**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086**
**(For candidates admitted from the academic year 2011-12 & thereafter)**

**SUBJECT CODE : 11MT/PE/FD44**

**M. Sc. DEGREE EXAMINATION, APRIL 2014**
**BRANCH I – MATHEMATICS**
**FOURTH SEMESTER**

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

**SECTION – A**

**ANSWER ALL QUESTIONS : (5 X 2 = 10)**

1. Define stream lines.
2. State Kelvin's theorem.
3. Define a simple source.
4. What is a two dimensional flow.
5. Define the coefficient of viscosity.

**SECTION – B**

**ANSWER ANY FIVE QUESTIONS : (5 X 6 = 30)**

6. The velocity components at a point of an incompressible fluid having spherical polar coordinates are $[2M\lambda^{-3}\cos\theta, M\lambda^{-3}\sin\theta, \theta]$ where $M$ is a constant show that the velocity is of the potential kind and find the velocity potential.
7. Show that the motion specified by $\bar{q} = \frac{k^2(x\hat{j}-y\hat{\imath})}{x^2+y^2}$ $(k - constant)$ is a motion for incompressible fluid. Prove that the streamlines are circles.
8. Derive the most general form of Bernoulli's equation. Find the corresponding equation for a steady motion and for a homogenous, incompressible fluid.
9. Discuss the flow for which $w = z^2$.
10. Define Stoke's stream function and obtain it for a simple source.
11. Using the circle theorem, obtain $w$ for
    a. Uniform flow past a stationary cylinder.
    b. Uniform stream at incidence $\alpha$ to $OX$.
12. State and prove a uniqueness theorem.

**SECTION – C**

**ANSWER ANY THREE QUESTIONS : (3 X 20 = 60)**

13. Derive the equation of continuity in the form $\frac{\partial \rho}{\partial t} + \nabla.(\rho \bar{q}) = 0$. Also prove that for steady, homogenous, irrotational flow the velocity potential $\phi$ satisfies Laplace's equation.
14. Derive Euler's equation of motion.
15. State and prove Milne-Thomson circle theorem.
16. Derive the Navier-Stoke's equation of motion of a viscous fluid.
17. Discuss uniform flow past a fixed infinite circular cylinder.