Enrolment No.

## GUJARAT TECHNOLOGICAL UNIVERSITY M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 714303N

Date: 03-01-2014

07

Subject Name: Theory of Elasticity & Plasticity 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) Is the following 2-D state of plane strain is possible? Check.  

$$\varepsilon_X = 4x^3y + 3x^2 - 13.5x^2y^2 + 18y + 4$$
  
 $\varepsilon_Y = 4xy^3 + 6x - x^2 + 3y^2 + 5$   
 $\varepsilon_{XY} = \frac{1}{2}\gamma_{XY} = -2x^2 - 1.5y^2 - 4.5x^3y - xy + 4$   
(b) Using Sprift's construction find mercula and merculant charge strain

- (b) Using Swift's construction, find normal and resultant shear stress on a 07 plane whose normal has direction cosines are l=0.544, m= 0.766 and n=0.342 respectively w.r.t principal stresses p1= 650 MPa(tensile), p2=150 MPa (tensile) and p3=350 MPa (compressive).
- Q.2 (a) Derive the basic differential equation for beam column subjected to axial 07 compressive force P and distributed lateral load of intensity Q.
  - (b) Derive the critical load using energy approach for stability of column with 07 end condition as one end fixed and one end free.

### OR

- (b) Using trigonometry series determine the value of critical load by assuming 07 suitable shape of curve. State the advantages of energy approach.
- Q.3 (a) Discuss imperfection approach and state the principle of imperfection for 07 stability of column.
  - (b) State the differential equation for the case of non-conservative forces for 07 column with one end fixed & one end free using static criteria of stability

### OR

- Q.3 (a) Define co-efficient of end restrained using beam column theory. Derive 07 basic equations for statically indeterminate beam column with elastic restraints.
  - (b) Derive the standard equation for bucking of frames to get critical load. Use **07** symmetrical bucking.
- Q.4 (a) For the following state of stresses, find the principal stresses and the 10 direction cosines of any ONE principal stress. 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,
  - (b) Write the compatibility equation for 2-D strains. From which derive the 04 equation  $\nabla^4 \phi = 0$ , where  $\phi$  represents Airy's stress function.

#### OR

Q.4 (a) Calculate radial and transverse stresses at inner, outer and every quarter 07 thickness points and plot their variations using the following equations with usual notations:

**Radial stress:**  $\sigma_r = -\frac{^{4M}}{_N} [a^2b^2/r^2 \ln (b/a) + b^2 \ln (r/b) + a^2 \ln (a/r)]$  **Tangential stress:**   $\sigma_{\theta} = -\frac{^{4M}}{_N} [-a^2b^2/r^2 \ln (b/a) + b^2 \ln (r/b) + a^2 \ln (a/r) + b^2 - a^2]$ If, moment: M = 150 kJ, internal & external radii: a = 200 mm & b = 300 mm respectively. Here; N =  $(b^2 - a^2)^2 - 4 a^2b^2 [\ln (b/a)]^2$ 

- (b) Derive basic differential equation of equilibrium in Cartesian co-ordinate 07 system.
- **Q.5** (a) Discuss energy approach for stability of columns & derive the general **07** equation to get critical load P using energy approach. ( $P_{cr}=\beta l, \Delta v=\Delta T$ )
  - (b) Find the linear strains:  $\varepsilon_{xx}$ ,  $\varepsilon_{yy}$  and shear strain:  $\gamma_{xy}$ , if the linear strains **07** measured by the strain gauges in the direction are  $\varepsilon_{25^\circ} = 90x10^{-3}$  (Tensile),  $\varepsilon_{70^\circ} = -20x10^{-3}$  (Compressive) and  $\varepsilon_{140^\circ} = 30x10^{-3}$  (Tensile). Also, calculate the state of stresses.

### OR

- Q.5 (a) Discuss in details dynamic or vibration approach. Discuss any one 07 structural application.
  - (b) Drawing neat sketch, explain the soap-bubble analogy of torsion in and derive the 07 equation  $\phi = (2 C \theta S/p) z$  with usual notations.

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