



**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**

**B.Sc.DEGREE EXAMINATION – MATHEMATICS**

**FIFTHSEMESTER – NOVEMBER 2017**

**MT 5405- FLUID DYNAMICS**

Date: 15-11-2017  
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

**SECTION A**

Answer **ALL** questions:

(10 × 2 = 20)

1. Define stream tube.
2. Show that  $q = 2x\vec{i} - y\vec{j} - z\vec{k}$  is a possible motion.
3. The velocity vector  $q$  is given by  $\vec{q} = \vec{i}x - \vec{j}y$  determine the equation of stream line.
4. Write down the boundary condition for the flow when it is moving.
5. What is the complex potential of a source with strength  $m$  situated at the points  $z = z_1$ ?
6. Find the stream function  $\psi$ , if  $\phi = A(x^2 - y^2)$  represents a possible fluid motion.
7. Find the vorticity components of a fluid motion, if the velocity components are  $u = Ay^2 + By + C, v = 0, w = 0$ .
8. Define vortex tube and vortex filament.
9. What is lift of an aerofoil?
10. Define camber.

**SECTION B**

Answer any **FIVE** questions:

(5 × 8 = 40)

11. The velocity  $\vec{q}$  in a 3-dimensional flow field for an incompressible fluid is  $\vec{q} = 2xi - yj - zk$ . Determine the equation of streamlines passing through the point (1, 1, 1).
12. Find the equation of streamlines and path lines of a flow given by  $u = \frac{x}{1+t}, v = \frac{y}{1+t}, w = \frac{z}{1+t}$ .
13. Draw and explain the working of a Venturi tube.
14. Prove that for the complex potential  $\tan^{-1} z$  the streamlines and equipotentials are circles.
15. Obtain the complex potential due to the image of a doublet with respect to a plane.
16. Show that the velocity vector  $\vec{q}$  is every where tangent to the lines in the  $XY$ -plane along which  $\psi(x, y) = a$  constant.
17. Let  $\vec{q} = (Az - By)\vec{i} + (Bx - Cz)\vec{j} + (Cy - Ax)\vec{k}$ , (A, B, C are constants) be the velocity vector of a fluid motion. Find the equation of vortex lines.
18. Discuss the structure of an aerofoil.

**SECTION C**

Answer any **TWO** questions:

(2 × 20 = 40)

19. (a) Derive the equation of continuity.

(b) If the velocity of an incompressible fluid at the point  $(x, y, z)$  is given by  $\left(\frac{3xz}{r^5}, \frac{3yz}{r^5}, \frac{3z^2 - r^2}{r^5}\right)$  where  $r^2 = x^2 + y^2 + z^2$ . Prove that the fluid motion is possible and the velocity potential is  $\frac{\cos \theta}{r^2}$ .

(10 + 10)

20. Derive the Euler's equation of motion and deduce the Bernoulli's equation of motion.

21. (a) What arrangement of sources and sinks will give rise to the function  $w = \log\left(z - \frac{a^2}{z}\right)$ ?

(b) Obtain the complex potential due to the image of a source with respect to a circle. (12+8)

22. (a) Discuss the structure of an aerofoil.

(b) Derive Joukowski transformation.

(10 + 10)

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