17HS054 FLUID MECHANICS

Course Description and Objectives:

This course to establish an understanding of the fundamental concepts of fluid dynamics. And to make students understand the importance of fluid dynamics in diverse real-life applications, also build the necessary theoretical background for solving a variety of problems.

Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Analyse fluid flow problems with the application of the momentum and energy equations.
2	Understand modelling approximations in finding exact solutions.
3	Apply basic principles of multi-variable calculus, differential equations and complex variables to fluid dynamic problems.
4	Identify how properties of fluids change with temperature and their effect on Pressure and fluid flow
5	Use the general energy equation to calculate changes in fluid flow for circular and Non-Circular pipes for in-compressible fluids.

Unit – I (10 hours)

Kinematics of Fluids in Motion

Real fluids and Ideal fluids – Velocity of a Fluid at a point – Streamlines and pthlines – steady and Unsteady flows – the velocity potential – The Vorticity vector – Local and Particle Rates of Change – The equation of Continuity – Acceleration of a fluid – Conditions at a rigid boundary – General Analysis of fluid motion.

Unit – II (10 hours)

Equations of motion of a fluid- Pressure at a point in fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equations of motion – Bernoulli's equation – Worked examples.

Unit – III (10 hours)

Discussion of the case of steady motion under conservative body forces - Some flows involving axial symmetry – Some special two-dimensional flows – Impulsive motion – Some further aspects of vortex motion.

Unit – IV (15 hours)

Some Two – dimensional Flows, Meaning of two-dimensional flow – Use of Cylindrical polar coordinates – The stream function – The complex potential for two-dimensional, Irrotational, Incompressible flow – Uniform Stream – The Milne-Thomson Circle theorem – the theorem of Blasius.

Unit – V (15 hours)

Viscous flow, 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 - The Navier-Stokes equations of motion of a viscous fluid.

Reference Text Books:

1. A Text Book of Fluid Dynamics by F. Charlton, CBS Publications, New Delhi.

2. Classical Mechanics by Herbert Goldstein, Narosa Publications, New Delhi.

3. Fluid Mechanics by T. Allen and I.L. Ditsworth, McGraw Hill, 1972

4. Fundamentals of Mechanics of fluids by I.G. Currie, CRC, 2002

5. Fluid Mechanics, An Introduction to the theory by Chia-shun Yeh, McGraw Hill, 1974

6. Fluids Mechanics by F.M White, McGraw Hill, 2003

7. Introduction to Fluid Mechanics by R.W Fox, A.T Mc Donald and P.J. Pritchard, John Wiley and Sons Pvt. Ltd., 2003