

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034



B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – NOVEMBER 2013

MT 5405/5401 - FLUID DYNAMICS

Date : 14/11/2013
Time : 9:00 - 12:00

Dept. No.

Max. : 100 Marks

Part A

Answer all Questions:

(10 x 2 = 20)

1. Define stream tube.
2. When do you say the flow is irrotational.
3. Write down the boundary condition for the flow.
4. Define a two- dimensional sink and source.
5. Show that $q = 2x \vec{i} - y \vec{j} - z \vec{k}$ is a possible motion.
6. What is the complex potential of sink with strength situated at the origin?
7. Define vortex tube.
8. What is C-R equation?
9. Find the vorticity vector for the velocity $q = ui + vj$
10. What is lift of an aerofoil?

Part B

Answer any FIVE questions:

(5 x 8 = 40)

11. Prove that for the complex potential $\tan^{-1} z$ the streamlines and equipotentials are circles.
12. Explain the construction of a Venturi tube.
13. State and prove the theorem of Kutta-Joukowski.
14. Obtain the complex potential due to the image of a source with respect to a plane.
15. The velocity \vec{q} in a 2-dimensional flow field for an incompressible fluid is $\vec{q} = -3y^2 \vec{i} - 6x \vec{j}$.
Determine the equation of streamlines passing through the point (1, 1).
16. Derive the equation of continuity.
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. Define path lines and determine the equation of path lines if $u = \frac{x}{1+t}$, $v = \frac{y}{1+t}$, $w = \frac{z}{1+t}$.

Part C

Answer any TWO questions:

(2 × 20 = 40)

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

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

(8+12)

20. (a) The velocity components for a two dimensional fluid system can be given in the

Eulerian system by $u = 2x + 2y + 3t$, $v = x + y + \frac{t}{2}$. Find the displacement of a fluid particle in the

Lagrangian system.

(b) Draw and explain the working of a Pitot tube.

(12+8)

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

(b) Derive Joukowski transformation.

(8+12)

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