**Karunya University**

**(Karunya Institute of Technology and Sciences)**

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

**Supplementary Examinations – June 2016**

**Subject Title: APPLIED ELASTICITY AND PLASTICITY Time : 3 hours**

**Subject Code: 14CE3001 Maximum Marks: 100**

**Answer ALL questions (5 x 20 = 100 Marks)**

1. a. Explain ‘Stress at a Point” and calculate the body forces for the given state of stresses at a point P having coordinates P ( 1,2,3) (10)

σx = 20x3 + y3 τxy = z

σy = 30x3 + 200 τyz = x3

σz = 30y2 + 30z3 τzx = y2

b. The state of stress at a particular point relative to the xyz coordinate system is given by the stress matrix. (10)

5 10 -10

10 10 0 MPa

-10 0 40

Determine the normal stress and the magnitude and direction of the shear stress on a surface intersecting the point and parallel to the plane given by the equation.

2x – y + 3z = 9

**(OR)**

2. a. Develop the St. Venant compatibility equations in 3 D rectangular coordinates. (5) b. Develop the Generalized Hook’s law for an isotropic material. (5) c. The displacement field in micro units for a body is given by (10)

U = (x2 + y) i + (3 + z)j + ( x + 2y)k

Determine the principal strains at a point P (3, 1, -2) and their directions. Compare the

strain invariants before and after transformation.

3. a. Explain Plane strain problem with examples and develop the constitutive law therefore.

(10)

b. Show that the following function is a stress function and investigate what problem of plane stress is solved by it in the region y=+/- c on the side x positive (10)

φ = (q/8c3)[x2(y3-3c2y+2 c3)-(1/5)( y3(y2-2c2))]

**(OR)**

4. a. Explain Airy’s Stress function and develop the Biharmonic equation for plane stress problem. (5)

b. Explain Plane stress problem with examples and develop the constitutive law therefore. (5)

c. Develop the strain displacement relations for a plane stress problem. (5)

d. Develop the differential equations of equilibrium in 2-D rectangular coordinates (5)

5. a. Develop the differential equations of equilibrium in polar coordinates. (5)

b. What is an axi-symmetric problem? Derive the constitutive law therefore. (5)

c. Develop the stress distribution in a rotating disc with a small hole at the centre. (10)

**(OR)**

6. a. Develop the strain displacement relations in polar coordinates. (5)

b. Determine the stress distribution in a thick cylinder under external pressure. (5)

c. Determine the stress distribution in an infinite plate with a hole under tension. (10)

[P.T.O]

7. a. Develop the governing equation and boundary conditions for St Venant warping function approach for torsion of non-circular section. (10)

b. Develop the necessary equations for maximum and minimum torsion stresses in an elliptic bar. (10)

**(OR)**

8. a. Develop the expression for torsional constant of a thin narrow rectangle and explain how to evaluate the torsional stress in a thin walled open section with an example. (10)

b. Develop the necessary expression for torsional stress in a thin walled closed tube and hence explain how you will evaluate the torsional capacity of a 2 celled tube. (10)

**COMPULSORY:**

9. Explain the following

a. Yield criteria (5)

b. Elastic-plastic bending of beam (5)

c. Sand heap Analogy for plastic torsion of a circular bar (5)

d. Concept of plastic potential (5)