

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 712003N**Date: 03-01-2014****Subject Name: Theory of Elasticity and Stability****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain state of plane strain and stress in detail. **07**
 (b) Give detailed classification of structures based on Geometry and Stiffness. **07**
- Q.2** (a) Derive an equation of critical load based on Euler's buckling theory for a column having fixed at end and hinged at top. **07**
 (b) Explain Airy stress function. With example discuss its application for solving two dimensional stress problems. **07**
- OR**
- (b) Explain various parameters for Safety and Stability of structures. **07**
- Q.3** (a) Check whether $\phi = Ax^4 + By^3 + Cz^3$ is a valid stress function and examine the stress distribution given by this equation. **07**
 (b) With neat sketches explain the fundamental behavior of linear and planar type structural elements under vertical and horizontal forces. **07**
- OR**
- Q.3** (a) State and explain Saint Venant's principle with its application to the solution of a cantilever beam loaded at free end. **07**
 (b) Investigate what problem of plane stress is solved by the stress function $\phi = ((3F/4c) * (xy - xy^3/3c^2)) + Py^2/2$ **07**
- Q.4** (a) Explain in detail: Equations of equilibrium, Boundary conditions and Compatibility conditions for Cartesian coordinate system. **07**
 (b) Distinguish between the rigid and flexible structural systems with neat sketches and appropriate examples. **07**
- OR**
- Q.4** (a) If $u_x = x^3 + 3$, $u_y = 4y^2z$ and $u_z = x + 5z$ find the stress at a point (1, 2, 3). **07**
 (b) What is Beam-column system? Derive an equation for beam column system with point load at center. **07**
- Q.5** (a) At a point Q, in a body subjected to tensile stress are $\sigma_x = 10 \text{ N/mm}^2$, $\sigma_y = 15 \text{ N/mm}^2$ and $\sigma_z = 10 \text{ N/mm}^2$ and $\tau_{xy} = \tau_{yz} = \tau_{xz} = 8 \text{ N/mm}^2$. Determine the normal and shear stress on a plane whose normal has following directions
 Case 1: $n_x = 0.5$, $n_y = 0.5$ and $n_z = 0.707$, case 2: $n_x = 0.707$, $n_y = 0.5$ and $n_z = 0$. **07**
 (b) Explain post buckling of columns and frames with appropriate examples. **07**
- OR**
- Q.5** (a) Explain stress and strain invariants with neat sketches and examples. **07**
 (b) Explain Hook's law and Poisson's ratio. Write the strain components in compression induced due to stress in a vertically placed linear axially loaded element. **07**
