

2022

**APPLIED MATHEMATICS WITH OCEANOLOGY AND  
COMPUTER PROGRAMMING**

**[P.G.]**

**(M.Sc. Second Semester End Examination-2022)**

**PAPER-MTM 201**

*Full Marks: 50*

*Time: 02 Hrs*

*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*

**[Fluid Mechanics]**

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

1. Attempt any **four** questions: **4 × 2 = 8**
- a) State the limitations of Navier-Stokes equation.
  - b) Find the complex potential of a source of strength  $m$  at a point  $z = z_1$
  - c) Does the velocity distribution  $\mathbf{q} = (5x, 5y, -10z)$  satisfy the law of conservation of mass for incompressible flow?
  - d) Define the Reynolds number for viscous fluid motion and write its physical significance.
  - e) Draw an infinitesimally small moving element and show all energy fluxes along  $y$  direction associated with the above element.

(2)

- f) State the physical principle of the equation of continuity and write the equations of continuity for incompressible viscous two-dimensional flow.
2. Derive the Karman momentum integral equation of the two-dimensional steady incompressible boundary layers. **8**
  3. Show that the average velocity is the half of the maximum velocity in case of Hagen-Poiseuille flow through a circular pipe. **8**
  4. Show that the vortex at the origin is at rest for a system of two infinite rows of parallel rectilinear vortices of same strength placed at a distance  $b$  apart. **8**
  5. 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**
  6. An incompressible velocity fields is given by  $u = 2(x^3 - 2xz)$ ,  $v = c$  and  $w$  is unknown, where  $c$  is any constant. What must be the form of  $w$ ? Also, derive the energy equation for non-Newtonian, incompressible, viscous fluid flow with negligible radiation effects. **2 + 6**
  7. Make  $y$  component of Navier-Stokes equation for non-Newtonian, incompressible, viscous fluid flow with negligible gravity in non-dimensional form [Use characteristic length, velocity and pressure ]. **8**

[Internal Asssment-10]