INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

FLUID MECHANICS								
III Semester: CE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACEE05	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Engineering Mechanics								

I. COURSE OVERVIEW:

Fluid Mechanics is a branch of physics that deals with the behavior of fluids, the forces acting on them, and the fundamental concepts related to fluid properties, fluid dynamics, and fluid flow in both closed and open conduits. A significant part of this subject focuses on the flow of incompressible fluids in pressurized systems. The course equips learners with the skills to develop and apply models for analyzing fluid systems using the control volume approach. Moreover, the principles of Fluid Mechanics form the foundation for understanding topics in Hydraulic Machinery and Water Resources Engineering.

II. COURSE OBJECTIVES:

The students will try to learn:

I. To understand the primary principles of fluid properties at rest and in motion under various conditions in both closed and open channels.

II. To study the concepts of buoyancy, stability of floating bodies, and the forces acting on immersed bodies through the application of pressure principles.

III. To apply the fundamental laws of continuity, energy, and momentum, and formulate their governing equations for fluid flow analysis.

IV. To analyze equivalent pipe flow systems and branching pipe networks using the Hardy Cross method.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Explain the basic principles and concepts of fluid mechanics to interpret and describe fluid flow problems.

CO 2 Execute the principles of manometry and Archimedes Principle for locating the point of application of force on various types of floating and immersed bodies.

CO 3 Apply conservation laws in their differential form to analyze and determine the velocity, pressure, and acceleration of a moving liquid.

CO 4 Analyze fluid flow with the mass and energy equations for determining analytical solutions of fluid flow problems.

CO 5 Apply the law of conservation of energy and Bernoulli's theorem to evaluate the total energy for different geometrical cross-sections and to determine the discharge through them.

CO 6 Apply fluid mechanics concepts and dimensional analysis to analyze head losses, pipe networks, and model studies for practical engineering solutions.

IV. COURSE CONTENT:

MODULE –I: FLUID PROPERTIES (09)
Distinction between a fluid and a solid, Basic concepts of a fluids, Types of fluids, Properties of fluids - Viscosity, Newton law of viscosity; vapor pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

MODULE -II: FLUID STATICS (09)
Fluid Pressure: Pressure at a point, Pascal's law, Hydrostatic pressure and pressure variation in fluids at rest; Absolute pressure and gauge pressure (measurement of pressure); piezometer, Manometers, different types of manometers and pressure gauges; Hydrostatic forces on plane and curved surfaces for submerged bodies. Buoyancy and stability of floating bodies, metacenter

MODULE -III: FLUID KINEMATICS AND DYNAMICS (12)
Classification of fluid flow, Reynolds number, Froude number, combinations of fluid flows: Streamline, path line, streak line and stream tube; stream function, velocity potential function, flow net, One, two- and three-dimensional Continuity equations in Cartesian coordinates.

Forces acting on a fluid in motion; Euler's equations of motion; Bernoulli's equation and its derivation; Applications of Bernoulli's equation; Impulse-momentum equation and its applications: force exerted by a flowing fluid on a pipe bend, force exerted by a jet on a plate, applications.

MODULE -IV: FLOW THROUGH PIPES (09)
Head Loss through pipes, Darcy- Wies batch equation, minor losses, total energy line, hydraulic grade line, Pipes in series, equivalent pipes, pipes in parallel, siphon, branching of pipes, three reservoir problems. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures.

MODULE -V: DIMENSIONAL ANALYSIS AND HYDRAULIC SIMILITUDE: (09)
Dimensional homogeneity – Rayleigh's method and Buckingham's π methods–Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problems**.**

V. TEXTBOOKS:

1. Modi, P.N. and Seth, S.M., "*Hydraulics and Fluid Mechanics including Hydraulic machines*", 22nd edition, Standard Book House, 2017.
2. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, "*Fluid Mechanics and Machinery*", Oxford University Press, 2010.
3. P M Modi and S M Seth, "*Hydraulics and Fluid Mechanics*", Standard Book House, 2014

VI. REFERENCE BOOKS:

1. K. Subramanya, "*Theory and Applications of Fluid Mechanics*", Tata Mc Graw Hill, 2012.
2. Modi, P. N., and S. M. Seth. "*Hydraulics and fluid mechanics",* Standard Book House, 1980.
3. C.S.P. Ojha, R. Berndtsson and P. N. Chadramouli, "*Fluid Mechanics and Machinery*", Oxford University Press, 2010

VII. ELECTRONICS RESOURCES:

1. https://www.youtube.com/watch?v=fa0zHI6nLUo
2. https://www.youtube.com/playlist?list=PLwdnzlV3ogoV-ATGY2ptuLS9mwLFOJoDw
3. https://www.youtube.com/watch?v=F_7OhKUYV5c

VIII. MATERIAL ONLINE:

1. Course outline description
2. Tutorial question bank
3. Tech-talk topics
4. Assignments
5. Definition and terminology
6. Open ended experiments

7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation