Total No. of printed pages = 3

2 PGDE MTH 3

2012

(Nov.-Dec.)

MATHEMATICS

Paper : 203

(Advance Fluid Dynamics)

Full Marks – 80

Time – Three hours

The figures in the margin indicate full marks for the questions.

1. (a) Find the image of a vortex filament in a plane. 6

   (b) Describe Karman Vortex Street. 6

Or

An infinite row of equidistant rectilinear vortices are at a distance apart. The vortices are of the same numerical strength K but they are alternatively of opposite signs. Find the complex function that determines the velocity potential and the stream function.

2. Derive the relation between stress and rate of strain for a Newtonian fluid. 10

Or

Describe stress components in a real fluid.

3. Derive Navier-Stoke's equation of motion for an incompressible fluid. 10

Or

Show that the vorticity vector $\vec{\Omega}$ of an incompressible viscous fluid moving under no external forces satisfies the differential equation

$$\frac{d\vec{\Omega}}{dt} = \left(\vec{\Omega}.\nabla\right)\vec{q} + \upsilon\nabla^2\Omega$$

where υ is the kinematic coefficient of viscosity.

4. Discuss generalised plane Couette flow. 8

Or

Discuss Hagen-Poiseuille flow through a pipe.

5. Discuss the unsteady flow due to a plane wall suddenly set in motion. Also, find the expression for shearing stress at the wall. 8+2=10

Or

Discuss Stokes' second problem. 10

6. Discuss boundary layer thickness, displacement thickness and energy thickness. 10

Or

Write a short note on phenomenon of separation and vortex formation.

7. Derive Prandtl boundary layer equations. 10

Or

Derive energy integral equation of the boundary layer.

8. Discuss the limitations of the theory of Newtonian fluids. 10

Or

Write short notes on non-Newtonian fluids and visco elastic fluids.