

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-I Regular Examination January / February 2011****Subject code: 712003N****Subject Name: Theory of Elasticity & Stability****Date: 02 /02 /2011****Time: 02.30 pm – 05.00 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 Body forces, Surface forces and stress vector. **07**
 (b) At a point P in a body subjected to tensile stress $\sigma_x = 20 \text{ N/mm}^2$, $\sigma_y = 15 \text{ N/mm}^2$, $\sigma_z = 15 \text{ N/mm}^2$ and $\tau_{xy} = \tau_{yz} = \tau_{zx} = 5 \text{ N/mm}^2$. Determine the normal and shearing stress on a plane whose normal has the following direction
 Case 1 : $n_x = 0.5$, $n_y = 0.5$, $n_z = 0.707$,
 Case 2 : $n_x = 0.707$, $n_y = 0.5$, $n_z = 0$ **07**
- Q.2** (a) At a point P, the rectangular stress components are **07**
 $\sigma_x = 3 \text{ MPa}$, $\sigma_y = -2 \text{ MPa}$, $\sigma_z = 2 \text{ MPa}$,
 $\tau_{xy} = -2 \text{ MPa}$, $\tau_{yz} = 3 \text{ MPa}$, $\tau_{zx} = 2 \text{ MPa}$,
 Find the Principal stress, also check on the Invariance of I_1, I_2, I_3
 (b) Explain “Cauchy’s stress formula” in detail. **07**
OR
 (b) (1) Explain Principal stress. **04**
 (2) Prove that “Principal Planes are orthogonal”. **03**
- Q.3** (a) (1) Write rectangular strain components and explain state of strain at a point. **03**
 (2) Two points P and Q in the undeformed body have a co-ordinates (1, 2, 0) and (2, -1, 0) respectively. The displacement field $u = [(x^2 + 2y)i + (1 + z)j + (x + 3y^2)k]$ **04**
 Find the distance between points P and Q after deformation.
 (b) The displacement field for a body is given by **07**
 $u = [(x^2 + 2y)i + (1 + z)j + (x + 3y^2)k]$
 Determine the Principal strain at (2, 1, -3)
OR
- Q.3** (a) (1) The displacement field for a body is given by **03**
 $u = [(x^3 - 2y)i + (3x - z)j + (2x - y - z)k]$
 Find the deformed position of a point originally at (3, 2, -1).
 (2) The displacement field for a body is given by **04**
 $u = [(x^2 + y^2)i + (4x + 5y^2)j + (3x^2 + 3z)k]$
 Find out the Strain components at the point P (2, 0, 2)
 (b) Explain the Torsion for non-circular section. **07**
- Q.4** (a) Define term Beam-Column and explain the practical example with neat sketch. **07**
 (b) Explain with suitable example of stability of cantilever type of retaining wall. **07**
 Consider retaining earth 4.5m, soil bearing capacity 180 kN/m^2 , unit weight of soil 20 kN/m^3 , co-efficient of friction 0.35, angle of repose 30 degree. Assume additional data if required.

OR

- Q.4** (a) Derive the differential equation for beam-column. **07**
(b) A hollow circular column 5m long with 300mm internal diameter and 325mm external diameter is fixed at both ends. Find out buckling load and central deflection. **07**
Take $f_y = 250\text{MPa}$, $E = 2 \times 10^5 \text{ N/mm}^2$.

- Q.5** (a) Explain and derive the equations of compatibility. **07**
(b) Explain structural stability and structural instability with sketches. **07**

OR

- Q.5** (a) Explain law of minimum potential energy implication for column analysis. **07**
(b) State and explain different approaches for stability analysis **07**
