FLUID MECHANICS SYLLABUS

Unit-I

Kinematics of fluids in motion: Real and fluid and ideal fluids – Velocity of fluid at a point – Stream lines and path lines – Steady flow and unsteady flow, Velocity potential – Velocity vector – local and partical of fluid, conditions at a rigid boundary, general analysis of fluid motion – Equation of motion of a fluid – Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at boundary of two in viscid in compressive fluids – Euler's equation of motion – Bernoulli's equation.

Unit-II

Three Dimensional Flows: Sources – Sinks – Doublets – Images in a rigid infinite plane – Images in solid spheres – Axisymmetric flows – Stokes stream function for axisymmetrical irrotational motions.

Two Dimensional Flows: Meaning of two dimensional flow – Use of cylindrical polar coordinates – Stream function, complex potential for two dimensional irrotational incompresive flow – Complex velocity potentials for standard two dimensional flow – Uniform stream line sources and line sinks – Line doublets line vortices.

Unit-III

Milne-Thomson Circle Theorem – applications of circle theorems extensions of circle theorem – theorem of blassius.

Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid element – The rate of strain quadric and principal stresses – Some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relations between stress and rate of strain – The coefficient of viscosity and laminar flow.

Unit-IV

The Navier-Stokes equations of motion of a viscous fluid – Some solvable problems in viscous flow – Steady motion between parallel planes – Steady flow through tube of uniform circular cross-section – Steady flow between concentric rotating cylinders – Steady viscous flow in tubes of uniform cross-section – Tube having equilateral triangular cross-section.
Diffusion of vorticity – Energy dissipation due to viscosity – Steady flow past a fixed sphere – Dimensional analysis; Reynolds number Prandti's boundary layer.

Unit-V

Magneto Hydrodynamics – MHD approximations – Alfren wave equations – Alfren Theorem – Law of Isorotation – Flow between parallel planes (Hartman Problem)

Reference: 1. F. Charlton, Textbook of Fluid Dynamics

<u>FLUID MECHANICS – PAPER III</u>

Model question Paper

Max. Marks : 100 **Time : 3 hours**

Note : 1. Answer any FIVE Questions

2. Each Question carries 20 Marks.

***

Q. No. (1)

(a) Discuss general analysis of Fluid motion.

(b) Test whether the motion represented by $\bar{q} = \frac{k^2(x_i - y_j)}{(x^2 + y^2)}$ where K is constant represents the possible fluid motion? Find the equations of the stream lines and equi potentials.

Q. No. (2)

(a) Show that in a two dimensional irrotational flow, the families of stream surfaces and equi potentials intersect orthogonally.

(b) Find the complex velocity potential for a uniform stream and a doublet. Discuss the flow for which $w = z^2$.

Q. No. (3)

(a) Derive Euler equation of motion.

(b) Derive Bernoulli equation.

Q. No. (4)

(a) Discuss the axi symmetric flow past a fixed sphere.

(b) Determine the stream functions corresponding (i) to a uniform stream U parallel to the axis θ=0 and (ii) to the spherically symmetric radial velocity field from a point source at the origin, the total outward flux being 4 π m.

Q. No. (5)

(a) State and prove Milne-Thomson circle Theorem

(b) A vertex of circulation 2 π k is at rest at the point $z = na(n > 1)$, in the presence of a plane circular boundary $|z| = a$, around which there is a circulation $2\pi\lambda k$. Show that $\lambda = \frac{1}{(n^2 - 1)}$

Q. No (6)

(a) Derive Navier Stokes Equation for a viscous incompressible fluid

(b) Discuss the steady flow of a viscous fluid between parallel plates.

Q. No. (7)

(a) Discuss the steady flow of a viscous fluid past a fixed sphere.

(b) Derive Van – Coalmen Integral Equations

Q. No. (8)

(a) Derive Alfven Theorem

(b) State and Prove Law of Isorotation.