Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII(NEW) • EXAMINATION – WINTER 2016

Subject Code:2171916 Date:18/11/2016

Subject Name: Applied Mechanics of Solid(Department Elective - I)

Time:10.30 AM to 1.00 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)** A differential element of material at a point is subjected to a state of plane strain $\varepsilon_x = 500x10^{-6}$, $\varepsilon_y = -300x10^{-6}$, $\gamma_{xy} = 200x10^{-6}$, which tends to distort the element. Determine the principal strains on the element and equivalent strains acting on an element of the material oriented at the point, clockwise 30° from the original position. **07**

(b) Determine direct and shear stresses on an axis located at 15 degrees, counter clockwise from *x-axis*. $\sigma_x = -90MPa,\ \sigma_y = 50MPa,$ and $\tau_{xy} = 60MPa.$ **07**

Q.2 **(a)** Derive the equilibrium equations for a three dimensional problem. **07**

(b) The engineering strain matrix relative to *xyz* coordinate system is defined as: **07**

$\varepsilon_{ij} = 10^{-4}\begin{bmatrix} 2 & -1 & 2 \\ -1 & 0 & 1 \\ 2 & 1 & -4 \end{bmatrix}$ Determine the engineering strain matrix relative to *x'y'z'* system if matrix of direction cosines is given as $\frac{1}{15}\begin{bmatrix} 14 & -5 & 2 \\ 2 & 10 & 11 \\ -5 & -10 & 10 \end{bmatrix}$.

OR

(b) Explain following terms: **07**
(1) Bouschinger Effect (2) Kinematic Hardening (3) Loading surface for an elastoplastic material

Q.3 **(a)** Derive the equation of strain transformations in 2D. **07**

(b) Enlist theories of failure and explain why theory of Maximum Principal stress is not suitable for ductile materials? **07**

OR

Q.3 **(a)** A thin walled cylindrical pressure vessel with closed ends, has diameter of 508 mm and thickness of 6.35 mm. It is subjected to an internal pressure *p*. The yield stress of 225 MPa. Find the maximum pressure p_y under which the vessel will begin to yield using (i) Tresca criterion and (ii) von Mises criterion. **07**

(b) With the help of neat sketch, discuss behavior of Prandit-Reuss under plane stress $\sigma_{ij} = [\sigma_1, 0, \sigma_3]$. **07**

Q.4 **(a)** With the help of neat sketch, explain following terms associated with the photoelasticity: (i) Polarizer (ii) Wave-plate (iii) Birefringence **07**

(b) Write constitutive relation for incremental stress-strain relation for elastic solid. Also describe conditions under which it should be used. **07**

OR

Q.4 **(a)** With the help of neat sketch, explain term associated flow rule and state its benefits compared to non-associated flow rules. **07**

(b) Explain following terms associated with an elastic solid. **07**
(i) Normality (ii) Uniqueness

Q.5 **(a)** State compatibility equations and explain their significance. **07**

(b) Explain Druker's stability postulate for stability of work-hardening materials. **07**

OR

Q.5 **(a)** Consider a simply supported beam of span *L*, has depth of *2c* and width of *b*, where *b* and *c* are constants. The beam is loaded at its mid-span with a point load of *2P*. Obtain stress field for using following stress function. **08**

$$\Phi = Axy + Bx^2 + Cx^2y + Dy^3 + Exy^3 + Fx^2y^3 + Gy^5$$

(b) Prove that to convert a plane strain solution to a plane stress solution, substitute $\frac{1+2\nu}{(1+\nu)^2}E$ for E and $\frac{\nu}{(1+\nu)}$ for ν. **06**

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