/(2E)$, where g is the gravitational acceleration and E is the modulus of elasticity,

b. If the mass of the bar is M, show that $\delta = MgL/(2EA)$.

Q3. With suitable assumptions drive the flexure formula for straight beams.

Q4. The inner diameter of the hollow shaft is one-half its outer diameter D. Show that the maximum torque that can be carried by this shaft is 15/16th of the maximum torque that could be carried by a solid shaft of diameter D that is made of the same material.

Q5. The horizontal steel rod, 2.5 m long and 1200 mm^2 in cross-sectional area, is secured between two walls. If the rod is stress-free at 20°C, compute the stress when the temperature (has dropped to -20° C. Assume that

a. The walls do not move.

b. The walls; move together a distance $\Delta = 0.5$ mm.
Use $\alpha = 11.7\times10^{-6}$/°C and E = 200 GPa.

Q6. Compare the strength of a solid steel column to that of a hollow of the same Cross-sectional area. The internal diameter of the hollow column is $^3/_4$ of external diameter. Both the columns have the same length and are pinned at both ends.

SECTION-C

Q7. The overhanging beam ABC in Fig. 1 carries a concentrated load and a uniformly distributed load.

a. Derive the shear force and bending moment equations.

b. Draw the shear force and bending moment diagrams.

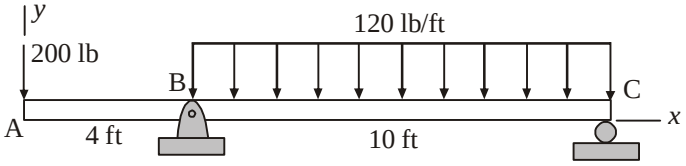

Figure - 1

Q8. The state of plane stress at a point with respect to the xy-axes is shown in Fig. 2. Using Mohr's circle, determine :

a. The principal stresses and principal planes.

b. The maximum in-plane shear stress.

c. The equivalent state of stress with respect to the x'y'-axes. Show all results on sketches of properly oriented elements.

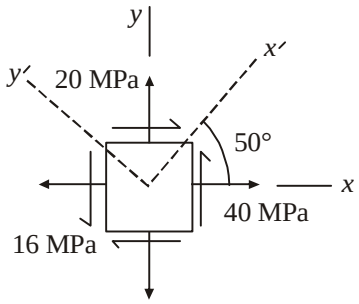

Figure - 2

Q9. The vertical shear force acting on the I-section shown in Fig. 3 is 100 kN. Compute

a. The maximum shear stress -acting on the section.

b. The percentage of the shear force carried by the web.

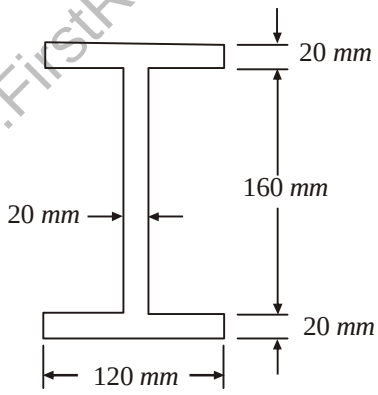

Figure -3