STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2008 – 09)

SUBJECT CODE : MT/PC/FD35

M. Sc. DEGREE EXAMINATION, NOVEMBER 2009
BRANCH I - MATHEMATICS
THIRD SEMESTER

COURSE : CORE
PAPER : FLUID DYNAMICS
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION – A **(5 X 8 = 40)**

ANSWER ANY FIVE QUESTIONS

1. Define vorticity vector.Prove that the vortex lines and tubes cannot orginate or terminate at internal points in fluids.
2. State and prove Kelvin's theorem on circulation..
3. Discuss: Doublet in a uniform stream.
4. Discuss the problem of a sphere moving with constant velocity in liquid which is otherwise at rest.
5. Discuss uniform flow past a fixed infinite circular cylinder.
6. Find the equations of the streamlines due to uniform line sources of strength m through the points $A(-c,0)$, $B(c,0)$ and a uniform line sink of strength 2m through the origin.
7. Derive an expression for the diffusion of vorticity in the form $\frac{d\zeta}{dx} = \nu\nabla^2\zeta$.

SECTION – B **(3 X 20 = 60)**

ANSWER ANY THREE QUESTIONS

8. (a) Derive Bernoullis equation for potential flow under conservative body forces.
   (b) Explain how Venturi tube is used for measuring fluid velocities.

..2

9. A sphere of center O and radius a is moving through an infinite liquid of constant density ρ at rest at infinity, O describing a straight line with velocity V(t). If there are no body forces, show that the pressure p at points on the surface of the sphere in a plane perpendicular to the straight line at a distance x from O measured positively in the direction of V is given by $p = p_0 - \frac{5}{8}\rho V^2 + \frac{9}{8}\rho V^2 \frac{x^2}{a^2} + \frac{1}{2}\rho x \frac{dV}{dt}$ where p_0 is the pressure at infinity. Deduce that the thrust on the sphere is $\frac{1}{2}M'\left(\frac{dV}{dt}\right)$ where M' is the mass of the liquid having the volume of the sphere.

10. (a) Obtain Stoke's stream function for a uniform line Source along $\overline{oz}$.
(b) Find the complex velocity potencial for a line doublet.
(c) State and prove Milne-Thompson's circle theorem

11. (a) State and prove Blasius theorem.
(b) Verify that $w = ik\log\left\{(z-ia)/(z+ia)\right\}$ is the complex potential of a steady flow of liquid about a circular cylinder, the plane $y = 0$ being a rigid boundary.Find. the force exerted by the liquid on unit length of the cylinder.

12. (a) Describe the steady motion between parallel plates and show that the velocity profile between the plates is parabolic.
(b) Show the energy dissipation due to viscosity when the boundary is at rest is $W = \mu\int_V \zeta^2 dv$.

▲▲▲▲▲▲▲▲▲▲