Date:16/05/2016

Total Marks: 70

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GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER I (OLD) – • EXAMINATION – SUMMER 2016

Subject Code: 710901N

Subject Name: Theory of Elasticity

Time:02:30 pm to 05:00 pm

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Derive the Cauchy stress formula.
 - (b) Prove that the principal planes are orthogonal.
- **Q.2** (a) Derive the equations of equilibrium in Cartesian coordinates.
 - (b) For a given state of stress, determine the principal stresses and their directions. 07

$$\sigma_{ij} = \begin{vmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{vmatrix}$$

OR

(b) The displacement field for a body is given by $u_x = x^2 + y$, $u_y = 3 + z$ and 07 $u_z = x^2 + 2y$ at a point P(3,1,-2). Determine the principal strains.

Q.3 (a) Derive the equation for cubic dilatation in three dimensional Cartesian 07 coordinate system.

(b) Consider the displacement field $u_x = y^2(10^{-2})$, $u_y = 3yz(10^{-2})$ and 07 $u_z = (4 + 6x^2)(10^{-2})$. What are the rectangular strain components at the point P(1,0,2)?

OR

| Q.3 | (a) | Discuss the deviatoric state of strain and its invariants. | 07 |
|-----|------------|--|----|
| - | (b) | Derive the displacement equations of equilibrium. | 07 |
| Q.4 | (a) | Explain Maxwell reciprocal theorem. | 07 |
| • | (b) | Determine the slope at the end A of the cantilever beam of length L. | 07 |
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| Q.4 | | Derive the expression for strain energy of beam due to pure bending. Explain Menabrea's theorem. | 07 07 |
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| Q.5 | (a) | Derive the equation for the allowances in composite tubes. Determine the stresses induced in the rotating disc of uniform thickness. | 07 |
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OR

| Q.5 | (a) | Determine the shape for a disc with uniform stress $\sigma_r = \sigma_{\theta}$. | 07 |
|-----|------------|---|----|
| | (b) | What is Airy's stress function? Discuss its importance in plane elasticity. | 07 |
