Roll No. _____

23723

M. Tech. 1st Semester (Civil Engg. Computer Aided Structural Engg.) Examination – February, 2022

THEORY OF ALASTICITY

Paper : 21MTCASE2C3

Time : Three Hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any *five* questions. All questions carry equal marks.

1. (a) Derive a compatibility equation for plane strain problem considering deformation in x-y plane only. 10

   (b) Derive an expression to give the relation between three elastic constants. 10

2. A thick cylinder of internal radius 400mm and external radius 500mm subjected to internal pressure. If the

yield stress of the material 250MPa, determine the stresses when the whole of the cylinder has plastic front of radius 225mm. 20

3. Derive an expression by elastic theory to find the deflection of cantilever beam of uniform rigidity (EI) and length, L if beam is applied point load = P at free end. 20

4. Explain the following principles in the theory of elasticity. $10 \times 2 = 20$

   (i) Uniqueness theorem of 2D elements

   (ii) Stress invariants in 3 D elements

5. The state of stress at a point with respect to the xyz system is: 20

$$\begin{bmatrix} 3 & 2 & -2 \\ 2 & 0 & -1 \\ -2 & -1 & 2 \end{bmatrix} kN/m^2$$

Determine the stress tensor relative to the x'y'z' coordinate system obtained by a rotation through 30° about the z-axis.

6. (a) State the principle of Saint-Venant's. Give its application in elastic problems. $10 \times 2 = 20$

(b) Explain the stress distribution for a pure bending of curved bars.

7. Explain the following concepts. $4 \times 5 = 20$

   (i) The Kronecker's delta

   (ii) Betti's reciprocal theorem

   (iii) Homogeneous deformation in 3D elements

   (iv) Principal axis of strain rotation

8. A load P = 70 kN is applied to the circular steel frame shown in fig below. The rectangular cross section is 0.1 m wide and 0.05m thick. Determine the Tangential stress at points A and B. 20