**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY** **B**

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2015

**Civil Engineering**

(Structural Engineering)

# 01CE6103 Theory of Elasticity

Max. Marks : 60 Duration: 3 Hours

(Answer any TWO out of Three questions from each part)

PART A( Each question carries 9 marks )





1) At a point in an elastic body subjected to loading the stress components is given by,

$$[\sigma]=\begin{bmatrix}15 & 10 & 5\\ 10 & 25 & 0\\ 5 & 0 & 20\end{bmatrix} MPa$$

Determine the normal and shear stress components on an inclined plane where normal is equally inclined to the three coordinate axes x, y, z.

2) Determine the set of body forces that will keep the following stress field in equilibrium.

$$\sigma_{xx} = 8x^2 - 14xy^2 + 8x^2z^2 + 6yz^2$$

$$\sigma_{yy} = 15x^3 + 12xy^3 + 6y^2z^2 - 5x^2yz$$

$$\tau_{xy} = 6x^2y^2 - 4xy^3 + 4x^3y + 3y^3$$

3) Given the state of stress at a point in a loaded continuum as:

$$[\sigma]=\begin{bmatrix}9 & 6 & 3\\ 6 & 5 & 2\\ 3 & 2 & 4\end{bmatrix}$$ Mpa Determine the principal strain and principal directions. Poissons ratio is 0.25, modulus of elasticity is 2 x $10^5$ MPa.

PART B( Each question carries 9 marks )

4) . Show that $\phi = \frac{q}{8c^3}\left\{x^2\left(y^3 - 3c^2y + 2c^3\right) - \frac{1}{5}y^3\left(y^2 - 2c^2\right)\right\}$ is an acceptable stress function and hence find the stress field it represents.

5) . Given the following strain field. Find the condition under which it is a possible strain field.

$$\varepsilon_x = a_0 + a_1(x^2 + y^2) + (x^4 + y^4)$$

$$\varepsilon_y = b_0 + b_1(x^2 + y^2) + (x^4 + y^4)$$

$$\gamma_{xy} = c_0 + c_1 xy(x^2 + y^2 + c_2)$$

$$\varepsilon_z = \gamma_{yz} = \gamma_{xz} = 0$$

6) Derive Beltrami-Michell's Equations

PART C( Each question carries 12 marks )

7)
   a) Derive the Poisson's equation for torsion of prismatic bars of non circular cross sections.
   b) Explain the torsion in thin walled closed tubes.

8) A thick cylinder of inner radius 10 cm and outer radius 15 cm is subjected to an internal pressure of 12 N/mm$^2$. Determine the radial and hoop stress in the cylinder at the inner and outer surfaces.

9) Derive the expression for shear stress for an equilateral triangular cross section