FLUID DYNAMICS

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB03	Foundation	3	1	-	4	30	70	100
Contact Classes: 33	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Illustrate about the basic properties of a fluid, hydrostatic forces on submerged bodies and different manometers.
II. Derive the basic principles of a fluid-continuity, momentum, Euler and Bernoulli's equations.
III. Explain the concept of boundary layer theory and importance of Prandtl's boundary layer theory.
IV. Understand the flow behavior through different fluid pump systems.

COURSE OUTCOMES(COs):

CO 1 Understand the basic fluid properties and fluid dynamic concepts with its applications of fluid statics to determine forces of buoyancy and stability; and to fluids in rigid-body motion.
CO 2 Use of conservation laws in differential forms and Understand the dimensional methods and kinematics of fluid particles.
CO 3 Use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and inviscid fluids.
CO 4 Understand the concepts of viscous boundary layers, mechanics of viscous flow effects on immersed bodies and its forces.
CO 5 Apply principles of fluid mechanics to the operation, design, and selection of fluid machinery and to understand the ethical issues associated with decision making.

COURSE LEARNING OUTCOMES (CLOs):

1. Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.
2. Explain the hydrostatic forces on submerged bodies, variation with temperature and height with respect to different types of surfaces.
3. Define different types of manometers and explain buoyancy force, stability of floating bodies by determining its metacenter height.
4. Dimensional similarity and prediction of flow behavior using dimensionless numbers.
5. Classification of fluid flows and governing equations of inviscid fluid flows.
6. Conceptual analysis of fluid flow and exact solutions of navier stokes equations for coquette flow and poiseuille flow.
7. Define Fluid forces and describe the motion of a fluid particle with fluid deformation;
8. Determine the Euler's and Bernoulli's equation and obtain its phenomenological basis of Naviers-stokes equation.
9. Describe about the flow measurements using different equipments of fluid flows.
10. Understand the Concept of boundary layer flows and control of flow separation.
11. Determine the flows over streamlined and bluff bodies to predict the drag and lift forces.
12. Understand the thickness factor with respect to Displacement, momentum and energy thickness.
13. Explain about the turbo machinery systems and working.
14. Describe the concepts of turbo machinery in the field of aerospace engineering and concepts of internal flows through engines.
15. Demonstrate the knowledge gained from the working of compressors, fans and pumps

MODULE-I	FLUID PROPERTIES AND FLUID STATICS	Classes: 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	**FLUID KINEMATICS AND BASIC EQUATIONS OF FLUID FLOW ANALYSIS**	**Classes: 09**
Statement of Buckingham’s π- theorem, similarity parameters - Reynolds number, Froude number, concepts of geometric, kinematic and dynamic similarity, Reynolds number as a very approximate measure of ratio of inertia force and viscous force. Types of fluid flows, differential equations of mass and momentum for incompressible flows, inviscid eulers equation and viscous flows- navier stokes equations, concept of fluid rotation, vorticity and stream function, exact solutions of navier stokes equations for coquette flow and poiseuille flow, numericals.		
MODULE-III	**FLUID DYNAMICS**	**Classes: 10**
Fluid forces and Motion of a fluid particle; Fluid deformation; Euler's and Bernoulli's equation, phenomenological basis of Naviers- stokes equation, flow measurements : pressure, velocity and mass flow rate, viscosity, pitot-static tube, venturi meter, orifice meter and V-Notch, numericals.		
MODULE-IV	**BOUNDARY LAYER THEORY**	**Classes: 08**
Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces. Displacement, momentum and energy thickness, numericals.		
MODULE-V	**TURBO MACHINERY**	**Classes: 08**
Introduction and classification of fluid machines: Turbo machinery analysis; The angular momentum principle; Euler turbo machine equation; Application to fluid systems, working principle overview of turbines, fans, pumps and compressors.		

Text Books:

1. D.J Tritton, “Physical Fluid Dynamics”, Oxford university press, 2nd edition 2016.
2. R. K Bansal, “Fluid mechanics and hydraulic machines”, Laxmi publications ltd, 9th Edition, 2011.
3. Robert W Fox, Alan T McDonald, “Introduction to fluid Mechanics”, John Wiley and Sons, 6th Edition, 1995.
4. Streeter V. L, Wylie, E.B., “Fluid Mechanics”, McGraw-Hill, 9th Edition, 1983.

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. Rathakrishnan. E, “Fundamentals of Fluid Mechanics”, Prentice-Hall, 5th Edition, 2007.
   Som S. K, Biswas. G, “Introduction to fluid mechanics and fluid machines”, Tata McGraw-Hill, 2nd Edition, 2004.

Web References:

1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf
3. https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf
4. https://www.scribd.com/doc/16605891/Fluid-Mechanics

E-Text Books:
1. https://bookboon.com/en/engineering-fluid-mechanics-ebook 2. https://www.slideshare.net/asifzhcet/fluid-mechanics-and-hydraulic-machines-dr-r-k-bansal 3. https://eprints.staffs.ac.uk/222/1/engineering-fluid-mechanics%5B1%5D.pdf 4. https://www.engr.uky.edu/~acfd/me330-lctrs.pdf