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2 PGDE MTH 3

2013

(December)

MATHEMATICS

Paper/Course : 203

(Advance Fluid Dynamics)

Full Marks : 80

Time : Three hours

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

1. (a) Prove that the product of the cross-section and vorticity at any point on a vortex filament is constant along the filament for all time provided the body forces are conservative and the pressure is a single valued function of density only. 6
- (b) Find the image of a vortex filament in a plane. 6

Or

Show that the complex potential due to a set of line vortices of strength K at points $z = \pm na$ ($n = 0, 1, 2, 3, \dots$) is given by

$$w = \frac{iK}{2\pi} \log \sin(\pi z/a).$$

2. Show that the state of stress at a point completely known if the nine components of stress at that point are known. 10

Or

The stress tensor at a point is given with respect to the axes x, y, z by the values

$$\sigma_{ij} = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}.$$

Determine the principal stress values and the principal stress directions represented by the axes x', y', z' .

3. Find the expression for the rate of dissipation of energy of a liquid due to viscosity. 10

Or

Discuss the steady flow past a fixed sphere.

4. Discuss the steady flow of a viscous incompressible fluid between two concentric rotating cylinders. 8

Or

What do you mean by parallel flow? Discuss Couette flow and find the expression for shearing stress at the plate.

5. Discuss the unsteady flow of viscous incompressible fluid over a suddenly accelerated flat plate. 10

Or

Discuss the unsteady flow of viscous incompressible fluid between two parallel plates.

6. Discuss boundary layer concept and boundary layer thickness. 10

Or

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

7. Discuss the boundary layer flow along a flat plate. 10

Or

Derive momentum integral equation of the boundary layer.

8. Discuss Weissenberg effect and Merrington effect. 10

Or

Write a short note on constitutive equation of a material.
