Reg. No. :

Question Paper Code: 32962

M.E DEGREE EXAMINATION, NOVEMBER 2015

Elective

Structural Engineering

01PSE505 – THEORY OF ELASTICITY AND PLASTICITY

(Regulation 2013)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Write the equilibrium and compatibility equation for a general three dimensional body.

2. Why do we call strain as a tensor quality?

3. Prove that the following are airy's stress function (i) $\emptyset = Ax^3-y$ (ii) $\emptyset = Ax^2-By^2$.

4. Write the bi-harmonic equation in polar co-ordinates.

5. Explain briefly about St.Venant's approach for torsion.

6. What is warping function?

7. Give short notes on the term "strain energy".

8. Explain any two energy theorems.

9. Define plastic flow.

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

11. (a) The state of stress at a point is given by (14)

$$\sigma_x=120MPa; \ T_{xy}=-55MPa$$
$$\sigma_y=55MPa; \ T_{yz}=33MPa$$
$$\sigma_z=-85MPa; \ T_{zy}=-75MPa$$

Determine the principal stresses and direction cosines of principal plane. (14)

Or

(b) (i) Derive the equilibrium equations in three dimension cartesian coordinate system. (7)

(ii) If an elastic body is isotropic and homogeneous. Show that the linear stress strain relationship can be expressed in terms of only two elastic constants. (7)

12. (a) A circular disc of 80mm diameter and 5mm thick is subjected to diametral compression. If the applied load is 800N, determine the stress distribution in the disc at the center. (14)

Or

(b) Show that the following stress function satisfies the boundary condition in a beam of rectangular cross-section of width 2h and depth d under a total shear force W.
$$\emptyset = [(W/2nd^3) \ xy^2 \ (3d-2y)]$$ (14)

13. (a) Find the maximum permissible torque if, $T_{max}=100MPa$. Find also the twist over 1 m length. Assume uniform thickness of cell wall as 4 mm. Take $G = 80GPa$. (14)
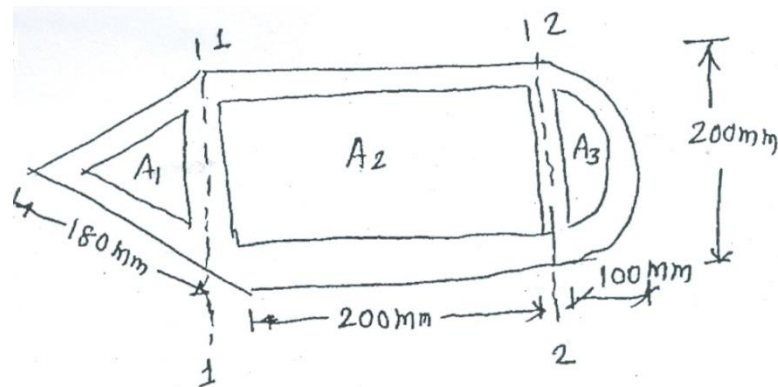
Or

(b) Discuss the effect of shear and torsion
   (i) Elliptical cross section (7)
   (ii) Triangular cross section of bar (7)

32963

14. (a) Derive the expression for the deflection of a simply supported beam with UDL over the entire span by Rayleigh–Ritz method. (14)

Or

(b) Explain the finite element method with basic steps involved. (14)

15. (a) A solid circular shaft of 90*mm* radius is subjected to a twisting couple so that the outer 40*mm* deep sheet of the shaft yields plastically. If the yield stress in shear for the shaft material is 150*Mpa*, determine the value of twisting couple is applied and associated angle of twist. $G = 80Gpa$. (14)

Or

(b) Write short notes on the following
    (i) Mechanism of strain hardening (5)
    (ii) Bauschinger's effect (5)
    (ii) St.Venant's theory of plastic flow (4)

PART - C (1 x 10 = 10 Marks)

16. (a) Discuss the effect of radial and tangential stress for a circular hole on a plate. (10)

Or

(b) Assuming proper stress functions and derives expressions for stresses in a cantilever beam of narrow rectangular section with moment at the free end. (10)

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32963

32963