B

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M. TECH. DEGREE EXAMINATION

Civil Engineering

(Structural Engineering and Construction Management)

04CE 6403 Theory of Elasticity

Maximum Marks: 60 Duration: 3 Hours

Part A

*Answer all questions. Each question carries **3** marks*

1. Define stress and Cauchy's stress tensor at a point.
2. Explain the term 'stress transformation' and thus discuss about the principal planes.
3. Explain Saint Venant's principle and its applicability.
4. Discuss about the axisymmetric simplification in solid continuum mechanics.
5. List the assumptions involved with Coulomb's expression for torsion of circular shafts.
6. Brief on Prandtl's stress function approach towards torsion problems.
7. Sketch and briefly explain the stress – strain curve of mild steel up to rupture.
8. Explain the behaviour of a perfectly (ideal) plastic material with example.

(8 × 3 = 24 marks)

Part B

*Answer all questions. Each question carries **6** marks*

9. (a) The displacement field in a solid continuum is given by $\mathbf{u} = (x^2 + y)\,\mathbf{i} + (3 + z)\,\mathbf{j} + (x^2 + 2y)\,\mathbf{k}$. Determine the principal strains at a point P (3, 1, -2) and the major principal direction.

Or

(b) (i) Explain Lame's stress ellipsoid.
(ii) Define homogeneity, isotropy and elasticity in solid mechanics.

10. (a) Derive the differential equations of equilibrium for plane solid continuum problems in Cartesian coordinates.

Or

(b) Explain plane problems in Cartesian coordinates with examples.

11. (a) A cantilever beam of span L, unit width and depth $2h$, is subjected to a concentrated load P at the free end. Assume an Airy's stress function, $\phi = Axy + Bxy^3$, where A and B are constants. Determine the expressions for stress components. Plot the variation of the stress components.

Or

(b) Discuss the Airy's stress function approach for the analysis of boundary value problems in elastic solid mechanics.

12. (a) Derive the expressions for the stress components of a thick cylinder subjected to external pressure using Lame's approach.

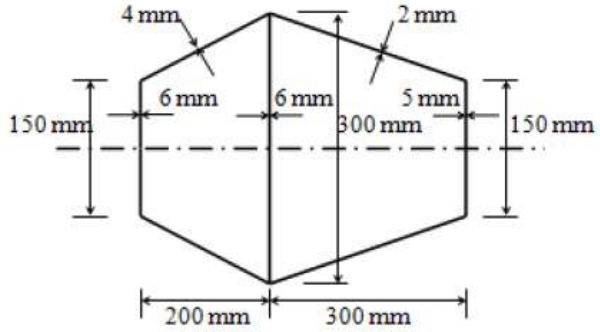
Or

(b) Derive the governing differential equation and the stress components of a rotating disc of uniform thickness and mass density.

13. (a) Discuss Prandtl's membrane analogy.

Or

(b) Using Bredt-Batho theory, find the shear stress distribution and the angle of twist over a 5 m length of the thin-walled double cell tube subjected to a torque of 50 kNm. The section is symmetrical with respect to the horizontal axis. Assume that the centre of twist lies at the centroid of the section. Take G = 30 GPa.



14. (a) Discuss about yield theories and their applications in detail.

Or

(b) Explain the elasto-plastic bending of beams, specially mentioning the difference between behaviour of symmetric and asymmetric sections.

(6 × 6 = 36 marks)