Hall Ticket No | | | | | | | | | | Question Paper Code: BSTB02

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

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

Regulation: IARE–R18

ADVANCED SOLID MECHANICS

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) Generalize the constitutive relations in theory of elasticity problems. **[7M]**

   (b) The displacement field in a body is specified as **[7M]**
   u = x^3+3y^2
   v = 3y2+4x
   w = 0
   Determine the stress and strain component at a point whose coordinates are (2, 3) take E = 2 x 10^5 N/mm^2, Poisson's ratio = 0.3.

2. (a) Explain the concept of stress with neat sketch. **[7M]**

   (b) At a point P, the rectangular stress components are $\sigma_{x,} = 1, \sigma_y = -2, \sigma_z = 4, \tau_{xy} = 2, \tau_{yz} = -3, \tau_{xz} = 1$ all in units of kPa. Find the principal stresses and check for invariance. **[7M]**

UNIT – II

3. (a) Show that $(A\ e^{\alpha y} + B\ e^{-\alpha y} + Cy\ e^{\alpha y} + Dy\ e^{-\alpha y}) \sin \alpha x$sinx is a stress function in two dimensional stress field. **[7M]**

   (b) With respect to the frame of reference Oxyz, the following state of stress exists. **[7M]**

$$[\tau_{ij}] = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

4. (a) The state of stress at a point is such that $\sigma_{x,} = \sigma_y = \sigma_z = \tau_{xy} = \tau_{yz} = \tau_{xz} = p$. Determine the principal stresses and their directions. **[7M]**

   (b) The stress (MPa) acting on an element of a loaded body is shown in Fig.1. Apply Mohr's circle to determine the normal and shear stresses acting on a plane defined by 30^0. **[7M]**

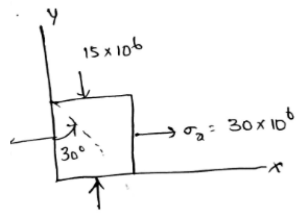

Figure 1

UNIT – III

5. (a) Explain how Fourier series can be applied for two dimensional problems under gravity loading. **[7M]**

   (b) The displacement field for a body is given by $\left(x^2+y\right)i+(3+z)\,j+\left(x^2+2y\right)k$. What is the deformed position of a point originally at (3, 1, -2). **[7M]**

6. (a) Develop differential equation of equilibrium for two dimensional problems. **[7M]**

   (b) Consider the displacement field $U=\left[y^2 i+3yzj+\left(4+6x^2\right)k\right]10^{-2}$. What are the rectangular strain components at the point P (1, 0, 2)? Use only linear terms. **[7M]**

UNIT – IV

7. (a) Give the torsion equation for circular cross-section and explain its terms. **[7M]**

   (b) Given the following stress equation $\Phi=\frac{P}{\pi}\,r\theta cos\theta$. Determine the stress components $\sigma_r, \sigma_{r\theta}$ *and* $\tau_{r\theta}$. **[7M]**

8. (a) Write the simple bending equation for symmetrical cross-sections of a beam and discuss the assumptions followed in the bending equation. **[7M]**

   (b) Explain plane stress and plane strain problems with examples and neat sketches. **[7M]**

UNIT – V

9. (a) Derive the torque equation of rectangular bar. **[7M]**

   (b) The following Figure 2 below shows a two-cell tubular section whose wall thicknesses are as shown. If the member is subjected to a torque T, determine the shear flows and the angle of twist of the member per unit length. **[7M]**

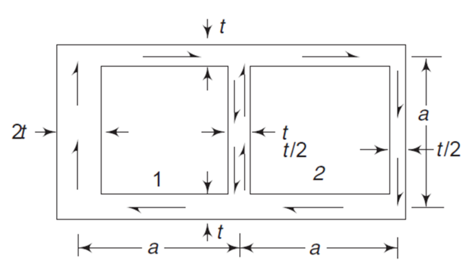

Figure 2

10. (a) Write about membrane analogy theory. **[7M]**

    (b) Explain in detail about Strain hardening and Isotropic hardening . **[7M]**

– ◦ ◦ ◯ ◦ ◦ –