A–1042

Total Pages : 3 **Roll No. .....**

MT-602

M.A./M.Sc. Mathematics (MAMT/MSCMT)

Viscous Fluid Dynamics-I

Examination, 2026 (Feb.)

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. Describe Stokes Second Problem.

2. Discuss the flow of an incompressible viscous fluid between two parallel plates taking the fluid properties to be constant when one of the plated is given a constant velocity in its own plane.

3. Obtain Navier-Stokes equations of motion in Cartesian coordinates for two-dimensional incompressible viscous flow.

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

5. Write short notes on the following :

   (a) Viscosity

   (b) Thermal conductivity..

   Also Show that the following velocity components represent a rigid body motion

   $u = a + by - cz$; $v = d - bx + ez$; $w = f + cx - ey$ where a, b, c, d, e and f are arbitrary constants.

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. Write short notes on the following :
   (i) Reynold's Number
   (ii) Eckert Number
2. Derive relation between Stress and Rate of Strain Components.
3. Discuss the plane Poiseuille flow between two parallel plates.
4. Explain the principal of dynamic similarity.
5. State and prove Buckingham π-theorem.
6. Deduce Kelvin's circulation theorem.
7. Define Stoke's law of friction.
8. Show that the rate of strain tensor is a symmetric tensor.

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