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M.Sc (Mathematics) EXAMINATION, Oct. 2020

(Ninth Semester)

(Re-appear Only)

MAT623H

(5 Year Integrated)

Mechanics of solids

Time: 3 Hours] *Maximum Marks:* 75

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

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Note: Attempt any four questions in all. All questions carry equal marks.

Q.1a. The stress matrix at a point P in a material is given as

$$\tau_{ij} = \begin{bmatrix} 3 & 1 & 4 \\ 1 & 2 & -5 \\ 4 & -5 & 0 \end{bmatrix},$$

Find

(i) the stress vector on a plane element through P and parallel to the plane $2x_1 + x_2 - x_3 = 1$

(i) the magnitude of the stress vector, normal stress and the shear stress

(ii) the angle that the stress vector makes with the normal to the plane.

Q.1b. Show that stress tensor is symmetric.

Q.2a. Define stress quadric of Cauchy and Show that normal to the quadric surface at the end of a radius vector is parallel to the stress vector acting on plane through P^0 normal to the radius vector.

Q.2b. Show that stress components at any point inside the body form a tensor of order two

Q.3a. Explain geometrical representation of shearing strain.

Q.3b Prove that corresponding to real strain tensor, there exist a real eigen value.

Q.4a. Discuss general infinitesimal deformation.

P.T.O.

Q.4b. For the small linear deformation given by

(i) $u_1 = \alpha x_1 x_2$, $u_2 = \alpha x_1 x_2$, $u_3 = 2\,\alpha(x_1 + x_2)$

(ii) $u_1 = -\alpha x_1 x_2$, $u_2 = \alpha x_1 x_2$, $u_3 = 0$

Find (i) strain tensor (ii) strain invariant (iii) rotation vector

Q.5a. Derive generalized Hooke's law for an orthotropic material.

Q.5b. Derive Navier equation of equilibrium for an isotropic elastic solid.

Q.6a. If the body force F is derived from a harmonic potential function, show that the strain and stress invariant are harmonic functions and stress and strain components are biharmonic.

Q.6b. Prove that $\nabla^2\theta = -\left(\frac{1+\sigma}{1-\sigma}\right) div\, f$, where the symbols have their usual meaning.

Q.7. Define strain energy function and its connection with Hooke's law.

Q.8. Explain complex variable method for plane problem.