FLUID MECHANICS

UNIT I - FLUID PROPERTIES AND HYDROSTATIC FORCES

Introduction - Introduction to fluid, Distinction between solid and fluid, Liquid and gas as a fluid, Fluid mechanics, Applications of fluid mechanics in civil engineering**. Physical properties of fluids –**Density, Specific gravity, Specific weight, Spefici volume, Temperature, Viscosity, Newton's law of viscosity, Surface tension, Capillarity, Capillary rise and fall, Vapour pressure and their influences on fluid motion pressure at a point, Units and dimension, problems based on properties of fluids. **Concept of fluid static pressure**- Fluid statics, Pressure, Pascal's law, Hydrostatic law, pressure head, Atmospheric, Gauge and Vacuum pressure, problems on pascal's law. **Measurement of pressure** - Pressure gauges, Simple manometers, U-tube manometer, Single column manometers, Differential manometers, Inverted U-tube differential manometer, Micro manometer, Problems related to pressure measurement. **Hydrostatic Forces -** Hydrostatic forces on submerged plane, Horizontal, Vertical, inclined and curved surfaces, Center of pressure, Derivations and problems**.**

UNIT II - FLUID KINEMATICS

Introduction to fluid kinematics – Fluid kinematics, Description of fluid flow**. Classification of flows**- Steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Rotational and Irrotational flows. **Velocity and acceleration field**- Scalar and vector fields, velocity components, acceleration components, Problem related to velocity and acceleration. **Continuity equation** – Rate of flow, discharge, Equation of continuity for one, two , three dimensional flows, Problems based on continuity equation. **Flow visualization -** Stream line, Path line, Streak lines and Stream tube, Vortex flow.**Stream and velocity potential functions** - Relation between stream function and velocity potential function, Equipotential line and steam line, flow net analysis, Circulation and vorticity, Types of motion, Problems on velocity potential function and stream function.

UNIT III - FLUID DYNAMICS

Introduction – Fluid dynamics, Surface and body forces. **Bernoulli's equation** - Equation of motion, Euler's and Bernoulli's equations for flow along a stream line for 3D flow, Bernoulli's equation for real fluids, Navier stokes equations, problems based on Bernoulli's equation. **Momentum equation** - Linear momentum equation and its application, Problems – forces on pipe bend. **Applications of Bernoulli's equation** - Pitot tube, Venturi meter and orifice meter, problems on applications of Bernoulli's equation. **Orifice** - classification of orifices, Flow through on orifice, Hydraulic coefficicients, Discharge through a large rectangular orifice, Discharge through fully submerged orifice, Discharge through partially submerged orifice, problems. **Notches and weir** - Introduction to notches and weir, Classification of notch, Classification of weir Flow over rectangular, Triangular, Trapezoidal and Stepped notches –Broad crested weirs, Problems.

UNIT IV - BOUNDARY LAYER THEORY

Boundary layer theory - The Navier Stokes and Euler equations, Prandtl contribution to boundary layer, Introduction to boundary layer Classification of boundary layer, Characteristics of boundary layer along a thin flat plate, Zones of boundary layer. **Boundary layer thickness** - Displacement thickness, Momentum thickness, Energy thickness. Drag force - Drag force on a flat plate due to boundary layer, Turbulent boundary layer on flat plate, Total drag on a flat plate due to laminar and turbulent boundary layer, Vonkarmen momentum integralequation, laminar and turbulent Boundary layers (no deviation). **Boundary layer separation** - BL in transition, separation of BL, control ofBL, Effect of pressure gradient, Location of separation point and disadvantages, Problem based on boundary layer separation. **Flow of fluid around submerged bodies** - Force exerted by a flowing fluid on a stationary body, Expression for drag and lift, Magnus effect, Problems.

UNIT V - CLOSED CONDUIT FLOW

Characteristics of laminar and turbulent flow - Reynold's experiment,Reynold's number, Significance of Reynold's number, Laminar flow, Characteristics of laminar flow, Turbulent flow, Characteristics of turbulent flow. **Flow of viscous fluid through circular pipe** – problems. **Flow of viscous fluid between two parallel plates** - problems. **Turbulent flow –** Shear stress in turbulent flow, Velocity distribution in turbulent flow in pipes, Hydrodynamically smooth and rough boundaries, Velocity distribution for turbulent flow in smooth pipes, Velocity distribution for turbulent flow in rough pipes, Problems. **Flow through pipes** - Loss of energy in pipes, Major loss in pipe, Pipe roughness, Moody's Chart, Minor energy losses, Loss of head due to sudden enlargement, Loss of head due to sudden contraction, Loss of head at the entrance of a pipe, Loss of head at the exit of a pipe, Loss of head due to an obstruction in a pipe, Other minor losses in pipe, Hydraulic gradient and total energy, Problems on losses of flow in pipe. **Flow through pipes in series and parallel** - Flow through parallel pipes, Flow through pipes in series, Equivalent pipe, Problems.