Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 714303 **Date: 19-06-2014**

Subject Name: Theory of Elasticity and Plasticity

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 mark.**

Q.1	**(a)**	Explain the concept of stability and State the various stability criteria used for generating alternative configurations in structural analysis. Also state the types of failure associated with structures.	**07**
	(b)	An elastic body under the action of external forces has displacement field given by $\delta = (3x^2)\,\mathbf{i}$ ï (zy) **j** + (x^2z ï y) **k** in nm where x, y and z are expressed in mm. Determine all the strain components at (1, ï 2, 1).	**07**
Q.2	**(a)**	Derive basic differential equation in Cartesian co-ordinate system.	**07**
	(b)	Check whether the following 2-D state of stresses without body forces is in equilibrium or not. $\sigma_X = 3x^2 + 9xy$ ï $8y^2$, $\sigma_Y = 2x^2 + 5xy + 3y$, τ_{XY} = ï ½ x^2 ï 6xy ï $3y^2$	**07**
		OR	
	(b)	Derive the following equation with usual notations : $\sigma_\theta = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau_{xy} \sin 2\theta$	**07**
Q.3	**(a)**	Discuss imperfection approach and state the principle of imperfection for stability of column. State the differential equation for the case of non-conservative forces for column with one end fixed and one end free using Dynamic criteria of stability.	**07**
	(b)	Using beam-column theory derive basic equations for a beam of length "l" resting on two simple supports carrying several concentrated lateral loads "Q_1 ,Q_2--------Q_n" at some known distance from right hand support.	**07**
		OR	
Q.3	**(a)**	For the curved beam subjected to moment: M = 150 kJ, internal and external radii: a = 150 mm and b = 350 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: **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	**07**
Q.3	**(b)**	Derive the strain displacement relation in Cartesian co-ordinate system.	**07**
Q.4	**(a)**	Using Swift's construction, find normal and resultant shear stress on a plane whose normal has direction cosines are l=0.848, m= 0.342 and n=0.405 respectively w.r.t principal stresses p1= 400 MPa(tensile), p2=100 MPa (tensile) and p3=500 MPa (compressive).	**07**

	(b)	Drawing neat sketch, explain the soap-bubble analogy of torsion in and derive the equation ű = **(2 C** ď **S/p) z** with usual notations.	**07**
		OR	
Q.4	**(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: $\nabla^2 (\phi)$ = ï 2Gθ with usual notations	**07**
Q.4	**(b)**	Derive Airyôs stress function: Ø = **A ln r + B r^2 ln r + Cr^2 + D** in Polar Coordinate System for an Axi-symmetric stress distribution.	**07**
Q.5	**(a)**	Discuss in brief the importance of Modulus of Elasticity ďEô and its effect on various end conditions of columns. Explain various empirical formulas for column design using imperfection approach: (i) Rankine Gorden formula (ii) AISC (iii) Straight line formula	**07**
	(b)	Explain plane stress and plane strain problem. Also explain Generalized Hookôs law.	**07**
		OR	
Q.5	**(a)**	Discuss effect of transverse shear on buckling of the beam and derive equation of critical load for the same.	**07**
	(b)	Discuss energy approach for stability of columns and derive the general equation to get critical load P using energy approach. (P_{cr}= βl, φv = φT)	**07**