LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FOURTH SEMESTER – NOVEMBER 2016

MT 4816 - FLUID DYNAMICS

Date: 12-11-2016 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

Answer ALL Questions.

1. (a) (i) Briefly explain the condition for rigid boundaries .

OR

(ii)Define and derive the equation for stream lines and path lines. **(5)**

(b) (i) Show that $u = \frac{-2xyz}{\left(x^2+y^2\right)^2}, v = \frac{z\left(x^2-y^2\right)}{\left(x^2+y^2\right)^2}, w = \frac{y}{x^2+y^2}$ are the velocity components of a possible fluid motion. Is this motion irrotational?

(ii) Derive the equation of velocity potential. **(8+7)**

OR

(iii) 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) Define Vortex line and derive the strength of a Vortex tube.

OR

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

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

OR

(ii) Draw and explain the mechanism of Pitot tube and Venturi tube. **(15)**

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

OR

(ii) Show that $u = 2Axy, v = A(a^2+x^2-y^2)$ are the velocity components of the possible motion, also determine the stream function. **(5)**

(b) (i) Show that in case of a source in front of the circular cylinder and its image system is a circular cylinder is the part of the dividing system.

OR

(ii) State and prove Blasius theorem. **(15)**

4. (a) (i) State and prove Kutta Joukowski theorem.

OR

(ii) Find the velocity potential of 3D flow. **(5)**

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

OR

(ii) Explain the construction of Aerofoil. **(15)**

5. (a) (i) Discuss the stress components in a viscous flow.

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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