

CC317

M. Sc. EXAMINATION, 2020

(Third Semester)

(B. Scheme) (Re-appear Only)

MATHEMATICS

MAT615B

Mechanic of Solids-I

Time : 3 Hours]

[Maximum Marks : 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Define Contraction and also prove that the result of applying a contraction to a tensor of order n is a tensor of order $n - 2$. **10**
(b) Prove that eigen vectors corresponding to two distinct eigen values of a real, symmetric tensor u_{ij} are orthogonal. **10**
2. (a) Find eigen values and eigen vectors of second order tensor u_{ij} whose matrix representation : **10**

$$u_{ij} = \begin{bmatrix} 2 & 2 & 0 \\ 2 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

- (b) Obtain the three scalar invariant of a second order symmetric tensor and also define symmetric tensor. **10**

Unit II

3. (a) Write a note on geometrical interpretation of shearing strain. **15**
 (b) Show that normal to the quadric surface at the end point of a radius vector is parallel to the displacement vector. **5**
4. (a) Prove that for a strain tensor e_{ij} there exist at least three principal direction which are usually orthogonal due to an infinitesimal deformation. **15**
 (b) Prove that principal strains are invariant. **5**

Unit III

5. (a) Write notes on the following : **10**
 (i) Normal and tangential stress
 (ii) Cauchy reciprocal relation.

- (b) The stress matrix at a certain point in a material is given by $\tau_{ij} = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{pmatrix}$.

Find the normal stress and shear stress on the octahedral plane elements through the point. **10**

6. Elaborate balance of angular momentum. **20**

Unit IV

7. (a) What is generalised Hooke's law for an isotropic medium in terms of stress. **10**
 (b) Find the stress with the following displacement field : **10**
 (i) $u = kyz, v = kzx, w = kxy$
 (ii) $u = kyz, v = kzx, w = (x^2 - y^2),$
 k is constant.

8. (a) Evaluate strain energy function for the stress field. Given that $\tau_{11} = 0 = \tau_{22} = \tau_{33} = \tau_{12}$ and $\tau_{13} = -\mu < x_2$, $\tau_{23} = +\mu < x_3$. **10**
- (b) Find whether the following stress system can be a solution of an electrostatic problem in the absence of body force are : **10**
- $$\tau_{11} = x_1x_2, \tau_{22} = x_3x_1, \tau_{12} = x_3^2, \tau_{13} = \tau_{33} = \tau_{32} = 0$$