# M. Sc. Mathematics Examination, 2022

( 2nd Year, 2nd Semester )

## Solid Mechanics III

## Paper – DSE - 06 (B8)

Time : Two hours　　　　　　　　　　Full Marks : 40

*The figures in the margin indicate full marks.*

*Symbols / Notations have their usual meanings.*

Answer ***any Four*** questions.

1. What are Kirchoff's assumptions for the problem of bending of thin Plates? Establish the differential equation

$$\frac{\partial^4 w}{\partial x_1^4}+2\frac{\partial^4 w}{\partial x_1^2\partial x_2^2}+\frac{\partial^4 w}{\partial x_2^4}=\frac{P}{D}$$

For small deflection of thin plate, where $P(x, y)$ is the intensity of the Load, $w$ is the deflection in $x_3$ direction and $D$ denotes the flexural rigidity of the plate. 10

2. a) Obtain solution of the two-dimensional biharmonic equation $\nabla_1^4\omega=0$ in the form of analytic functions.

   b) Obtain the stresses and displacements in the absence of body force in the form

$$\sigma_x+\sigma_y=2\left[F'(z)+\bar{F}'(\bar{z})\right]$$

$$\sigma_y-\sigma_x+2i\tau_{xy}=2\left[2\bar{z}F''(z)+X''(z)\right]$$

4+6

3. A simply supported rectangular plate occupying in the region $0\le x\le a$, $0\le y\le b$ is subjected to a uniformly





distributed transverse load $q(x, y)$ over the surface of the plate. Show that the deflection $w$ at any point $(x, y)$ of the plate is

$$W=\frac{1}{\pi^4 D}\sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{a_{mn}}{\left(\frac{m^2}{a^2}+\frac{n^2}{b^2}\right)^2}\sin\frac{m\pi x}{a}\sin\frac{n\pi y}{b}$$

Where $a_{mn}=\frac{4}{ab}\int_0^a\int_0^b q(x,y)\sin\frac{m\pi x}{a}\sin\frac{n\pi y}{b}\,dxdy$

Hence calculate bending of moments when $q(x,y)=q_0$. 10

4. Find the stress distribution in a wedge of a conical shape of semi-vertical angle '$\alpha$' when a force $\bar{F}$ acts at the vertex making an angle $\beta$ with its axis. 10

5. State and prove minimum complementary energy theorem. 10

6. Apply the principle of conservation of energy to deduce the stress-strain-temperature relations for anisotropic solids in the form $\sigma_{ij}=C_{ijkl}\varepsilon_{kl}-\beta_{ij}\theta\; i,j=1,2,3$. 10