

**FOURTH SEMESTER M.Sc DEGREE (MATHEMATICS) EXAMINATION,
JUNE 2012
(CUCSS-PG-2010)**

MODOEL QUESTION PAPER

MT4E04 : FLUID DYNAMICS

Time: 3 hrs.

Max. Weightage: 36

PART – A

(Short Answer Type Questions)

Answer all questions. Each question carries 1 weightage.

1. Show that a vortex filament can not terminate at a point with in the fluid.
2. Define acyclic and cyclic irrotational motions.
3. Show that at a stagnation point the stream line crosses itself.
4. Show that in irrotational motion the curves of constant velocity potential cut the stream lines orthogonally.
5. Determine the condition that $u=ax+by$, $v=cx+dy$ may give the velocity components of an incompressible fluid.
6. What is complex velocity?
7. Write a note on cavitation.
8. State Blasius's theorem.
9. Write a short note on aerofoil.
10. What is doublet?
11. Describe the source in an angle between two walls.
12. Obtain the complex potential for a simple source.
13. What is Stoke's stream function?
14. Determine Stoke's stream function for a uniform stream

(14 x 1 =14)

PART – B

(Paragraph Type Questions)

Answer any seven questions. Each question carries 2 weightage

15. Derive Helmholtz's equation.
16. State and prove Kelvin's minimum energy theorem.
17. Show that in steady motion the vorticity is constant along a streamline.
18. Obtain vector expressions for velocity and vorticity.
19. State and prove the circle theorem.
20. State and prove the theorem of Kutta and Joukowski.
21. Show that the motion due to a uniform stream and any number of sources, can be obtained by addition of the corresponding complex potentials, when no boundaries occur in the liquid.
22. Obtain the image system for a source out side a circular cylinder.

23. Consider a line source stretching along the axis is from O to A, the strength at a distance r, from O being $\frac{m}{a}$ per unit length where OA = a, show that the streamlines are hyperbolas with foci at O and A.
24. What is Rankine's solids?

(7 x 2 = 14)

PART – C

(Essay Type Questions)

Answer any two questions. Each question carries 4 weightage

25. Establish the equation of continuity for an incompressible fluid in the form $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$. Show that $u = \frac{-2xyz}{(x^2 + y^2)^2}$, $v = \frac{x^2 - y^2}{(x^2 + y^2)^2}$, $w = \frac{y}{x^2 + y^2}$ are the velocity components of a possible fluid motion. Is this motion irrotational?
26. Show that the Joukowski transformation maps the concentric circles with centre at the origin in the Z-plane into confocal ellipses in the Z-plane and the inverse of the Joukowski transformation maps the region out side the ellipse of semi-axis a,b in the Z-plane on the region out side the circle of radius $\frac{1}{2}(a+b)$ in the Z-plane.
27. Discuss the streaming and circulation for a circular cylinder.
28. Show that a cylinder of radius 'a' placed in a stream of velocity 'u' behaves as would a doublet of strength ua^2 on the axis of the cylinder.

(2 x 4 = 8)