M.Sc. (Part-II) (Mathematics) (New CBCS Pattern) Semester - III

PSCMTH14A : Paper-III - Fluid Dynamics - I

P. Pages : 2 **GUG/S/23/13758**

Time : Three Hours * 2 4 9 4 * Max. Marks : 100

Notes : 1. Solve all **five** questions.
2. All questions carry equal marks.

UNIT – I

1. a) Derive the equation of continuity. **10**

b) Test whether the motion specified by $q = \frac{k^2(x\bar{j} - y\bar{i})}{x^2 + y^2} K$ = constant, is a possible motion for an incompressible fluid. If so, determine the equation of the streamlines. Also test whether the motion is of the potential kind and if so determine the velocity potential. **10**

OR

c) Derive the Bernoulli's equation. $\frac{q^2}{2} + \int \frac{dp}{\rho} + \Omega + \left(\frac{-\partial\phi}{\partial t}\right) = F(t)$. **10**

d) Prove that for an inviscid fluid the circulation around any closed circuit of fluid particles, moving along with the fluid remain constant provided that the body forces are conservative and the pressure is a single valued function of density only. **10**

UNIT – II

2. a) Discuss the flow due to a uniform line doublet at 0 of strength μ per unit length. Its axis being along $\overline{ox}$. **10**

b) Show that the image of a line source in a rigid infinite plane is a line source of equal strength at the optical image in the plane of the point at which the given line source is situated. **10**

OR

c) Show that the line vortex of strength K situated at point A in an infinite plane in a line vortex of strength -K at a point A'. Where A' is reflection of A in that plane. **10**

d) Verify that $w = ik \log\left\{\frac{z - ia}{z + ia}\right\}$ is the complex potential of a steady flow of liquid about a circular cylinder the plane y = 0 being a rigid boundary. Find the force exerted by the liquid on unit length of the cylinder. **10**

UNIT – III

3. a) Find the profile $\phi(x,t)$ of a one-dimensional wave propagation if at t = 0, $\phi = F(x)$, $\frac{\partial \phi}{\partial t} = G(x)$. **10**

b) Obtain two dimensional wave equation. **10**

OR

c) Describe progressive and stationary wave. **10**

d) Obtain one dimensional wave equation. **10**

UNIT – IV

4. a) Derive the equation of motion of a gas. **10**

b) Discuss reservoir discharge through a channel of varying section. **10**

OR

c) Describe the investigation of maximum mass flow through a Nozzel. **10**

d) Discuss the formation of shock waves. **10**

5. a) Define : **5**
i) Steady and unsteady flow.
ii) Velocity potential.

b) Discuss the flow for which $w = z^2$. **5**

c) Discuss Isothermal and Adiabatic processes. **5**

d) Define sonic and supersonic flow. **5**

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