Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 712003N **Date: 17/02/2012**

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) Write basic equations of equilibrium, compatibility and stress-strain relations for a point in Cartesian coordinate system. 07

Q 1 (b) The state of stress at a point with respect to xyz coordinate system is given by $[\tau_{ij}] = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 4 & 0 \\ -2 & 0 & 1 \end{bmatrix}$ KN / mm^2. Find the stress tensor relative to a new x'y'z' coordinate system obtained by a rotation through 60˚ about the z axis. 07

Q 2 (a) The state of stress at a particular point relative to the xyz coordinate system is given by $[\tau_{ij}] = \begin{bmatrix} 10 & 5 & 25 \\ 5 & 15 & 30 \\ 25 & 30 & 20 \end{bmatrix}$ N / mm^2. Find the normal and shearing stresses with a surface intersecting the point and parallel to the plane given by the equation
x - 2y + 3z = 5. 07

Q 2 (b) Explain with neat sketch octahedral stress. 07

OR

Q 2 (b) The stress tensor of a point is given by $[\tau_{ij}] = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 3 \\ 3 & 3 & 5 \end{bmatrix}$ KN / m^2. Find the stress invariants and the principal stresses. 07

Q 3 (a) Explain principal stresses and stress invariants. 07

Q 3 (b) If $u_x = x^3 + 3$, $u_y = 3y^2z$ and $u_z = x + 3z$, find the strain a point (1,2,3). 07

OR

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

Q 3 (b) For a displacement field $u = 3x^2y^2\, i + 4y^2z\, j + (2y + z^2)\, k$, find the rectangular strain components at a point (1,2,3) 07

Q 4 (a) Enlist various methods to solve two dimensional stress problems and explain the Airy Stress function method in brief. 07

Q 4 (b)	Show that the Airy Stress function $\varphi = A[\, xy^3 - 0.75\, xyh^2]$ represents stress distribution in a cantilever beam loaded at the free end with load " P". Find the value of A if $\tau_{xy} = 0$ at $y = \pm h/2$, where b = width and h = height of the section.	07
	OR	
Q 4 (a)	Explain Saint Venant's Principle applicable for torsion of prismatic bars.	07
Q 4 (b)	Write basic equations of equilibrium, compatibility and stress-strain relations for plane strain condition in polar coordinate system.	07
Q 5 (a)	Enlist the parameters of safety and stability. Explain any two of them.	07
Q 5 (b)	Derive the equation to calculate the critical load based on Euler's column buckling theory for the column having both the ends hinged.	07
	OR	
Q 5 (a)	What do you mean by beam-column? Derive differential equation for beam-column with a concentrated central load.	07
Q 5 (b)	Explain in brief the effect of initial curvature on the capacity of column.	07

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