(c) (i) Solve the acceleration sphere moving in fluid at rest at infinity problem.

Or

(ii) Explain: Images in a rigid infinite plane.

5. (a) Find the equations of the streamlines due to uniform line sources of strength $m$ through the points $A(-c,0), B(c,0)$ and a uniform line sink of strength $2m$ through the origin.

(b) (i) Explain: Line sources and Line sinks.

Or

(ii) Solve the uniform flow past a fixed infinite circular cylinder problem.

(c) (i) State and Prove Milne-Thomson circle theorem.

Or

(ii) Explain: Magnus effect.

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**S.No. 7334** **RNENS 4**

(For candidates admitted from 2006–2007 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2023.

Mathematics

CLASSICAL AND FLUID MECHANICS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Subdivisions (a), (b) and (c) in each questions carry 4,6 and 10 marks respectively

1. (a) A particle of mass $m$ is suspended by a massless wire of length $r = a + b\cos\omega t$ $(a > b > 0)$ to form a spherical pendulum. Find the equation of motion.

(b) (i) Explain: Angular Momentum of system of particles.

Or

(ii) Explain. Liouville's System.

(c) (i) Explain: Potential Energy and Conservation of Energy.

Or

(ii) Two particles, each of mass $m$ are connected by a rigid massless rod of length $l$. The particles are supported by knife edges placed perpendicular to the rod. Assuming that all motion is confined to the horizontal $xy$ plane. Find the Jacobi integral.

2. (a) Explain: Electromagnetic forces.

(b) (i) A particle of mass $m$ and charge $e$ moves under the influence of uniform electric and magnetic fields which are mutually orthogonal. Relative to a fixed Cartesian frame, these fields are $E = Ej$ and $B = Bk$. Find the equation of motion and the path of the particle if it is initially at rest at the origin.

Or

(ii) Explain: Stationary value of a Definite integral.

(c) (i) State and Prove Hamilton's Principle.

Or

(ii) Explain: Rayleigh's Dissipation Function.



3. (a) Find the velocity of a fluid at a point.

(b) (i) State and Prove Bernoulli's Equation.

Or

(ii) Explain: Equation of Continuity.

(c) (i) Test whether the motion specified by $q = \frac{k^2(xj - yi)}{x^2 + y^2}$ is a possible motion for an incompressible fluid. If so, determine the equations of the streamlines. Also test whether the motion is of the potential kind and if so determine the velocity potential.

Or

(ii) Explain: Euler's equation of motion.

4. (a) Explain: Impulsive motion.

(b) (i) Solve the doublet in a uniform stream problem.

Or

(ii) Explain Special Two-dimensional flows.