

**16MEC213 FLUID MECHANICS AND MACHINERY**  
(Common to MECH and EEE Branches)

**Course Educational Objectives:**

- To study and analyze various laws relevant to flow through pipes and hydraulic machines
- To understand the importance of dimensional analysis
- To study and evaluate performance of hydraulic machines

**UNIT- 1: PROPERTIES OF FLUIDS, PRESSURE MEASUREMENTS, BUOYANCY AND KINEMATICS OF FLOW**

**Properties of Fluids:** Introduction - Definition - Mass density - Specific weight - Specific gravity - Specific volume - Compressibility - Surface tension and capillarity. **Pressure and its Measurements:** Variation of static pressure - Atmospheric, absolute, gauge and vacuum pressure - Pressure measurements - Piezometer - U tube manometer - Differential manometers. **Buoyancy and Floatation:** Basic concepts of Buoyancy, buoyancy force, centre of buoyancy, metacentre and metacentric height. **Kinematics of Flow:** Basic principles of fluid flow - Types of fluid flow - Rate of flow - Continuity equation - Velocity and acceleration - Velocity potential function - Stream function - Equipotential lines.

**UNIT – 2: DYNAMICS OF FLUID FLOW, BOUNDARY LAYER THEORY FORCES ON SUBMERGED BODIES AND FLOW THROUGH PIPES**

**Dynamics of Fluid Flow:** Equations of motion - Euler's equation of motion - Bernoulli's equation - Bernoulli's equation for real fluid - Application of Bernoulli's equation in venturimeter, orifice meter and pitot tube - Application of momentum equation and pipe bend. **Boundary Layer Theory:** Boundary layer characteristics - Types of boundary layer - Boundary layer, displacement, momentum and energy thickness. **Forces on Submerged bodies:** Expression for Drag and Lift – Drag on a sphere – Terminal velocity – Development of lift on an airfoil. **Flow Through Pipes:** Reynold's experiment - Loss of energy in pipes - Loss of energy due to friction: Darcy's Weisbach equation and Chezy's formula - Minor energy losses - Hydraulic gradient and energy gradient line - Siphon - Pipes in series and parallel - Equivalent pipe.

**UNIT – 3: DIMENSIONAL ANALYSIS AND TURBO MACHINERY**

**Dimensional Analysis and Hydraulic Modeling:** Dimensions - Dimensional homogeneity - Rayleigh method - Buckingham  $\pi$ -method - Methods of selecting repeating variables - Model analysis - Similitude and types of similarities - Forces acting in moving fluid - Dimensionless numbers - Similarity laws - Model testing of partially submerged bodies - Distorted and undistorted models. **Basics of Turbo Machinery:** Force exerted by the jet on a stationary and moving of flat, inclined and curved vanes - Jet on a hinged plate - Jet striking centrally and at tip of moving curved plate - Jet striking series of flat and radial curved vanes.

**UNIT – 4: HYDRAULIC TURBINES**

**Hydraulic Turbines:** Turbine - Layout of hydroelectric power plant - Heads and efficiencies of a turbine - Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan turbine - Working principles - Velocity triangle diagrams - Work done - Heads and efficiencies - Hydraulic

design - Draft tube - Unit quantities and specific speed - Characteristics curves - Governing of turbines - Water hammer - Surge tank.

### **UNIT – 5: HYDRAULIC PUMPS**

**Centrifugal pumps:** Classification – Principles of working - Work done - Heads and efficiencies of a centrifugal pump - Minimum starting speed - Multi stage centrifugal pump - Specific speed - Model testing - Priming - Characteristics curves - Cavitation - Suction height - NPSH. **Reciprocating pumps:** Classification and working - Discharge - Slip - Indicator diagrams - Air vessels.

#### **Course Outcomes:**

- ✓ Upon completion of this course, the students will be able to apply mathematical knowledge to solve problems in flow of fluids and also critically analyse the performance of pumps and turbines.

#### **Text Books:**

1. Hydraulics and Fluid Mechanics, Dr.P.N. Modi and Dr.S.M. Seth, 18/e, Standard Book House, Delhi, 2011.
2. Fluid Mechanics, Dr.A.K. Jain, 11/e, Khanna Publishers, New Delhi, 2012.

#### **Reference Books:**

1. Fluid Mechanics and Hydraulic Machinery, R.K. Rajput, 4/e, S. Chand & Company, Pvt. Ltd., New Delhi, 2010.
2. Fundamentals of Fluid Mechanics, Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, 5/e, McGraw - Hill, New York, 2008.
3. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, 9/e, Laxmi Publications (P) Ltd, 2011.
4. Fluid Mechanics, Yunus A. Cengel, Tata McGraw Hill Education Private, 2010.
5. Introduction to Fluid Machines, S.K. Som and G. Biswas, 2/e, Tata McGraw-Hill Education, Pvt. Ltd., Noida, 2010.