

## FLUID DYNAMICS

<b>III Semester: AE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
<b>AAEB03</b>	<b>Core</b>	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	

### I. COURSE OVERVIEW:

The aim of this course is to introduce basic principles of fluid dynamics and it is further extended to cover the application of aeronautical engineering. This course also deals with the large variety of fluids such as air, water, steam, etc.; however, the major emphasis is given for the study of water. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

### II. 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 through pipes and their losses for different geometries.

### III. COURSE OUTCOMES (COs):

#### COs Course Outcome

- 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.

### IV. SYLLABUS:

<b>MODULE -I</b>	<b>FLUID PROPERTIES AND FLUID STATICS</b>	<b>Classes: 10</b>
<p>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.</p>		

<b>MODULE -II</b>	<b>FLUID KINEMATICS AND BASIC EQUATIONS OF FLUID FLOW ANALYSIS</b>	<b>Classes: 10</b>
<p>Statement of Buckingham's <math>\pi</math>- 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.</p> <p>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.</p>		
<b>MODULE -III</b>	<b>FLUID DYNAMICS</b>	<b>Classes: 10</b>
<p>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.</p>		
<b>MODULE -IV</b>	<b>BOUNDARY LAYER THEORY</b>	<b>Classes: 09</b>
<p>Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces. Displacement, momentum and energy thickness, numericals.</p>		
<b>MODULE -V</b>	<b>TURBO MACHINERY</b>	<b>Classes: 09</b>
<p>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.</p>		
<b>V. Text Books:</b>		
<ol style="list-style-type: none"> <li>1. D.J Tritton, "Physical Fluid Dynamics", Oxford university press, 2nd edition 2016.</li> <li>2. R. K Bansal, "Fluid mechanics and hydraulic machines", Laxmi publications ltd, 9<sup>th</sup> Edition, 2011.</li> <li>3. Robert W Fox, Alan T McDonald, "Introduction to fluid Mechanics", John Wiley and Sons, 6<sup>th</sup> Edition, 1995.</li> <li>4. Streeter V. L, Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9<sup>th</sup> Edition, 1983.</li> </ol>		
<b>VI. Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2<sup>nd</sup> Edition, 1987.</li> <li>2. Milne Thompson L M, "Theoretical Hydrodynamics", MacMillan, 5<sup>th</sup> Edition, 1968.</li> <li>3. Rathakrishnan. E, "Fundamentals of Fluid Mechanics", Prentice-Hall, 5<sup>th</sup> Edition, 2007.</li> <li>4. Som S. K, Biswas. G, "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2004.</li> </ol>		
<b>VII. Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://nptel.ac.in/courses/112105171/1">https://nptel.ac.in/courses/112105171/1</a></li> <li>2. <a href="https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf">https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf</a></li> <li>3. <a href="https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf">https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf</a></li> <li>4. <a href="https://www.scribd.com/doc/16605891/Fluid-Mechanics">https://www.scribd.com/doc/16605891/Fluid-Mechanics</a></li> </ol>		
<b>VIII. E-Text Books:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://bookboon.com/en/engineering-fluid-mechanics-ebook">https://bookboon.com/en/engineering-fluid-mechanics-ebook</a></li> <li>2. <a href="https://www.slideshare.net/asifzhcet/fluid-mechanics-and-hydraulic-machines-dr-r-k-bansal">https://www.slideshare.net/asifzhcet/fluid-mechanics-and-hydraulic-machines-dr-r-k-bansal</a></li> <li>3. <a href="https://eprints.staffs.ac.uk/222/1/engineering-fluid-mechanics%5B1%5D.pdf">https://eprints.staffs.ac.uk/222/1/engineering-fluid-mechanics%5B1%5D.pdf</a></li> <li>4. <a href="https://www.engr.uky.edu/~acfd/me330-lctrs.pdf">https://www.engr.uky.edu/~acfd/me330-lctrs.pdf</a></li> </ol>		