Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 714303N Date: 13-06-2013

Subject Name: Theory of Elasticity and 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)** Discuss energy approach for stability of columns and derive the general equation to get critical load P using energy approach. (Pcr=ϭl, qpv=qpT) **07**

(b) Derive strain-displacement relation in polar co-ordinate system. **07**

Q.2 **(a)** Derive the basic differential equation for equilibrium in Cartesian coordinate system. **07**

(b) Is the following 2-D state of plane strain is possible? Check. **07**

ŮX = 7x2y - 3x2 +7xy2 + 9

ŮY = 9x3 + 8xy +2x2 + 8

ŮXY = ½ ɔXY = 17x²y+2xy+15

OR **07**

(b) For the following state of stresses, find the principal stresses and the direction cosines of any **ONE** principal stress. Normal stresses: ůxx=300 MPa, ůyy = 200 MPa, ůzz = 100 MPa, and Shear stresses: Ű́xy = 50 MPa, Ű́yz = 50 MPa, Ű́zx = 50 Mpa.

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) Discuss the principle of imperfection approach for stability of column and derive the equation for critical load for end condition as one end fixed and one end free. **07**

OR

(b) Define co-efficient of end restrained using beam column theory. Derive basic equations for statically indeterminate beam column with elastic restraints.

Q.4 **(a)** Explain Airyôs stress function for a circular plate with hole **10**

(b) A cylinder 100 mm ū (internal) is subjected to an internal pressure 60 MPa. There is no external pressure. If the allowable stress in the metal is 160 Mpa, calculate external diameter. **04**

OR

Q.4 **(a)** Locate principal planes and obtain principal strains at point (3, ï 1) for the following system of strains: **07**

Ůx = $x_3y + 5x_2 + 3x_3 + 2y_3 + 12$

Ůy = $x_2 + 3y_2 + 2x_4 + 5y_3$

ɔxy = $3x_2 + y_2$ ï ½ $x_4 + y_4$ where strains are in nm and x and y in mm.

Q.4 **(b)** 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: ∇^2 (ű) = ï 2Gd with usual notations **07**

Q.5 **(a)** Derive general equation of deflection to study initial effect of curvature using imperfection approach. **07**

(b) Derive the basic equation of equilibrium for column in bent configuration subjected to dynamic force. Also explain mode shapes of buckling. **07**

OR

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 = 0.405 respectively w.r.t. Principal stresses: P_1 = 900 MPa (Tensile), P_2 = 200 MPa (Tensile) and P_3 = 300 MPa (Compressive). **07**

(b) 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: **07**

Radial stress: $\mathring{u}_r = ï\ 4M/N\ [a^2b^2/r^2 \ln (b/a) + b^2 \ln (r/b) + a^2 \ln (a/r)]$

Tangential stress:

$\mathring{u}_d = ï\ 4M/N\ [ï\ a^2b^2/r^2 \ln (b/a) + b^2 \ln (r/b) + a^2 \ln (a/r) + b^2 ï\ a^2]$

Here; $N = (b^2 ï\ a^2)^2 ï\ 4\ a^2b^2\ [\ln (b/a)]^2$

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