20MAP20

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2023
(Fourth Semester)

Branch – **MATHEMATICS**

FLUID DYNAMICS

Time: Three Hours Maximum: 50 Marks

SECTION-A (5 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (5 x 1 = 5)

1. The stream line of state of motion is _____.
   i) $q\ x\ d\tau = 0$ ii) $q\ x\ d\tau = 1$ iii) $q\ x\ d\tau = -1$ iv) $q + d\tau = 0$

2. The following is one of the equation of continuity.
   i) $\frac{D}{Dt}(\rho\nabla t) = 0$ ii) $\frac{D}{Dt}(\nabla t) = 0$ iii) $\frac{D}{Dt}(\rho) = 0$ iv) $\frac{D}{Dt}(\rho\nabla t) = 1$

3. The necessary condition of the existence of a velocity potential in a fluid is _____.
   i) rotational motion ii) irrotational motion
   iii) stream iv) sink

4. The Reynolds number of the flow based on the average velocity R= -------
   i) $u_{an}\frac{h}{v}$ ii) $u_{an}\frac{v}{h}$ iii) $u_{an}h$ iv) $u_{an}v$

5. _____ method is that the concept by which the solution satisfy the differential equation only on the average.
   i) Blasius ii) Prandtl iii) Von Karman iv) Navier Stokes

SECTION - B (15 Marks)
Answer **ALL** Questions
ALL Questions Carry **EQUAL** Marks (5 x 3 = 15)

6. a. The velocity vector filed in the flow filed is given by q=i(Az-By)+j(Bx-Cz)+k(Cy-Ax) where A,B and C are non zero constants. Determine the equations of the vortex lines.

   OR

   b. Determine the equation of stream lines where the velocity q is given by q = ix-jy.

7. a. Verify the equality of the shearing stresses of fluid $\sigma_{yz} = \sigma_{yz}, \sigma_{zx} = \sigma_{xz}, \sigma_{xy} = \sigma_{yx}$.

   OR

   b. State the relationship between stress and rate of strain.

8. a. Derive the equation of continuity.

   OR

   b. Give a note on irrotational flow of fluid.

9. a. Derive the shearing stress for flow between Two Coaxial cylinders.

   OR

   b. Write a brief note on the Hagan Poiseulle flow.

10. a. Derive the boundary layer equations in two dimensional flow.

    OR

    b. Based on the von Karman integral relation, determine the local frictional coefficient C_f for flow over a flat plate.

Cont...

SECTION -C (30 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 x 6 = 30)

11. a. Assuming that the velocity components for a two dimensional flow system can be given in the Eulerian system by u=A(x+y)+Ct and v=B(x+y)+Et. Find the displacement of a fluid particle in the Lagrangian system.

(Or)

b. Given the velocity field $q=iAx^2y+jBy^2zt+kczt^2$, determine the acceleration of a particle of fixed identity.

12. a. Derive the energy equation.

(Or)

b. Derive the equation of continuity.

13. a. State and prove Kelvin's theorem at constancy of circulation.

(Or)

b. Show that the velocity potential $\phi = \frac{a}{2}(x^2 + y^2 - 2z^2)$ satisfies the Laplace equation and represents the flow against a fixed plane wall.

14. a. Derive the velocity distribution of the Plane Poiseuille flow through a pipe.

(Or)

b. Determine the shearing stress of flow between two concentric rotating cylinders.

15. a. Derive the Blasius solution of boundary layer along a flat plate.

(Or)

b. Solve von Karman integral relation by momentum law.

Z-Z-Z END