

XE	Engineering Sciences
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XE1: Fluid Mechanics**Section XE1.1: Classification of Flows**

Concept of a fluid, Viscous versus inviscid flows, Concept of viscosity, Newtonian versus non-Newtonian fluid, Incompressible versus compressible flows, Internal versus external flows, Steady versus unsteady flows, Laminar versus turbulent flows.

Section XE1.2: Hydrostatics

Buoyancy, Manometry, Forces on submerged bodies and their stability.

Section XE1.3: Kinematics of Fluid Motion

Eulerian and Lagrangian descriptions of fluid motion, Concept of local, Convective and material derivatives, Streamline, Streakline, and Pathline.

Section XE1.4: Integral Analysis for a Control Volume

Reynolds Transport Theorem (RTT) for conservation of mass and linear momentum.

Section XE1.5: Differential Analysis

Differential equations of mass and momentum for incompressible flows, Euler equation, Bernoulli equation and its application for venturi meter, Pitot-static tube, and Orifice meter.

Navier-Stokes equation and its exact solutions for Couette flow and Poiseuille flow.

Concept of fluid rotation, Vorticity, Stream function, and Circulation.

Section XE1.6: Dimensional Analysis

Concept of similarity, Buckingham Pi theorem and its applications. Dimensionless groups and their physical significance - Reynolds number, Froude number, and Mach number.

Section XE1.7: Internal Flows

Fully developed pipe flow - Friction factor, Darcy-Weisbach relation and Moody's chart, Major and minor losses. Concept of flow development.

Section XE1.8: Potential Flows

Velocity potential function, Uniform flow, Source, Sink, and Vortex.

Section XE1.9: External Flows

Concept of Prandtl boundary layer, Boundary layer thickness, Displacement thickness and momentum thickness. Qualitative idea of boundary layer separation, Streamlined and bluff bodies, Drag and lift forces.