[This question paper contains 3 printed pages.]

3159 *Your Roll No.* .....

MEC **J**

Paper – CE.551

THEORY OF ELASTICITY AND PLASTICITY

Time : 3 Hours *Maximum Marks : 100*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any **FIVE** *questions.*
Assume any data, if missing, suitably.

1. (a) Derive equations of equilibrium for 3-D cylindrical system of coordinates. (8)

   (b) Derive strain-displacement relationships for 3-D cylindrical system of coordinates. (12)

2. The state of stress at a point is represented by the given stress tensor :

$$\hat{c}_{ij} = \begin{bmatrix} -80 & 16 & 26 \\ 16 & 26 & -28 \\ 26 & -28 & -36 \end{bmatrix} \text{ (unit of stress)}$$

P.T.O.

For a plane with unit normal, $n = \left(\frac{1}{4}, \frac{1}{2}, \frac{\sqrt{\pi}}{4}\right)$

Calculate :

(a) Magnitude of stress vector for plane, n. (8)

(b) The normal and shear stress components for plane, n. (6+6)

3. A thin circular disc of uniform thickness is of 40 cm outer diameter and 20 cm inner diameter. Determine (a) speed of rotation, so that the disc just starts yielding plastically of the inner radius, (b) stresses in the disc when the disc has yielded upto 18 cm radius and (c) the speed for full yielding. Given, ρ = 7850 kg/m^3, δ_y = 250 MPa & ν = 0.30. (20)

4. A thick cylinder of internal radius 15 cm and external radius 30 cm is subjected to an internal pressure p MPa. If the yield strength of the cylinder material is 220 MPa, determine (a) pressure at which cylinder start yielding just at inner radius, (b) the stresses when the cylinder has a plastic front of radius 25 cm and (c) stresses when whole of the cylinder has yielded.

Assume Tresca yield criterion and plane strain condition. (20)

5. A solid circular shaft of 8 cm radius is subjected to a twisting couple, so that the outer 3 cm deep shell of shaft yields plastically. If the yield stress in shear for the shaft material is 150 MPa. Determine the value of twisting couple applied and the associated angle of twist. Given, $G = 0.84 \times 10^5$ MPa. (20)

6. A rectangular beam having linear stress-strain behaviour is 6 cm wide and 8 cm deep. It is 3 m long, simply supported at the ends and carries an uniformly distributed load over the whole span. The load is increased so that the outer 2 cm depth of the beam yields plastically. If the yield stress for the beam material is 240 MPa, plot the residual stress distribution in the beam. (20)

7. Explain in detail, yielding conditions for ductile materials. (20)

8. A concentrated point load in 2-D acts on a plate of unit thickness. This load is uniformly distributed along the thickness. Find out stresses and strains on a plane at θ angle with the load line. (20)

(100)****

This question paper contains 2 printed pages.

3160 *Your Roll No.* .....

MEC **J**

Paper— CE.554

(THEORY OF PLATES AND ELASTIC STABILITY)

Time : 3 hours *Maximum Marks* : 100

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions.

Assume any missing data suitably.

1. Discuss the cylindrical bending of a rectangular plate under a UDL fully covering the plate. Supports at edges are elastically built in. Explain how stress at a particular point may be determined in such a plate. 20

2. Derive the relation between bending moment and curvature in pure bending of plates. 20

3. What is the effect of axial load on bending stiffness in the case of a beam column? Discuss taking an example. 20

4. Determine critical load for a column whose one end is fixed and the other one is in a hinged condition. Derive the expression using the concept of effective length. 20

P. T. O.

5. Derive an expression for calculating the twist of the surface at a point in pure bending of plates in any direction. 20

6. Derive an expression for calculating deflection for a beam column with a uniformly distributed transverse load. The beam column is in a simply supported condition. 20

7. Write short notes on any *two* of the following:

   (*i*) Strain energy

   (*ii*) Flexural stiffness of plates

   (*iii*) Column design curve

   (*iv*) Circular plates. 20

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