LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FOURTHSEMESTER – APRIL 2018

MT 4816- FLUID DYNAMICS

Date: 08-05-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

Answer ALL Questions.

1. a) Briefly explain the classification of fluids.

OR

b) Derive the velocity and acceleration of a fluid particle. (5)

c) 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 $r^2 = x^2 + y^2 + z^2$, show that the fluid motion is possible and velocity potential is $\frac{cos\theta}{r^2}$. Find the equation of streamlines. (15)

OR

d) The velocity component of a three dimensional flow filed for an incompressible fluids are $(2x, -y, -z)$. Is it a possible field? Determine the equation of the stream line passing through the point (1, 1, 1).

e) Derive the equation of stream lines. (9 + 6)

2. a) State and prove Kelvin's circulation theorem.

OR

b) Derive Euler's equation of motion. (5)

c) Discuss the fluid flow of stationery sphere in a uniform stream. (15)

OR

d) State and prove Helm Hortz vorticity theorem.

e) State and derive the Bernoulli's equation of motion. (8 + 7)

3. a) Show that $u = 2Axy$, $v = A(a^2 + x^2 - y^2)$ are the velocity components of the possible motion determine the stream functions.

OR

b) State and prove Milne Thompson circulation theorem. (5)

c) State and prove Blasius theorem.

OR

d) Analyze the fluid motion of a particle whose CP is $w = U\left(z + \frac{a^2}{z}\right)$. (15)

4. a) Show that a circular cylinder moving with a velocity U and having a circulation μ will experience a lift perpendicular to the motion of the cylinder.

OR

b) State and prove Kutta Joukowski theorem. (5)

c) State and prove Butler sphere theorem.

OR

d) Explain the construction of Aerofoil. (15)

5. a) Prove that in the slow steady motion of viscous liquid in two dimensional $\upsilon\nabla^4\varphi = \frac{\partial Y}{\partial x} - \frac{\partial X}{\partial y}$ where (X, Y) is the impressed force per unit area.

OR

b) Derive the equation satisfied by vorticity in the case of viscous incompressible fluid motion, prove that $\frac{d\bar{\xi}}{dt} = \left(\overline{\xi \cdot \nabla}\right)\vec{q} + \upsilon\nabla^2\xi$. (5)

c) Derive the Navier-Stokes equation of motion for viscous fluid.

OR

d) Discuss the viscous flow through a tube of uniform circular cross-section. (15)

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