2063
M.E. (Mechanical Engineering)
Second Semester
MME-201: Continuum Mechanics

Time allowed: 3 Hours   Max. Marks: 50

NOTE: *Attempt five questions in all, selecting atleast two questions from each Part.*
x-x-x

Part A

Question 1: Find appropriate tensors in the following cases:
(a) Find tensor **R,** which corresponds to a $90°$ right hand rigid body rotation about the x_3 axis.
(b) Find tensor **S,** which corresponds to a 90° right hand rigid body rotation about the x_1 axis.
(c) Find the tensor that corresponds to the rotation **R** followed by **S.**
(d) Find the tensor that corresponds to the rotation **S** followed by **R.**
Show all the rotations graphically as well.

[10 marks]

Question 2: For the following tensor, P, find the eigenvalues, unit eigenvectors and the first principal scalar invariants. Verify the characteristic equation of the tensor.

$$[P] = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 4 \\ 0 & 4 & -3 \end{bmatrix}$$

[10 marks]

Question 3: Given

$$x_1 = X_1 + 2X_2; x_2 = X_2; x_3 = X_3$$

(a) Find right Cauchy Green deformation tensor, **C.**
(b) Find the principal values of **C** and corresponding principal directions.
(c) Obtain matrices U and U^{-1} with respect to the principal directions.

[10 marks]

Question 4: The equilibrium configuration of a body is described by,
$x_1 = \frac{1}{2}X_1, x_2 = \frac{-1}{2}X_3, x_3 = 4X_2$. If the Cauchy stress tensor for the body is

$$[T] = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 100 \end{bmatrix} MPa$$

Find the first and second Piola Kirchhoff stress tensor.

[10 marks]

Part B

Question 5: Explain in detail the Isotropic Linear Elastic Solid, Anisotropic Linear Elastic Solid and Isotropic Solid under Large Deformation.

[10 marks]

Question 6: Explain in detail and provide proof of the Green's theorem.

[10 marks]

Question 7: Write notes on the following:
(a) Linear Maxwell Fluid (b) Nonlinear Viscoelastic Fluid (c) Viscometric Flow

[10 marks]

Question 8: Explain in detail the principle of moment of momentum and the principle of conversation of energy.

[10 marks]

x-x-x