Seat No.: _____ Enrolment No._____

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 $[\tau_{ij}] = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 4 & 0 \\ -2 & 0 & 1 \end{bmatrix}$ KN / mm^2. Find the stress tensor relative to a new x'y'z' coordinate system obtained by a rotation through 30˚ about the z axis. 07

Q 2 (a) The stress tensor of a point is given by $[\tau_{ij}] = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 4 & 3 \\ -2 & 3 & 1 \end{bmatrix}$ 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 $[\tau_{ij}] = \begin{bmatrix} 10 & 5 & 25 \\ 5 & 15 & 30 \\ 25 & 30 & 20 \end{bmatrix}$ N / mm^2. Find the normal and shearing stresses with α_{nx}= 0.7 , α_{ny}= 0.8 and α_{nz}= 0.5. 07

OR

Q 2 (b) Find octahedral normal and shearing stress on an octahedral plane whose state of stress is $[\tau_{ij}] = \begin{bmatrix} 12 & 4 & 8 \\ 4 & 2 & 8 \\ 8 & 8 & 6 \end{bmatrix}$ 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 $[\varepsilon_{ij}] = \begin{bmatrix} 0.001 & 0.001 & -0.002 \\ 0.001 & -0.005 & 0.0005 \\ -0.002 & 0.0005 & 0.002 \end{bmatrix}$. 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 $\varphi = A\ x^3 + B\ y^2$ 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

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