

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 712003N**Date: 12-01-2013****Subject Name: Theory of Elasticity and Stability****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 with neat sketch the state of stress at a point in three dimensions and the write Cauchy Stress Tensor in rectangular, cylindrical and spherical coordinate systems. 07

Q 1 (b) The state of stress at a point with respect to xyz coordinate system is given by 07

$$[\tau_{ij}] = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 4 & 0 \\ -2 & 0 & 1 \end{bmatrix} \text{ KN / mm}^2$$
 Find the stress tensor relative to a new x'y'z' coordinate system obtained by a rotation through 30° about the z axis.

Q 2 (a) The stress tensor of a point is given by $[\tau_{ij}] = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 4 & 3 \\ -2 & 3 & 1 \end{bmatrix} \text{ KN / m}^2$. Find the stress invariants and the principal stresses. 07

Q 2 (b) The state of stress at a particular point relative to the xyz coordinate system is given by $[\tau_{ij}] = \begin{bmatrix} 10 & 5 & 25 \\ 5 & 15 & 30 \\ 25 & 30 & 20 \end{bmatrix} \text{ N / mm}^2$. Find the normal and shearing stresses with $\alpha_{nx} = 0.7$, $\alpha_{ny} = 0.8$ and $\alpha_{nz} = 0.5$. 07

OR

Q 2 (b) Find octahedral normal and shearing stress on an octahedral plane whose state of stress is $[\tau_{ij}] = \begin{bmatrix} 12 & 4 & 8 \\ 4 & 2 & 8 \\ 8 & 8 & 6 \end{bmatrix} \text{ N / mm}^2$. 07

Q 3 (a) Explain the state of plane strain. 07

Q 3 (b) Write basic equations of equilibrium, compatibility and stress-strain relations for plane stress condition in polar coordinate system. 07

OR

Q 3 (a) Explain the state of strain applied to a small neighbourhood about a point. 07

Q 3 (b) If $[\epsilon_{ij}] = \begin{bmatrix} 0.001 & 0.001 & -0.002 \\ 0.001 & -0.003 & 0.0003 \\ -0.002 & 0.0003 & 0.002 \end{bmatrix}$. Find the strain invariants and principal strains. 07

- Q 4 (a) Explain Saint Venant's Principle applicable for two dimensional beam problems. 07
Q 4 (b) Check whether $\phi = A x^3 + B y^2$ is a valid stress function and examine the stress distribution represented by it. 07

OR

- Q 4 (a) Write basic equations of equilibrium, compatibility and stress-strain relations for plane stress condition in polar coordinate system. 07
Q 4 (b) Enlist various methods to solve two dimensional stress problems and explain the Airy Stress function method in brief. 07

- Q 5 (a) Explain the classification of structures based on Stiffness and Geometry. 07
Q 5 (b) What do you mean by critical load? Enlist the assumptions made in Euler's column buckling theory of column and explain the limitation of theory of Euler's column buckling. 07

OR

- Q 5 (a) Derive the equation to calculate the critical load based on Euler's column buckling theory for the column having both the ends fixed. 07
Q 5 (b) Explain various parameters of safety and stability. 07
