Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2712010 **Date:06/01/2017**

Subject Name: Advanced Solid Mechanics

Time: 2:30 pm to 5:00 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 equilibrium approach and derive its general equation to get critical load for end condition one end roller and one end fixed.	**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. $\varepsilon_X = 12x^3 - 81x^2 y^2 - y^3 + 4x + 11$ $\varepsilon_Y = x^4 + 4xy^2 - 3x^2y + 8y + 21$ $\varepsilon_{XY} = ½ \gamma_{XY} = 4y - 25x^3y - 3xy^2 + 6$	**07**
		OR	
	(b)	Show that the following 2-D state of stresses without body forces is in equilibrium: $\sigma_X = 3x^2 + 9xy + 10y^2$ $\sigma_Y = 7x^2 + 8xy + 3y^2$ $\tau_{XY} = -4x^2 - 6xy - 4.5y^2$	**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)	Explain the important observations made in equilibrium approach and derive general equation to get critical load for end condition as both end fixed.	**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 100 mm Φ (internal) is subjected to an internal pressure 70 MPa. There is no external pressure. If the allowable stress in the metal is 170 Mpa, calculate external diameter.	**04**
		OR	
Q.4	**(a)**	For the following state of stresses, find the principal stresses. Normal stresses: $\sigma_{xx} = 350$ MPa, $\sigma_{yy} = 80$ MPa, $\sigma_{zz} = -70$ MPa, and Shear stresses: $\tau_{xy} = 80$ MPa, $\tau_{yz} = 10$ MPa, $\tau_{zx} = -60$ MPa,	**07**
	(b)	Locate principal planes and obtain principal strains at point (4, 2) for the following system of strains: $\varepsilon_X = x^3y + 5x^2 + 3x^3 + 2y^3 + 12$ $\varepsilon_Y = x^2 + 3y^2 + 2x^4 + 5y^3$ $\gamma_{XY} = 3x^2 + y^2 - ½ x^4 + y^4$ 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 $\varepsilon_{40^\circ} = 400\text{x}10^{-6}$ (Compressive), $\varepsilon_{75^\circ} = 700\text{x}10^{-6}$ (Compressive) and $\varepsilon_{120^\circ} = 400\text{x}10^{-6}$ (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**