2020(New)

Time : 3 Hours

Maximum Marks : 70

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Answer all questions.

D-674

1. In each of the following statements, answer whether it is 'True' or 'False' : 2×10=20

(a) Velocity potential Øsatisfy the Laplace equation.

(b) Fluid motion may be studied by two different methods Newtonian and Eulerian methods.

(c) The equation of Impulsive action is

$$\Sigma_2 \quad - \Sigma_1 \quad = I + \left(\frac{1}{\rho}\right) \nabla \tilde{w}$$

(d) Euler's equation of motion in x-direction is

$$\frac{Du}{Dt} = x + \left(1/\rho\right) \times \left(\frac{\partial p}{\partial x}\right)$$

(e) The stream function Ψexists only in irrotational motion.

(f) The complex potential due to a sink at origin is $-m \log z$.

(g) For liquid streaming past a fixed circular cylinder a complex potential is $U_z + U\, a^2/_z$

(h) When an elliptic cylinder is rotating with angular velocity W in an infinite mass of liquid at infinity, then complex potential is

$$\{i\, w(a+b)^2/4\}^{e-2G}$$

(i) If a rectilinear vortex moves in two dimensions in a fluid bounded by a fixed plane. Then a stream line can never coincide with a line of constant pressure.

(j) Vortex lines and tubes can not orginate or terminate at internal point in a fluid.

2. Answer any four questions of the following : 5×4=20

(a) Find the stream lines and paths of the particle when

$u = \frac{x}{1+t}, v = \frac{y}{1+t}, z = \frac{z}{1+t}$

(b) Drive the equation of motion by flux method.

(c) Prove that the image system for a source outside a circle consists of an equal source at the inverse point and an equal sink at the centre of the circle.

(d) A circular cylinder is placed in a uniform stream, find the forces acting on the cylinder.

(e) To determine the complex potential due to a rectilinear vortex of strength K.

3. Answer any three questions of the following: 10×3=30

(a) To find equation of continuity in Cartesian Co-ordinates.

(b) Liquid is contained between two parallel planes, the free surface is a circular cylinder of radius a whose axis is perpendicular to the planes. All the liquid within a concentric circular cylinder of radius b is suddenly annihilated ; Prove that if π be the pressure at outer surface, the initial pressure at any point on the liquid distance r from the centre is :

$\pi \frac{\log r - \log b}{\log a - \log b}$.

(c) Show that the velocity potential $\emptyset$ and stream function Ψ satisfy the Laplace's equation when a two – dimensional irrotational motion is Considered. And also show that the Curves of Constant vortricity Potential and Constant stream functions Cut orthogonally at their point of intersection.

(d) State and prove Theorem of Blasius.

(e) Prove that the product of the cross section and Vorticity at any point on a vortex filament is constant along the filament and vortex lines moves with the fluid.

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