K-445

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MT-602

VISCOUS FLUID DYNAMICS-I

MA/MSC Mathematics (MAMT/MSCMT)

3rd Semester Examination, 2023 (Dec.)

Time : 2 Hours] **[Max. Marks : 35**

Note : This paper is of Thirty Five (35) 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)

Note : Section 'A' contains Five (05) long answer type questions of Nine and Half (9½) marks each. Learners are required to answer any Two (02) questions only. (2×9½=19)

1. Show that the stress tensor is symmetric.

2. Prove that the vorticity $\vec{\Omega}$ Satisfied the differential equation

$$\frac{D\vec{\Omega}}{Dt} = (\vec{\Omega}.\nabla)\vec{q} + v\nabla\nabla^2(\vec{\Omega})$$

where v is the coefficient of viscosity.

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

4. Discuss Stagnation Point flow of a incompressible viscous fluid. (Hiemenz Flow).

5. Discuss the plane Poiseuille flow between two parallel plates.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Four (04) marks each. Learners are required to answer any Four (04) questions only. (4×4=16)

1. Explain Prandtl number and Eckert number.

2. Define stress and stress vector and also write component of stress vector.

3. Derive the equation of continuity in Cartesian coordinates system.

4. Define the following

(a) Nusselt number

(b) Recovery factor

5. State Generalized law of Heat Conduction and specific heat.

6. 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 pressure drop in the prototype if the pressure drop is 3kg/cm^2 in the model when tested under hydrodynamically similar conditions?.

7. Discuss the plane Couette flow between two parallel plates.

8. Explain the physical significance of the Brinkman number and Euler's number.