A–1052

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MAMT-07

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

Viscous Fluid Dynamics

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. State and prove the Navier-Stokes equation of motion.

2. Discuss the flow in a circular pipe (Hagen-Poiseuille flow).

3. Explain Stoke's flow past a sphere.

4. Show that the state of stress at a point is completely known if the nine components of stress tensor at that point are known.

5. Discuss stagnation point flow of an incompressible, viscous fluid (Hiemanz flow).

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. What type of the motion do the following velocity components constitute?

$$u = a + by - cz;$$

$$v = d - bx + ez$$

and $$w = f + cx - ey$$

where a, b, c, d, e, f are arbitrary constant.

2. Provide the statement of Buckingham π-theorem. A 1 : 20 model of an air-duct is to be tested in water which is 45 times more viscous and 850 times more dense than air. What should be the pressure drop in the prototype if the pressure drop is 3 kg/cm^2 in the model when tested under hydrodynamically similar conditions ?

3. Obtain an expression for the flow between two parallel Porous plates.

4. Discuss the temperature distribution in plane Poiseuille flow.

5. Explain Prandtl's boundary leyer theory. Also discuss about the characteristics of boundary layer parameters.

6. Derive two dimensional thermal boundary layer equation for the viscous in compressible fluid flow past a thin plate.

7. Obtain Crocco's first integral for $P_r = 1$.

8. Obtain equation of continuity in Cartesian coordinate system.

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