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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2020 ONLY)

20PMS415

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS : JULY-2022

M.Sc.-MATHEMATICS **MAXIMUM MARKS: 70**
SEMESTER:IV **TIME : 3 HOURS**

FLUID DYNAMICS

SECTION - A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.
MULTIPLE CHOICE QUESTIONS.

1. A time-dependent flow is called _____.

   a) steady flow b)unsteady flow c) stream line flow d) In-viscid flow

2. The equation of continuity for an incompressible fluid is-----**.**

   a)$\nabla.\vec{q} = 0$ b) $\nabla\vec{q} = 0$ c) $(\nabla.\nabla)\vec{q} = 0$ d) $\nabla.(\nabla.\vec{q}) = 0.$

3. The surface generated by rotating the streamline about the axis of symmetry is called a _____ surface.

   a) streak b) stream c) flow net d) rectilinear

4. The stream function for the uniform flow of a fluid with velocity U_∞ in the direction of the positive x axis is _____.

   a)$\psi = U_\infty x$ + constant b)$\psi = U_\infty y$ +constant c)$\psi = U_\infty$ + constant d) ψ= y + constant

5. When the velocity distribution becomes ---- it remains unchanged from there on in the flow direction

   a) hyperbolic b) parabolic c) elliptic d) paraboloid

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. K2

6. Define stream line.
7. Define stream tube.
8. Write down the relation between the stream function and the velocity potential in cylindrical polar coordinates..
9. State the Kutta-Joukowski theorem.
10. Define couette flow.

SECTION – B (5 X 4 = 20 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

11. a) Derive the equation of the streak line by Lagrangian method.

(OR)

b) Consider a two-dimensional incompressible steady flow field with velocity components in rectangular coordinates given by $u(x,y) = \frac{k(x^2-y^2)}{(x^2+y^2)^2}$, $\mathbf{v}(x,y) = \frac{2kxy}{(x^2+y^2)^2}$ with k an arbitrary nonzero constant. Is the equation of continuity satisfied.

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12. a) Explain briefly the flow from a tank through a small orifice.

(OR)

b) State and prove Stokes theorem.

13.a) Show 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.

(OR)

b) Explain briefly the rectilinear flow.

14.a) Explain briefly the doublet in a uniform flow in two dimensional case.

(OR)

b) Explain briefly the superposition of sources and rectilinear flow in two dimensional case.

15.a) Derive the equation of the plane Poiseille flow.

(OR)

b) Water at 20°C flows between two large parallel plates at a distance of 1.5 mm apart. If the average velocity is 0.15m/s, find a)the maximum velocity, b)the pressure drop, c) the wall shearing stress, and d) the frictional coefficient.

SECTION – C (4 X 10 = 40 MARKS)

ANSWER ANY FOUR OUT OF SIX QUESTIONS.
(16th QUESTION IS COMPULSORY AND ANSWER ANY THREE QUESTIONS (FROM Qn. No : 17 to 21) (K4 (Or) K5)

16. Derive the Navier Stokes equation for conservation of momentum .
17. Derive the equation of continuityfor conservation of mass.
18. Derive the Euler's equation of motion in one dimension.
19. Explain in detail the stream function in three dimensional motion.
20. Explain in detail the doublet in two dimensional case.
21. Derive the Blasius solution.

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