CLASS: M.Sc. MATHEMATICS **15A/ 320**

St. JOSEPH'S COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI – 620 002

SEMESTER EXAMINATIONS – APRIL 2015

TIME: 3 Hrs. **MAXIMUM MARKS: 100**

SEM	SET	PAPER CODE	TITLE OF THE PAPER
IV	2013	12PMA4114	FLUID DYNAMICS

SECTION – A

Answer all the questions: **10 x 2 = 20**

1. Define stream lines and write equations of stream lines.
2. Write any three forms of the equation of continuity.
3. Write Laplace's equation in spherical polar coordinates.
4. Define: Pressure at a point in a fluid.
5. What is the strength of a source?
6. What is Stoke's stream function?
7. What is the complex velocity potential of a uniform stream?
8. State the extension of circle theorem.
9. What is Laminar flow?
10. Define: coefficient of viscosity.

SECTION – B

Answer all the questions: **5 x 7 = 35**

11. a. Derive the equation of continuity.

OR

b. Test whether the motion specified by $\bar{q} = \frac{k^2(x_j - y_i)}{x^2 + y^2}$ (k is constant) is a possible motion for an incompressible fluid. Also Determine the equation of streamlines.

12. a. Derive the Bernoulli's equation of motion.

OR

b. Explain the method measuring the flow in a pipe by using Venturi tube.

13. a. Prove that the velocity potential at point P due to a uniform line source AB of strength m per unit length is of the form ϕ = m logf where $f = \frac{r_2 + x_2}{r_1 + x_1} = \frac{r_1 - x_1}{r_2 - x_2} = \frac{a + \ell}{a - \ell}$ in which AB = 2*l* PA = r_1, PB = r_2, NA = x_1, NB = x_2. N being the foot of the perpendicular from P m the line AB. 2a the length of the semi major axis of the spheroid.

OR

b. If $r^n S_n(\theta,\psi)$ is a harmonic function then prove that $r^{-(n+1)} S_n(\theta,\psi)$ is also harmonic.

14. a. Discuss the flow for which the complex velocity potential is given by $w = z^2$.

OR

b. State and prove Milne – Thomson Circle Theorem.

15. a. Derive the Navier – Stoks equation of motion of a viscous.

OR

b. Discuss the translational motion of fluid element.

SECTION – C

Answer any THREE questions: **3 x 15 = 45**

16. At the point in an incompressible fluid having spherical polar coordinates (r, θ, χ), 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 and equations of the stream lines.

17. Discuss the flow when a stationary sphere is introduced in a uniform stream.

18. State and prove Weiss's sphere theorem.

19. Find the equations of stream lines 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.

20. Prove that the stress matrix of a viscous fluid is diagonally symmetric and contains only six unknown.

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