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Question Paper Code : 71780

M.E. DEGREE EXAMINATION, JUNE/JULY 2013.

First Semester

Structural Engineering

ST 9203/ST 913/UST 9103/10211 SE 104 – THEORY OF ELASTICITY AND PLASTICITY

(Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define the state of stress at a point given by stress tensor.

2. Write strain compatibility equation.

3. What is called plane strain?

4. Write the basic equation of stress strain relation.

5. What are the analogous methods available to solve torsion problems?

6. What is the maximum Shear stress in hollow elliptical cross section of bar due to torsion?

7. State Castigliano's theorem.

8. What is the significance of finite difference method?

9. What do you understand by a yield criteria?

10. Draw the stress strain diagram for an elastic work hardening material.

PART B — (5 × 16 = 80 marks)

11. (a) Determine the magnitude and the direction of the principal stresses and the maximum shearing stress when,

σ_x = 1500 MPa, σ_y = –1000 MPa, σ_z = 1000 MPa, τ_{xy} = 100 MPa.

Or

(b) The state of stress at a point is given by

σ_x = 100 kPa, σ_y = 200 kPa, σ_z = – 100 kPa, τ_{xy} = –200 kPa, τ_{yz} = 100 kPa, τ_{xz} = –300 kPa.

Determine,

(i) the stress invarients (5)

(ii) the principal stresses (6)

(iii) the direction cosines of the principal planes. (5)

12. (a) A rectangular beam 80 mm wide and 100 mm thick is of 600 mm in length. It carries a uniformly distributed load of intensity of 10 N/mm throughout its length. Plot the variation of stresses in the beam at mid-span. Also compare the results as obtained from elementary strength of materials.

Or

(b) A circular disc of 80 mm diameter and 5 mm thick is subjected to diametral compression. If the applied load is 800 N, determine the stress distribution in the disc at the centre.

13. (a) A shaft is of elliptical cross section having semi major axis 100 mm and semi minor axis 50 mm. It is subjected to a torque of 2000 Nm. Determine the maximum shear stress developed in the shaft.

Or

(b) A 500 mm × 500 mm angle section with 10 mm thickness is subjected to a torque of 5000 Nm. Find the maximum shear stress induced in the section and the angle of twist per unit length. Assume G = 0.8 x 10^5 N/mm^2.

14. (a) The strain components at a point are

ε_x = 0.001, ε_y = 0.002, ε_z = – 0.001, γ_{xy} = – 0.0001, γ_{yz} = – 0.004 kPa, γ_{xz} = 0.006. Determine the strain energy per unit volume. G = 1.05 × 10^5 N/mm^2, γ = 0.30.

Or

(b) Explain the finite element method in brief and explain the basic steps involved.

15. (a) Explain the two yield criterias in two dimensional applications.

Or

(b) A solid circular shaft of 100 mm radius is subjected to twisting couple so that the outer 50 mm deep shell yields plastically, If the yield stress in shear for the shaft material is 175 N/mm^2, determine the twisting couple applied and the associated angle of twist. $G = 0.84 \times 10^5$ N/mm^2.
