Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 714303N Date: 09/07/2012

Subject Name: Theory of Elasticity & Plasticity

Time: 2:30 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)**	State the important observation made in equilibrium approach and derive its general equation to get critical load for end condition as both end hinged.	**07**
	(b)	Discuss energy approach for stability of columns & derive the general equation to get critical load P using energy approach. ($P_{cr}=\beta l$, $\Delta v=\Delta T$)	**07**
Q.2	**(a)**	Derive the basic differential equation for equilibrium in Cartesian co-ordinate system.	**07**
	(b)	Is the following 2-D state of plane strain is possible? Check. $\varepsilon_X = 4x^3y + 3x^2 - 13.5x^2 y^2 + 18y + 4$ $\varepsilon_Y = 4xy^3 + 6x - x^2 + 3y^2 + 5$ $\varepsilon_{XY} = \frac{1}{2}\gamma_{XY} = 2x^2 + 1.5y^2 + 4.5x^3y + xy + 4$	**07**
		OR	
	(b)	Show that the following 2-D state of stresses without body forces is in equilibrium: $\sigma_X = 3x^2 + 6xy - 5y^2 \quad \sigma_Y = x^2 + 2xy + 3y^2 \quad \tau_{XY} = -x^2 - 6xy - 3y^2$	**07**
Q.3	**(a)**	Derive the basic differential equation for beam column subjected to axial compressive force P and distributed load of intensity Q.	**07**
	(b)	Discuss the principle of imperfection approach for stability of column and derive the equation for critical load for end condition as one end fixed and one end free.	**07**
		OR	
Q.3	**(a)**	Define co-efficient of end restrained using beam column theory. Derive basic equations for statically indeterminate beam column with elastic restraints.	**07**
	(b)	Derive the standard equation for bucking of frames to get critical load. Use symmetrical bucking.	**07**
Q.4	**(a)**	Explain Airy's stress function for a circular plate with hole.	**10**
	(b)	A cylinder 90 mm Φ (internal) is subjected to an internal pressure 50 MPa. There is no external pressure. If the allowable stress in the metal is 150 Mpa, calculate external diameter.	**04**
		OR	
Q.4	**(a)**	For the following state of stresses, find the principal stresses. Normal stresses: $\sigma_{xx} = 100$ MPa, $\sigma_{yy} = 80$ MPa, $\sigma_{zz} = 60$ MPa, and Shear stresses: $\tau_{xy} = -10$ MPa, $\tau_{yz} = 10$ MPa, $\tau_{zx} = 20$ MPa,	**07**
	(b)	Locate principal planes and obtain principal strains at point (3, –1) for the following system of strains: $\varepsilon_X = x^3y + 5x^2 + 3x^3 + 2y^3 + 12$ $\varepsilon_Y = x^2 + 3y^2 + 2x^4 + 5y^3$ $\gamma_{XY} = 3x^2 + y^2 - \frac{1}{2}x^4 + y^4$ where strains are in nm and x and y in mm.	**07**

Q.5	**(a)**	Find the linear strains: ε_{xx}, ε_{yy} and shear strain: γ_{xy}, as well as state of stresses: σ_{xx}, σ_{yy} and shear strain: τ_{xy}, if the linear strains measured by the strain gauges in the direction are $\varepsilon_{35^\circ} = 400\text{x}10^{-6}$ (Compressive), $\varepsilon_{70^\circ} = 750\text{x}10^{-6}$ (Compressive) and $\varepsilon_{130^\circ} = 300\text{x}10^{-6}$ (Tensile).	**07**
	(b)	State the differential equation for the case of non-conservative forces for column with one end fixed and one end free condition using static criteria of stability.	
		OR	
Q.5	**(a)**	Enlist the assumptions involved in the theory of torsion of a long bar, subjected to twisting moment: T. Also, write steps in deriving the equation: $\nabla^2 (\phi) = -2G\theta$ with usual notations	**07**
	(b)	Derive general equation of deflection to study initial effect of curvature using imperfection approach.	**07**