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III Semester M.Sc. Degree Examination, April/May - 2022

MATHEMATICS

Fluid Mechanics

Paper : M-302 T

(CBCS Scheme Y2k17 (Repeaters))

Time : 3 Hours

Instructions to Candidates:

- i. Answer any **five** questions.
- ii. All questions carry **equal** marks.



1. a. List out all the properties of Cartesian Tensors.
b. Show that every tensor A can be represented as a sum of spherical and deviatoric parts. (7+7)
2. a. Establish the description of motion of a continuum. Also, discuss the Lagrangian and Eulerian description of motion of a continuum.
b. State and prove Reynolds transport formula. (7+7)
3. a. Derive the continuity equation for a compressible fluid in its usual notations. Also show that $\frac{D}{Dt} \int_V \rho \phi dV = \int_V \rho \frac{D\phi}{Dt} dV$ from the continuity equation.
b. Derive the energy equation in its usual notations. (7+7)
4. a. For certain flow of non - viscous fluids with a constant density under earth's gravitational field, the velocity is $\vec{q} = \Delta\phi$ where $\phi = x^3 - 3xy^2$, find the pressure distribution.
b. State and prove the Helmholtz vorticity equation. (7+7)
5. a. Derive the energy equation for an incompressible viscous fluid.
b. State and prove the Stoke's first problem. (7+7)
6. Determine the velocity distribution, average velocity, maximum velocity and shearing stress on the wall for the plane Couette flow. (14)

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7. a. Establish the diffusion of vorticity.
- b. Show that $W = -uz - m \ln(z) + m \ln(z - z_0)$ represents a system with a uniform flow, a source at $z = 0$ and a sink at $z = z_0$. (5+9)
8. a. Find the complex potential of a flow system that has a source of strength M at $z = \pm a$ and hence find the potential and stream functions.
- b. State and prove the Blasius theorem. (7+7)

