Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remidial Examination April 2010

Subject code: 710901 **Subject Name: Theory of Elasticity**

Date: 06 / 04 /2010 **Time: 12.00 noon – 02.30 pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Show that an arbitrary state of stress can be resolved into a hydrostatic state and deviatoric stress. **06**

(b) Draw the octahedral planes and prove that the normal octahedral stress is the mean normal stress at a given point in a body. **06**

Q.2 **(a)** All the six strain components can not be prescribed arbitrarily and there exist a compatibility conditions for the same – Evaluate. **06**

(b) Graphically represent the change in orientations of two line segments originally perpendicular to each other by rigid body motion. Also show the interpretation of any one of the shear strain component in the two line segments originally perpendicular to each other. **06**

OR

(b) The displacement field u is given by **06**
$u = (x^2+y)i + (3+z)j + (x^2+2y)k$
What is the deformed position at point originally located at (3,1,-2)?

Q.3 **(a)** Show that for an isotropic material only two independent elastic constants are involved in the generalized statement of Hooke's law. **06**

(b) A cubical element is subjected to the following state of stress. Assuming the material to be homogeneous and isotropic, determine the principal shear strains and octahedral shear strains if E = 2 x 10^5 MPa and $\nu = 0.25$. In usual notations **06**

$$G = \frac{E}{2(1+\nu)}, \tau_{oct} = \frac{1}{3}\left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma \ - \sigma_2)^2\right]^{\frac{1}{2}}$$

OR

Q.3 **(a)** Define modulus of rigidity, bulk modulus and Poisson's ratio. Show that for the bulk modulus to be positive the value of Poisson's ratio can not exceed the value of 0.5. **06**

(b) A thin rubber sheet is enclosed between two fixed hard steel plates as shown in **Fig. 1.** The friction between the rubber and steel faces is negligible. If the rubber plate is subjected to stresses as shown then determine the strains ε_{xx} and ε_{yy}. **06**

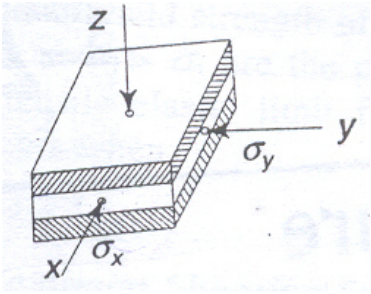

Figure 1

Q.4	**(a)**	Explain the maximum principal stress theory for predicting failure and bring out its limitations and conditions under which it is applicable.	**06**
	(b)	Compare octahedral shearing stress theory and maximum elastic energy theory of failure and bring out the limitations of the same.	**06**

OR

Q.4	**(a)**	The energy of distortion theory of failure and the octahedral shearing stress theory are almost similar. – Evaluate.	**06**
	(b)	The brittle materials like glass bulbs which are subjected to hydrostatic pressures do not fail when the pressure is acting but fail when the pressure is released. – Evaluate.	**06**
Q.5	**(a)**	The total strain present in the body is due to thermal expansion and due to the stress components in the body. – Evaluate the statement and also express the said concept in the form of mathematical expression.	**06**
	(b)	The linear variation of temperature with the radius r of the thin circular disk does not contradict that the stresses in the body is zero. –Evaluate.	**06**

OR

Q.5	**(a)**	Compare and contrast the finite element method with finite volume method.	**06**
	(b)	State the First theorem of Castlingo and explain the theorem of virtual work.	**06**

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