Hall Ticket No | | | | | | | | | | | Question Paper Code: BST001

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE–R16

Theory of Elasticity and Plasticity

Time: 3 Hours **(STE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Describe plane stress and plane strain for x, y, z coordinate system. **[7M]**

   (b) At a point in the structural member, the stresses are represented as shown in Figure 1. Determine
   i) the magnitude and orientation of the principal stresses
   ii) the magnitude and orientation of the maximum shearing stresses and associated normal stresses. In each case, show the results on a properly oriented element; represent the stress tensor in matrix form. **[7M]**

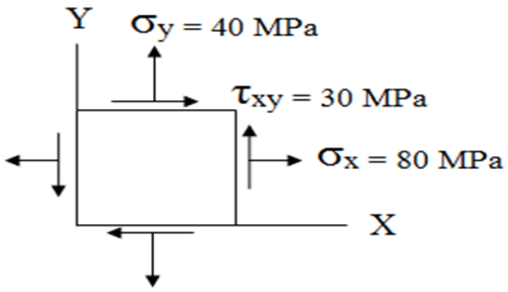

Figure 1

2. (a) What is meant by stress function? Describe its uses. **[7M]**

   (b) The stress tensor at a point in a machine element with respect to a Cartesian coordinate system is given by the following array:

$$[\tau_{ij}] = \begin{pmatrix} 50 & 10 & 0 \\ 10 & 20 & 40 \\ 0 & 40 & 30 \end{pmatrix}$$

   Determine the state of stress and I1,I2 and I3 for an x, y, z coordinate system defined by rotating x, y through an angle $= 45^0$ counter clockwise about the z axis.

   [7M]

UNIT – II

3. (a) State the principle of Saint-Venant. Give its application in elastic problems. **[7M]**
   (b) Write down the application of Fourier series for two dimensional problems under gravity loading. **[7M]**

4. (a) Explain the stress distribution for a pure bending of curved bars. **[7M]**
   (b) Describe Airy's stress function? Give its applications. **[7M]**

UNIT – III

5. (a) Write the equations of equilibrium for 3 dimensions in terms of direction cosines for a tetrahedron. **[7M]**
   (b) A three-dimensional complex stress system has principal stress values of 280 MN/m2, 50 MN/m^2 and -120 MN/m^2. Determine analytically and graphically:
   i) the limiting values of the maximum shear stress;
   ii)the values of the octahedral normal and shear stresses. **[7M]**

6. (a) What is meant by principal axes and principal stresses? **[7M]**
   (b) Analysis of a particular body indicates that stresses for orthogonal interfaces associated with reference xyz at a point given are, (in kPa).
   τ_{xx} = 3000; τ_{xy} = -1000; τ_{xz} = 0;
   τ_{yx} = -1000; τ_{yy} = 2000; τ_{yz} = 2000;
   τ_{zx} = 0; τ_{zy} = 2000; τ_{zz} = 0;
   Determine the normal stress on the infinitesimal interface at this point whose unit normal is n = 0.6j + 0.8k. Also determine the shear stress on the same interface in a direction parallel to the x-axis. **[7M]**

UNIT – IV

7. (a) Derive the solution for torsion of prismatic bars with prismatic elliptical cross sections. **[7M]**
   (b) Give the assumptions used in bending of prismatic bars. **[7M]**

8. (a) Explain in detail the solution of bending problems by soap-film method. **[7M]**
   (b) What is meant by shear centre in bending of prismatic bars? **[7M]**

UNIT – V

9. (a) What is meant by shape factor? Give the shape factor for rectangular and circular sections. **[7M]**
   (b) Determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN using maximum principal stress theory and maximum principal strain theory. Given the elastic limit in tension = 225 N/mm2, factor of safety = 3 and Poisson's ratio = 0.3. **[7M]**

10. (a) State and explain Rankine's and Saint Venant's yield criteria. **[7M]**
    (b) The principal stresses at a point in an elastic material are 100 N/mm^2(tensile), 80 N/mm^2(tensile) and 50 N/mm2(compressive). If the stress at the elastic limit in simple tension is 200 N/mm^2, determine whether the failure of material will occur according to maximum principal stress theory. If not, then determine factor of safety. **[7M]**