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MT–602

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

(Viscous Fluid Dynamics-I)

3rd Semester Examination, Session December 2024

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. Write short notes on the following :

   (i) Stress

   (ii) Strain

   (iii) Viscosity

   (iv) Thermal conductivity

2. Obtain equation of continuity in Cartesian coordinate system.

3. Derive Equation of Energy for both compressible and incompressible fluid.

4. Explain the physical significance of the Reynold number, Mach number, Prandtl number and Froude number.

5. Show that the volume rate of flow is given by :

$$Q = \frac{27Pa^2}{20\sqrt{3}\,\mu}$$

   in the steady flow of a viscous incompressible fluid through a tube with uniform equilateral triangular cross section.

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 :

   (i) Fourier's law of heat exchange

   (ii) Newton's law of cooling

2. Derive Stoke's Law of Friction.

3. Prove that the vorticity $\bar{\Omega}$ satisfies the differential equation :

$$\frac{D\bar{\Omega}}{Dt} = (\bar{\Omega}\nabla)\bar{q} + \nu\nabla^2(\bar{\Omega})$$

4. State the Buckingham π-theorem.

5. Write short notes on following non-dimensional coefficients :

   (i) Lift and drag coefficient

   (ii) Recovery factor

6. Discuss Hagen-Poiseuille flow in a circular pipe.

7. Discuss the flow due to a plane wall suddenly set in motion in its own plane in an infinite mass of viscous incompressible fluid, which is otherwise at rest.

8. Discuss stagnation point flow of an incompressible, viscous fluid.

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