

APPLIED MATHEMATICS WITH OCEANOLOGY AND  
COMPUTER PROGRAMMING (P.G.)

M.Sc. Second Semester End Examination-2024  
(Regular & Supplementary Paper)

PAPER- MTM-201

[Fluid Mechanics]

Full Marks: 50

Time: 02Hrs

*The figures in the right hand margin indicate marks.*

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

*Illustrate the answers wherever necessary.*

Attempt Question No. 1 and any four from the rest:

1. Attempt any four questions:  $4 \times 2 = 8$
- What do you mean by Uniform and No uniform Flow?
  - Find the image of a sink of strength  $-m$  placed at a point  $z = a$ .
  - Find the stream lines of motion where the velocity potential is  $\phi = \frac{a}{2}(x^2 + y^2 - 2z^2)$ .
  - For the Gulf Stream, velocity  $U \sim 1m/s$ , depth  $L \sim 100$  km and viscosity  $\nu \sim 10^{-6} m^2/s$  calculate the Reynolds number..
  - Define the Newtonian and Non-Newtonian fluids with examples.
  - What is similar flow?

(2)

2. Calculate the image of a doublet of strength  $\mu$  placed outside the circle of radius  $a$ . 8
3. Prove that the vector  $\Omega$  of an incompressible viscous fluid moving under no external forces satisfies the equation
$$\frac{d\Omega}{dt} = (\Omega \cdot \nabla)q + \mu \nabla^2 q.$$
8
4. Show that the average velocity is the half of the maximum velocity in case of Hagen-Poiseuille flow through a circular pipe. 8
5. Prove that the row for an infinite single row of parallel rectilinear vortices of the same strength behave like a vortex sheet. 8
6. What arrangement of source and sinks will give rise to the function  $w = \log\left(z - \frac{a^2}{z}\right)$ ? Draw the rough sketch of the stream lines to this curve. 8
7. Derive the Navier Stoke's equation of motion of incompressible viscons fluid. 8

**[Internal Asssment-10]**