Fluid Mechanics

Section 1: Flow and Fluid Properties

viscosity, relationship between stress and strain-rate for Newtonian fluids, incompressible and compressible flows, differences between laminar and turbulent flows. **Hydrostatics:** Buoyancy, manometry, forces on submerged bodies.

Section 2: Kinematics

Eulerian and Lagrangian description of fluids motion, concept of local and convective accelerations, steady and unsteady flows.

Section 3: Integral analysis

Control volume analysis for mass, momentum and energy.

Section 4: Differential Analysis

Differential equations of mass and momentum for incompressible flows: inviscid - Euler equation and viscous flows - Navier-Stokes equations, concept of fluid rotation, vorticity, stream function, Exact solutions of Navier-Stokes equation for Couette Flow and Poiseuille flow.

Section 5: Inviscid flows

Bernoulli's equation - assumptions and applications, potential function, Elementary plane flows - uniform flow, source, sink and doublet and their superposition for potential flow past simple geometries.

Section 6: Dimensional analysis

Concept of geometric, kinematic and dynamic similarity, some common non-dimensional parameters and their physical significance: Reynolds number, Froude number and Mach number.

Section 7: Internal flows

Fully developed pipe flow, empirical relations for laminar and turbulent flows: friction factor and Darcy-Weisbach relation.

Section 8: Prandtl boundary layer equations

Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces. **Flow measurements:** Basic ideas of flow measurement using venturimeter, pitot-static tube and orifice plate.