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 2015
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 acceleration of a fluid particle.
2. State Kelvin's circulation theorem.
3. Define simple source and simple sink.
4. Define two dimensional flow of a fluid.
5. Write the stress matrix and its use.

SECTION – B

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

6. At the point is an incompressible fluid having spherical polar coordinates (r, θ, φ) the velocity components are $[2Mr^{-3}\cos\theta,\ Mr^{-3}\sin\theta, 0]$ where M is a constant. Show that the velocity is of the potential kind. Find the velocity potential.
7. Prove that for steady, homogenous, irrotational flow, the velocity potential satisfies Laplace equation.
8. Discuss Pitot tube.
9. Prove that for irrotational, incompressible two-dimensional flow, the equipotentials and stream lines intersect orthogonally.
10. Discuss uniform flow past a fixed infinite circular cylinder.
11. State and prove Blasius theorem.
12. Show that for a steady motion between parallel planes, the velocity profile between the plates is parabolic.

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SECTION – C

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

13. a) Derive the general equation of continuity. Write its other forms.

    b) Test whether the motion specified by $\bar{q} = K^2 \frac{(x\bar{\imath} - y\bar{\jmath})}{x^2+y^2}$ (K = constant) is a possible motion for an incompressible fluid. If so, determine the equations of the streamlines.

14. Obtain Euler's equation of motion and deduce Bernoulli's equation from it.

15. a) Discuss the flow for which $w = z^2$.

    b) Discuss doublet in uniform stream.

16. a) State and prove Milne-Thomson's Circle Theorem.

    b) Discuss the Magmiseffect with an example.

17. a) Derive the Navier-Stokes equation of motion of a viscous fluid.

    b) State and prove uniqueness theorem for a steady viscous fluid in tubes of uniform cross section.