COURSE CONTENT

FLUID DYNAMICS								
III Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAED03	**Core**	3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Nil								

I. COURSE OVERVIEW:

Fluid dynamics is the study of fluids either in motion or at rest. This course introduces to a broad range of fundamental concepts, methods of fluid mechanics, mathematical description of fluid flows and the solution of some important flow problems. The course emphasizes importance of dimensionless numbers in various engineering fluid flow problems. It discusses the concept of boundary layer theory and bluff body aerodynamics. Compare and contrast various fluid machinery based on flow properties and its applications.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamental knowledge of fluids, their properties and behavior under various conditions of closed conduit and external flow systems.
II. Various mathematical models in fluid dynamics, how they are derived and how they can be used to solve practical problems
III. The importance of formation of boundary layer when fluid flows over the solid bodies and effect in reduction of displacement, momentum, energy and pressure gradient.
IV. Working principle of various turbo machineries, their application and analyze their characteristics using governing equations.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1 Identify the suitable pressure measuring devices for determining the flow measurements in fluid systems
CO 2 Utilize the concept of Similitude and Non-Dimensional numbers for validating physical parameters of a designed prototype
CO 3 Apply the law of conservation of mass and momentum for obtaining numerical solutions of internal fluid flow systems.
CO 4 Utilize the principle of Bernoulli equation for measurement of discharge in internal and external fluid flow systems
CO 5 Apply boundary layer theory for internal and external flow systems in determining drag forces and frictional losses.
CO 6 Classify the types of hydraulic machines based on working principle and performance characteristics for the selection in real world applications.

IV. COURSE CONTENT:

MODULE-I: FLUID PROPERTIES AND FLUID STATICS (10)

Density, specific weight, specific gravity, surface tension and capillarity, Newton"s law of viscosity, incompressible and compressible fluid, numerical problems; Hydrostatic forces on submerged bodies - Pressure at a point, Pascal's law, pressure variation with temperature and height, center of pressure plane, vertical and inclined surfaces, Manometers - simple and differential Manometers, inverted manometers, micro manometers, pressure gauges and numerical problems. Buoyancy - Archimedes principle, metacenter, Meta centric height calculations; Stability.

MODULE –II: DIMENSIONAL ANALYSIS (10)
Fundamental and secondary quantities, Dimensional homogeneity, Methods of dimensional Analysis-Rayleigh's method, Buckingham's π- theorem, method of selecting repeating variables, similarity parameters - Reynolds number,
Froude number, Euler's number, Weber's number, Mach number concepts of geometric, kinematic and dynamic similarity

MODULE –III: KINEMATICS AND DYNAMICS OF FLUIDS (09)
Methods of describing fluid motion, types of fluid flows, differential form of continuity equation-Cartesian, cylindrical and polar coordinate system, Numerical problems.

Euler's equation of Motion; Bernoulli's equation, Application of Bernoulli's equation in flow measurements: velocity and mass flow rate, pitot-static tube, venturi meter, orifice meter and V-Notch.

MODULE –IV: BOUNDARY LAYER THEORY (10)
Introduction and classification of boundary layer, boundary layer properties Displacement, momentum and energy thickness, Boundary Layers with Pressure Gradient, laminar-boundary-layer equations, limitations, Shear Stress in a Boundary Layer, Blasius Solution for Flat-Plate Flow, drag force on flat due to boundary layer, idea of boundary layer separation, separation control, streamlined and bluff bodies.

MODULE –V: TURBO MACHINERY (09)
Introduction and classification of fluid machines: Turbo machinery analysis; The angular momentum principle; Euler turbo machine equation; Application to fluid systems, working principle of Pelton wheel, Fransis turbine, Kaplan turbine, reciprocating pump, centrifugal pump, gas turbine, velocity triangle.

V. TEXT BOOKS:

1. Frank M. White, "Fluid Mechanics", McGraw Hill Education Private Limited, 9th edition, 2022.
2. R. K Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi publications ltd, 10th edition, 2019.
3. Yunus Cengel, John Cimbala, "Fluid Mechanics: Fundamentals and Applications", McGraw Hill Education Private Limited, 4th edition 2017.

VI. REFERENCE BOOKS:

1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2nd edition, 1987.
2. Milne Thompson L M, "Theoretical Hydrodynamics", MacMillan, 5th edition, 1968.
3. Som S. K, Biswas. G, "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2004.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf

VIII. MATERIALS ONLINE

1. Course template

2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation