FLUID MECHANICS

Course Code:	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prerequisites: Applied Mechanics, Mathematics

Course Outcomes:

At the end of the course the student will be able to:

CO1: Explain various fluid properties and compute pressures using manometers (L3)

CO2: Compute the hydrostatic forces on plane & curved surfaces and explain the concepts of Kinematics of fluids (L3)

CO3: Apply the fluid dynamic principles to measure quantities of fluid flowing in pipes, tanks and channels (L3)

CO4: Differentiate between turbulent and laminar fluid flows and also compute head loss due to pipe friction (L3)

CO5: Explain the concepts of boundary layer theory and compute the drag and lift forces (L3)

UNIT-I **(10 Lectures)**

INTRODUCTION:

Dimensions and units – Physical properties of fluids, density, specific weight, specific volume, specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion-fluid continuum, pressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge and vacuum pressure-measurement of pressure, Pressure gauges, Manometers: Simple, Differential Manometers.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the properties of fluids (L2)
2. explain the concepts of pressure measurement (L2)
3. estimate the fluid pressure in pipes using manometers (L3)

UNIT-II **(10 Lectures)**

HYDROSTATIC FORCES:

Hydrostatic forces on submerged plane (Horizontal, Vertical, inclined) and curved surfaces – Center of pressure, Derivations and problems.

FLUID KINEMATICS:

Lagrangean and Eularian approaches – Description of fluid flow, translation, deformation and rotation of a fluid element in motion; velocity, acceleration – convective, local and total, Stream line, path line and streak lines and stream tube. Classification of flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity- one, two, three dimensional flows – stream and velocity potential functions, flow net.

Learning outcomes:

At the end of the unit, the student will be able to

1. compute the hydro static fluid pressure on various surfaces (L3)
2. explain the concept of fluid kinematics and discuss various types of flowing fluids (L2)
3. demonstrate applications of continuity equations (L2)

UNIT-III **(10 Lectures)**

FLUID DYNAMICS:

Surface and body forces, Concepts of fluid system and control volume–Euler's and Bernoulli's equations for flow for 2-D flow, Impulse-Momentum equation and its application – forces on pipe bend.

MEASUREMENT OF FLOW: Pitot tube, Venturi meter and Orifice meter– classification of orifices and mouthpieces–flow over rectangular, triangular and trapezoidal notches.

Learning outcomes:

At the end of the unit, the student will be able to

1. demonstrate the applications of Bernoulli's equation (L2)
2. demonstrate the applications of Momentum equation (L2)
3. compute the discharge through pipes, tanks and channels (L3)

UNIT-IV **(10 Lectures)**

VISCOUS FLOW: Reynolds experiment – Classification of Laminar & Turbulent flows. Flow between two parallel plates, Flow through long pipes.

CLOSED CONDUIT FLOW: Laws of Fluid friction – Darcy-Weisbach equation, Minor losses –pipes in series – pipes in parallel – total energy line and hydraulic gradient line, Siphon, hydraulic power transmission through pipes, variation of friction factor with Reynolds number – Moody's Chart.

Learning outcomes:

At the end of the unit, the student will be able to

1. demonstrate Laminar, Transition and Turbulent flows through pipes (L2)
2. explain Laminar flow through parallel plates (L2)
3. estimate the various energy losses in pipe flow (L3)

UNIT-V **(10 Lectures)**

BOUNDARY LAYER THEORY: Concepts, Prandtl's contribution, Characteristics of Boundary Layer (BL) along a thin flat plate, laminar and turbulent Boundary layers (no derivations), BL in transition, separation of BL, control of BL separation, flow around submerged objects -Drag and Lift- Magnus effect.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the concepts of laminar and turbulent boundary layers (L2)
2. explain the concepts of boundary layer separation (L2)
3. compute the Drag and lift forces on objects presentation flowing fluid medium (L3)

Text Books:

1. A.K .Jain , "Fluid Mechanics including Hydraulic Machines" ,8th Edition , Khanna Publishers, New Delhi ,2003
2. P.N Modi and S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulic Machines", 14th Edition, Standard Book House, 2002.

References:

1. Frank.M. White, “Fluid Mechanics”, 14th Edition, Tata McGraw Hill Pvt. Ltd,2002.
2. A.K. Mohanty, “Fluid Mechanics”, 14th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
3. J.F. Douglas, J.M. Gasirock and J.A. Swaffield, “Fluid Mechanics”, 14th Edition, Pearson Education Publishers, 2002.
4. V.L.Streeter, E. Benjamin Wiley and W. Bedford, “Fluid Mechanics”, 9th Edition, McGraw-Hill Companies,1997.
5. K.L. Kumar, “Fluid Mechanics”, 6th Edition, Eurasia Publishing House,1995.
6. R.K. Rajput, “Fluid Mechanics and Hydraulic Machines”, 6th Edition, S Chand & Company Ltd., New Delhi, 2016.

Web References:

1. https://nptel.ac.in/courses/105/103/105103192/
2. https://nptel.ac.in/courses/105/101/105101082/
3. https://nptel.ac.in/courses/105/103/105103095/