20MAP20

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2022
(Fourth Semester)

Branch – **MATHEMATICS**

FLUID DYNAMICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 x 1 = 10)

1. The Unit of force is _____.
   (i) kg/m (ii) kg/m^2
   (iii) kg.m/s (iv) $kg.m/s^2$

2. The law of _____ is known as Newton's law of friction.
   (i) viscosity (ii) stress
   (iii) shearing stress (iv) strain

3. $\in_{xx}$ is called _____.
   (i) Normal strain (ii) Shearing stress
   (iii) strain (iv) stress

4. _____ is a tensor of order 2.
   (i) viscosity (ii) stress
   (iii) pressure (iv) density

5. Kelvin's theorem is sometimes called _____ theorem.
   (i) Thomson (ii) Newton
   (iii) Bernoulli (iv) Navier

6. For an irrotational flow, the following one is true.
   (i) $\nabla \bar{q} = 0$ (ii) $\nabla \circ \bar{q} = 0$
   (iii) $\nabla^2 \bar{q} = 0$ (iv) $\nabla \times \bar{q} = 0$

7. Inertia force /friction force = _____ number.
   (i) Froude (ii) Prandtl
   (iii) Reynolds (iv) Schmid

8. In _____ flow, the velocity profile is parabolic.
   (i) Couette (ii) Poiseuille
   (iii) radical (iv) Hagen

9. Boundary layer is a region in which _____ is predominant.
   (i) viscosity (ii) velocity
   (iii) density (iv) pressure

10. _____ on the surface of the plate can be easily calculated from the results of the Blasius solution.
    (i) viscosity (ii) flow
    (iii) shearing stress (iv) strain

Cont...

SECTION - B (35 Marks)

Answer **ALL** Questions

ALL Questions Carry **EQUAL** Marks (5 x 7 = 35)

11 a Define (i) kinematic viscocity (ii) specific heat (iii) Fourier heat conduction law.

OR

b Explain Lagrangian method of fluid flow.

12 a Prove that $\sigma_{xy} = \sigma_{yx}, \sigma_{yz} = \sigma_{zy}$ and $\sigma_{zx} = \sigma_{xz}$.

OR

b Prove that $\in_{x'x'} + \in_{y'y'} = \in_{xx} + \in_{yy}$ and $\in_{x'x'} . \in_{y'y'} - \frac{\gamma^2_{x'y'}}{4} = \in_{xx} . \in_{yy} - \frac{\gamma^2_{xy}}{4}$.

13 a State and prove Kelvin's theorem.

OR

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

14 a In a plane Poiseuille flow, derive maximum and average velocities.

OR

b Determine the maximum value of velocity profile in the annulus space between two coaxial cylinders.

15 a Based on Van Karman integral relation, determine the local frictional coefficient for flow over a flat plate.

OR

b Derive Prandtl's boundary layer equations.

SECTION - C (30 Marks)

Answer any **THREE** Questions

ALL Questions Carry **EQUAL** Marks (3 x 10 = 30)

16 In Eulerian system, if the velocity components for a two dimensional flow system is u= A(x+y) +ct, v = B(x+y) + Et, then find the displacement of a fluid particle in Lagrangian system.

17 Derive the relations between stress and rate of strain in the two dimensional flow.

18 State and prove Stoke's Theorem.

19 Discuss the flow between two parallel flat plates.

20 Derive Van Karman integral relation by using the boundary layer equations.

Z-Z-Z END