FLUID MECHANICS AND MACHINES

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB08	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to learn:

I. The fundamental knowledge of fluids, their properties and behavior under various conditions of closed conduit and external flow systems.
II. The development of various static and dynamic fluid flow governing equations from the fundamental conservation laws of motion studied under basic physics and classical mechanics.
III. The application of boundary layer theory, Euler's equation, continuity and impulse-momentum equation in fluid flows.
IV. The concepts of fluid mechanics and hydraulics to apply in real world engineering applications such as hydraulic turbines and pumps in power stations.

COURSE OUTCOMES:

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

CO 1 **Relate** the basic properties, various types and patterns of fluid flow configurations that are encountered in fluid flows.
CO 2 **Identify** the importance and application of physical dimensions, units and dimensional homogeneity in engineering calculations with specific emphasis to fluid mechanics.
CO 3 **Explain** various effects of viscosity, static pressure and surface tension using Newton's law of viscosity, pressure difference and capillary rise.
CO 4 **Apply** the basic laws of conservation for various phenomena of fluid flow systems by understanding appropriate parametric assumptions and limitations.
CO 5 **Demonstrate** several properties and parameters of fluid flow problems based on fluid flow governing equations related to different practical scenarios.
CO 6 **Outline** the regimes and separation of boundary layer during external fluid flow systems.
CO 7 **Compare** the total and hydraulic gradient lines for distinct cases of losses during a closed conduit fluid flow systems.
CO 8 **Explain** the theories, phenomena and working principles of hydraulic machines.
CO 9 **Illustrate** all the variations of the velocity triangles pertaining to the analyses of hydraulic machines.
CO 10 **Solve** the specific and unit indicators for performance of hydraulic machines such as speed, discharge and power numbers.
CO 11 **Identify** the working condition of fluid machines and equipment using various theoretical and experimental procedures of the laboratory.
CO 12 **Apply** the designing procedure of hydraulic machines for real world applications for enhanced performance and minimized losses.

MODULE-I	FLUID STATICS	Classes: 12
Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow.		
MODULE-II	**FLUID KINEMATICS AND DYNAMICS**	**Classes: 12**
Fluid Kinematics: Kinematics of fluid flow- Eulerian and Lagrangian descriptions, Stream line, path line, streak line and stream tube, classification and description of flows for one and three dimensions. Fluid Dynamics: Euler's equation of motion, Bernoulli equation for flow along a stream line and applications, Measurement of flow.		
MODULE-III	**BOUNDARY LAYER CONCEPTS AND CLOSED CONDUIT FLOW**	**Classes: 12**
Concept of boundary layer – Definition, characteristics along thin plate, laminar, transition and turbulent boundary layers, separation of boundary layer, measures of boundary layer thickness. Closed conduit flow: – Darcy Weisbach equation, friction factor, Head loss in pipe flow, Moody's diagram. Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli.		
MODULE-IV	**FLUID MACHINES**	**Classes: 12**
Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.		
MODULE-V	**DIMENSIONAL ANALYSIS AND PUMPS**	**Classes: 12**
Dimensional Analysis: Need for dimensional analysis–methods of dimension analysis, Similitude, types of similitude Dimensionless parameters–application of dimensionless parameters, Model analysis. Pumps: Theory of rotodynamic machines , various efficiencies , velocity components at entry and exit of the rotor, velocity triangles, Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump–working principle.		

Text Books:

4. V. Gupta and S. K. Gupta, Fundamentals of Fluid Mechanics, 4th Edition, New Age International 2011.
5. W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill International Edition 2005.
6. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall of India, 2005.
7. R. W. Fox, P. J. Pritchard and A. T. McDonald, Introduction to Fluid Mechanics, 7th Edition, Wiley-India 2010.
8. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition, 2007.

Reference Books:

1. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", Kotaria & Sons, 9th Edition 2013.
2. Dr. R K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 9th Edition, 2015.
3. B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch, Wiley-India, 6th Edition, 2010.
4. R. L. Panton, Incompressible Flow, , Wiley-India, 3rd Edition, 2005.
5. R. B. Bird, W. E. Stewart and E. N. Lightfoot, Transport Phenomena, 2nd Edition, Wiley- India 2002.

Web Reference:

1. https://nptel.ac.in/courses/112105171/