LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2018**

MT 5405 – FLUID DYNAMICS

Date: 02-11-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

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. Write down the boundary condition for the flow when it is in moving.
4. The velocity vector q is given by $q = ix - jy$ determine the equation of stream line.
5. What is the complex potential of source with strength m situated at the origin?
6. Find the stream function ψ, if $\varphi = A(x^2 - y^2)$ represents a possible fluid motion
7. Find the vorticity vector for the velocity $q = ui + vj$
8. Define vortex lines.
9. Find the vorticity components of a fluid motion, if the velocity components are $u = c(x + y)$, $v = -c(x + y)$.
10. What is the lift of an aero foil?

Section B

Answer any FIVE questions: **5 × 8 = 40**

11. Explain Material, Local and Convective derivative fluid motion.
12. Explain Pitot tube.
13. Derive the equation of continuity.
14. Derive the Bernoulli's equation of motion for the fluid.
15. Find the stream function $\psi(x, y, t)$ for a given velocity field $u = 2Axy$, $v = A(a^2 + x^2 - y^2)$.
16. Obtain the complex potential due to the image of a doublet with respect to the circle.
17. Derive the equation of stream lines.
18. State and prove the theorem of Kutta-Joukowski.

Section C

Answer any TWO questions: **2 × 20 = 40**

19. 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 $\frac{\cos\theta}{r^2}$.

20. (a)Derive the Euler's equation of motion.
(b)Draw and explain the working of a Venturi tube. (12 + 8)

21.(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. (12 + 8)

22. (a)Discuss the structure of an aerofoil.
(b) Derive Joukowski transformation. (8+12)

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