Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2712010 **Date: 12-01-2015**

Subject Name: Advanced Solid Mechanics

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)**	Derive an expression for the normal stress acting on an arbitrarily inclined (oblique) plane passing through a point in a linearly elastic strained material for a problem of 3 ï D elasticity in Cartesian co-ordinates. Hence derive characteristic cubic equation to evaluate stationary values of stresses	**10**
	(b)	Write a note on plane strain condition	**04**
Q.2	**(a)**	Derive D E of equilibrium for a 2 ï D problem of elasticity in Cartesian system considering body forces	**07**
	(b)	Find principal strains if the state of strain at a point is given by $\lfloor_x = 1 \times 10^{-4}$, $\lfloor_y = 12 \times 10^{-5}$, $\lfloor_z = 1.06 \times 10^{-4}$ $\supset_{xy} = 6.3 \times 10^{-5}$, $\supset_{yz} = 0$, $\supset_{zx} = 0$	**07**
		OR	
	(b)	If the state of strain in x-y plane is given by normal strains $\lfloor_x$, $\lfloor_y$ along axes x & y respectively and shear strain $\supset_{xy}$ find the normal strain $\lfloor_n$ along any axis ónô which is inclined at an angle ódô with the x-axis	**07**
Q.3	**(a)**	Derive expression for the Laplacian operator ∇^2 in polar coordinates	**07**
	(b)	Find buckling load for a fixed ï fixed column using classical method	**07**
		OR	
Q.3	**(a)**	Find the stress distribution in a prismatic shaft of elliptical cross-section subject to a torque ôTô throughout the length using stress function approach.	**07**
	(b)	Using principle of minimum total potential find buckling load for a fixed ï fixed column	**07**
Q.4	**(a)**	Find the stress distribution under a concentrated load, acting towards the point of application, normal to the free boundary of a semi-infinite elastic medium using the stress function ◖ = ï (P/ ´) r ɗ Sinɗ	**07**
	(b)	A thick cylinder carries internal bursting pressure 10.5 MPa and suction on outer face 4.2 MPa. Find modulus of elasticity of material of cylinder if circumferential strain at a point within the wall thickness at which radial stress becomes zero, is 1×10^{-4}. Take inner and outer radii as 150 mm & 250 mm	**07**
		OR	

Q.4 **(a)** Show that the deflection at center of a simply supported beam carrying transverse concentrated load at center is almost doubled if it also carries an axial compressive force equal to half that of its Eulerian Buckling load **07**

(b) What do you understand by stress concentration? Sketch different types of stress raisers. Write stress function required to find stress concentration factor due to stress distribution around a circular cavity of small radius located in an infinitely large plate of negligible thickness carrying unidirectional tension. Enlist various boundary conditions to be enforced to evaluate unknowns. Sketch the stress distribution along axes of symmetry of plate. What is stress concentration factor for this case? **07**

Q.5 **(a)** Using finite difference method find crippling load of a prismatic fixed-fixed column. Divide the height of column in 04 equal parts **07**

(b) Derive equation to deflection curve for an initially bent hinged-hinged column carrying axial compression. Take initial bent shape conforming to a sine curve. **07**

OR

Q.5 **(a)** A non-sway portal ABCD has ends óAô & óDô fixed. $l_{AB} = l_{BC} = l_{CD} = L$ and $I_{AB} = I_{BC} = I_{CD} = I$. Columns AB & CD are upright. Develop necessary equations to be satisfied by the critical load for the frame. **07**

(b) Derive necessary boundary condition to be satisfied by a warping function used in the St.Venantôs theory of torsion of shafts of non-circular cross-section in its most general form. Hence prove that a circular cross-section doesnôt warp. **07**

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