LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FOURTH SEMESTER – **APRIL 2016**

MT 4816 - FLUID DYNAMICS

Date: 21-04-2016 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

Answer ALL Questions.

1. (a) (i) Define and derive the equation for stream lines and path lines.

OR

(ii) Explain the significance of conservation of mass**.** **(5)**

(b) (i) At a point in an incompressible fluid having spherical polar co-ordinates (r, θ, ϕ), the velocity components are $\left(2Mr^{-3}\cos\theta, Mr^{-2}\sin\theta, 0\right)$ where M is a constant. Show that the velocity is of the potential kind. Find the velocity potential and the equations of stream lines.

OR

(ii) 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)**

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

OR

(ii) Derive Euler's equation of motion. **(5)**

(b) (i) State and prove Helm Hortz vorticity theorem.

OR

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

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

OR

(ii) State and prove Milne Thompson circulation theorem. **(5)**

(b) (i) State and prove Blasius theorem.

OR

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

4. (a) (i) 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

(ii) State and prove Kutta Joukowski theorem. **(5)**

(b)(i) State and prove Butler sphere theorem.

OR

(ii) State and explain Joukowski transformation. **(15)**

5. (a) (i) 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

(ii) Discuss the flow through a tube having equilateral triangular cross-section. **(5)**

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

OR

(ii) Derive the Navier-Stokes equation of motion for viscous fluid. **(15)**

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