Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 711503 **Date: 13-06-2013**

Subject Name: Advanced Solid Mechanics

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)**	State the types of failure associated with structure and show the various stability criteria for generating alternative configuration.	**07**
	(b)	Explain equilibrium approach and derive its general equation to get critical load for end condition as one end roller and one end fixed.	**07**
Q.2	**(a)**	Show that the following 2-D state of stresses without body forces is in equilibrium: $\sigma_X = 3x^2 + 4xy - 8y^2$ $\sigma_Y = 2x^2 + xy + 3y$ $\tau_{XY} = -\frac{1}{2}x^2 - 6xy - 2y^2$	**04**
	(b)	For the following state of stresses, find the principal stresses and the direction cosines of any **ONE** principal stress. Normal stresses: σ_{xx} = 400 MPa, σ_{yy} = 100 MPa, σ_{zz} = −50 MPa, and Shear stresses: τ_{xy} = 60 MPa, τ_{yz} = −20 MPa, τ_{zx} = −50 MPa,	**10**
		OR	
	(b)	Derive the equation $\nabla^4\phi = 0$ for polar co-ordinate system.	**10**
Q.3	**(a)**	Discuss energy approach for stability of column and derives its general equation to get critical load for end condition as one fixed and one end free.	**07**
	(b)	Discuss imperfection approach and state the principle of imperfection for stability of column. Derive general equation of deflection to study initial effect of curvature.	**07**
		OR	
Q.3	**(a)**	Using trigonometry series determine the value of critical load by assuming suitable shape of curve. State the advantages of energy approach.	**07**
	(b)	Derive the standard equation for bucking of frames to get critical load. Use anti-symmetrical bucking.	**07**
Q.4	**(a)**	Drawing neat sketch for a curved beam subjected to bending moment. Also, give various boundary conditions for the same.	**04**
	(b)	For the curved beam subjected to moment: M = 300 kJ, internal & external radii: a = 360 mm & b = 200 mm respectively, calculate radial and transverse stresses at inner, outer and every quarter thickness points and plot their variations using the following equations with usual notations:	**10**

		Radial stress: σ_r = ï $^{4M}/_{N}$ [a^2b^2/r^2 ln (b/a) + b^2 ln (r/b) + a^2 ln (a/r)] **Tangential stress:** σ_θ = ï $^{4M}/_{N}$ [ï a^2b^2/r^2 ln (b/a) + b^2 ln (r/b) + a^2 ln (a/r) + b^2 ï a^2] Here; N = (b^2 ï a^2)^2 ï 4 a^2b^2 [ln (b/a)]^2	
		OR	
Q.4	**(a)**	Derive strain displacement relation in Cartesian co-ordinate system.	**07**
	(b)	Derive the following relation with usual notations : $Ů_{ɗ}$ = ½($Ů_x$+$Ů_y$) + ½($Ů_x$-$Ů_y$)cos 2ɗ = $Ů_{xy}$ sin 2ɗ	**07**
Q.5	**(a)**	Using Swift construction, find normal and resultant shear stress on a plane whose normal has directions cosines are l = 0.342, m = 0.544 and n = 0.766 respectively w.r.t. Principal stresses: P_1 = 700 MPa (Tensile), P_2 = 250 MPa (Tensile) and P_3 = 300 MPa (Compressive).	**07**
	(b)	Using beam column theory derive basic equation for a beam of length l resting on two simple supports carrying concentrated lateral load Q at centre of the beam.	**07**
		OR	
Q.5	**(a)**	Drawing neat sketch, explain the soap-bubble analogy of torsion in and derive the equation ϕ **= (2 C θ S/p) z** with usual notations.	**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 dynamic criteria of stability.	**07**