

# C194

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## MT-602

### Viscous Fluid Dynamics-I

MA/M.Sc. Mathematics (MAMT/MSCMT-20)

3rd Semester Examination, 2022 (June)

**Time : 2 Hours]**

**Max. Marks : 40**

**Note :** This paper is of Forty (40) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein.

### SECTION-A

#### (Long Answer Type Questions)

**Note :** Section 'A' contains Five (05) long answer type questions of Ten (10) marks each. Learners are required to answer any Two (02) questions only.

(2×10=20)

1. Obtain Navier-Stokes Equations of motion of a fluid in Cartesian Coordinates.
2. Discuss the plane Poiseuille flow between two parallel plates.

3. Discuss the generalized plane Couette flow. Derive the results for various characteristic for plane Couette flow taking that as a particular case.
4. State and prove Stoke's First Problem.
5. Define the following :
  - (a) Lift and drag coefficient.
  - (b) Boundary Layer.
  - (c) Vorticity.
  - (d) Thermal conductivity.
  - (e) Viscosity.

### **SECTION-B**

#### **(Short Answer Type Questions)**

**Note :** Section 'B' contains Eight (08) short answer type questions of Five (05) marks each. Learners are required to answer any Four (04) questions only. (4×5=20)

1. Velocity field at point given by  $1 + 2y - 3z$ ,  $4 - 2x - 5z$ ,  $6 + 3x - 5y$ . Show that it represents a rigid body motion.
2. Find the Equation of Continuity in Cartesian form.
3. State Kelvin Circulation theorem.

4. An oil of specific gravity 0.85 is flowing through a pipe of 5 cm. diameter at the rate of 3 liter/sec. Find the type of flow, if the viscosity for the oil is 3.8 Poise.
5. Explain the principle of dynamic similarity.
6. Explain the physical significance of the Reynold number, Mach number, Prandtl number and Froude number.
7. Define Stress vector. The stress tensor at a point P is

$$\sigma_{ij} = \begin{pmatrix} 7 & 0 & -2 \\ 0 & 5 & 0 \\ 2 & 0 & 4 \end{pmatrix}$$

Determine the stress vector on the plane at P whose unit

normal is  $\hat{n} = \frac{2}{3}\hat{i} - \frac{2}{3}\hat{j} + \frac{1}{3}\hat{k}$ .

8. State and Prove Buckingham  $\pi$  theorem.
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