A–0716

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MT-602

MA/MSC Mathematics (MAMT/MSCMT)

(Viscous Fluid Dynamics-I)

Examination, June 2025

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

(Long Answer Type Questions) 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. The stress tensor at a point P is :

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

Determine the stress vector on the plane at P whose unit normal is :

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

2. Derive the equation of continuity in spherical polar coordinates.

3. State and prove Navier-Stoke's equations for the motion of a viscous compressible fluid.

4. Write short notes on the following :

   (i) Reynold's Number

   (ii) Froude Number

   (iii) Mach Number

   (iv) Prandtl Number

5. Find the velocity distribution for the steady flow of a viscous incompressible fluid in the annular.

Section–B

(Short Answer Type Questions) 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Velocity field at point is given by :

   $$1 + 2y - 3z,\ 4 - 2x + 5z,\ 6 + 3x - 5y$$

   Show that it represents a rigid body motion.

2. Derive relation between Stress and Rate of Strain Components.

3. Obtain Navier-Stokes equations of motion of a fluid in Cartesian coordinates.

4. State and prove Kelvin's circulation theorem.

5. State Plane Couette Flow and Plane Poiseuille Flow.

6. Discuss Hiemanz flow of an incompressible viscous fluid.

7. Derive Coefficient of Skin Friction.

8. Describe Stokes Second Problem.

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