A–1018

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

MAT-604

M.Sc. Math (MSCMT)

Fluid Mechanics

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. What is boundary condition? Derive the condition at boundary surface. Also show that the surface $\frac{x^2}{a^2k^2t^2} + kt^2\left(\frac{y^2}{b^2} + \frac{z^2}{c^2}\right) = 1$ is a possible form of boundary surface of a liquid at time *t*.

2. A mass of fluid is in motion so that the lines of motion lie on the surface of co-axial cylinders. Show that the equation of continuity is $\frac{\partial \rho}{\partial t} + \frac{1}{r}\frac{\partial}{\partial \theta}(\rho u) + \frac{\partial}{\partial z}(\rho v) = 0$, where *u*, *v* are the velocity perpendicular and parallel to *z*.

3. Write a note on Poiseuille flow and derive an expression of flux for the Poiseuille flow.

4. When the motion is steady and the velocity potential does not exist, then prove that $\frac{1}{2}q^2 + V + \int \frac{dp}{\rho} = C$ where V is the force potential from which the external forces are derivable.

5. Show that the image system of a source outside a circle consists of an equal source at the inverse point and an equal sink at the centre of the circle.

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. Define Newtonian and non-Newtonian fluids based on Newton's law of viscosity.

2. Determine the equation of stream lines passing through (1, 2, 1) for the velocity vector $v = xi - 2yj + 2zk$.

3. Define real and ideal fluids.

4. A jet of water 8 cm. in diameter impinges on a plate held normal to its axis. For a velocity of 4 m/sec., what force will keep the plate in equilibrium?

5. A horizontal pipe gradually reduces in diameter from 24 in. to 12 in. Determine the total longitudinal thrust exerted on the pipe if the pressure at the larger end is 501 bf / in^2 and the velocity of the water is 8 ft./sec.

6. Examine whether the velocity field: $V = 2ax(3y^2 - x^2)i + 2ay(3x^2 - y^2)j$ represents a possible two dimensional -incompressible fluid flow.

7. State and prove Pascal's law.

8. Find the stream function of the two-dimensional motion due to two equal sources and an equal sink situated midway between them.

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