PG/IIS/MA-1204/10

M.Sc. 2nd Semester Examination, 2010

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

(*Continuum Mechanics*)

PAPER—MA-1204

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **four** from the rest

The figures in the right-hand margin indicate marks

1. Answer any *two* questions : 4 × 2

(*a*) If the velocity of an incompressible fluid at the point (x, y, z) is given by

$$\left(\frac{3xz}{r^5}, \frac{3yz}{r^5}, \frac{3z^2 - r^2}{r^5}\right),$$

prove that the liquid motion is possible and the velocity potential is $\frac{\cos\theta}{r^2}$. 4

(*b*) What is the concept of image? Find the image of source with respect to a straight line. 1 + 3

(*c*) Given the displacement field

$$x_1 = X_1 + 2X_3,\ x_2 = X_2 - 2X_3,$$
$$x_3 = X_3 - 2X_1 + 2X_2,$$

determine the Eulerian finite strain tensor. 4

2. State and prove the Cauchy's first equation of motion. Deduce the equation of equilibrium when the continuum is in static equilibrium. 2 + 5 + 1

3. Establish the relation between strain vector and strain tensor at a point. What do you mean by normal strain? Define the strain quadric. Show that the extension of a line element through the centre of a strain quadric in the direction of any central radius vector is equal to the inverse of the square of the radius vector. 3 + 1 + 2 + 2

4. Derive the Bernoulli's equation of motion. Hence deduce the Bernoulli's equation for steady motion. 7 + 1

5. (*a*) Find the complex potential for a doublet. 3

   (*b*) State and prove Milne - Thomson's circle theorem. 5

6. Define the isotropic linearly elastic body. Find the constitutive equations of this body. 1 + 7

7. What is the concept of stress vector ? Show that the stress vector at a point across the plane with normal $\vec{n}$ is a linear combination of the stress vectors acting on the three orthogonal planes through that point. 2 + 6

[*Internal Assessment* : 10 Marks]