LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FOURTHSEMESTER – APRIL 2017

MT 4816- FLUID DYNAMICS

Date: 25-04-2017 Dept. No. Max. : 100 Marks
09:00-12:00

Answer ALL Questions.

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

OR

(b). What is Material, local and convective derivatives? (5)

(c). For a fluid moving in a fine tube of variable section A, prove from the first principles that the equation of continuity is $A\frac{\partial \rho}{\partial t}+\frac{\partial}{\partial s}(A\rho v)=0$, where v is the speed at a point P of the fluid and s the length of the tube up to P. What does this become for steady incompressible flow?

(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).

(9+6)

OR

(e). 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). Derive Euler's equation of motion.

OR

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

(c). Explain the Under Water Explosions Giving Spherical Gas Bubble.

OR

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

3. (a). If the speed of the fluid particle is a constant then show that its stream lines are constant.

OR

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

(c). State and prove Blasius theorem.

OR

(d). Define Source and Sink and also calculate the force exerted by a source on the circular cylinder. (15)

4. (a). Derive the velocity components ofDoublet in a uniform stream.

OR

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

(c). State and prove Butler sphere theorem.

OR

(d). State and explain Joukowski transformation. (15)

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

OR

(b). Derive the differential equation of the flow through a tube having equilateral triangular cross-section. (5)

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

OR

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

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