Introduction to Fluid Mechanics

Fluid

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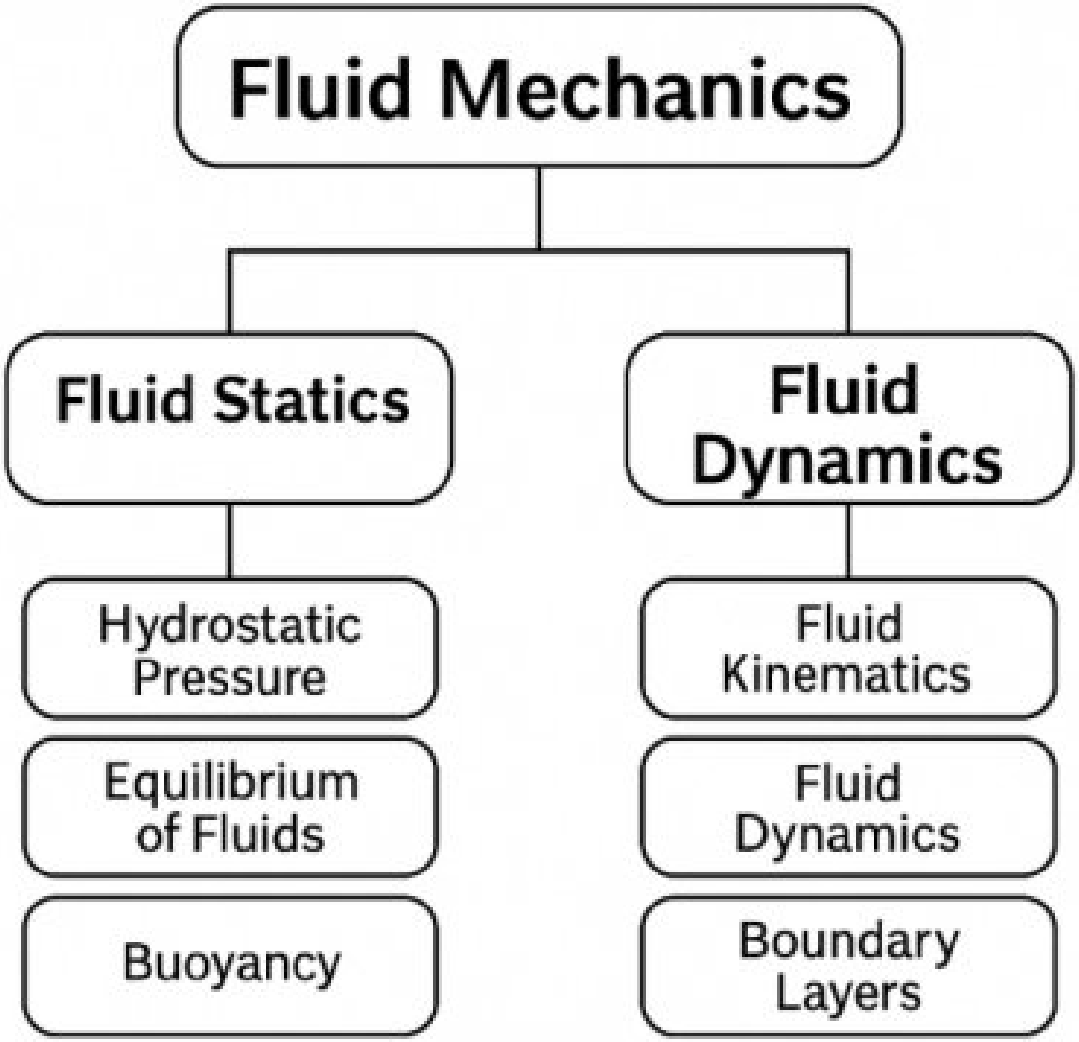
Fluid Mechanics is a branch of engineering and physical science concerned with the behavior of fluids—liquids and gases—either at rest or in motion.

It is broadly classified into:

- **Fluid Statics:** Study of fluids at rest
- **Fluid Dynamics:** Study of fluids in motion

Branches of Fluid Mechanics



Branches of Fluid Mechanics

Fluid Statics vs Fluid Dynamics

Fluid Statics deals with:

- Pressure variation in a fluid at rest
- Buoyancy and hydrostatic forces

Fluid Dynamics focuses on:

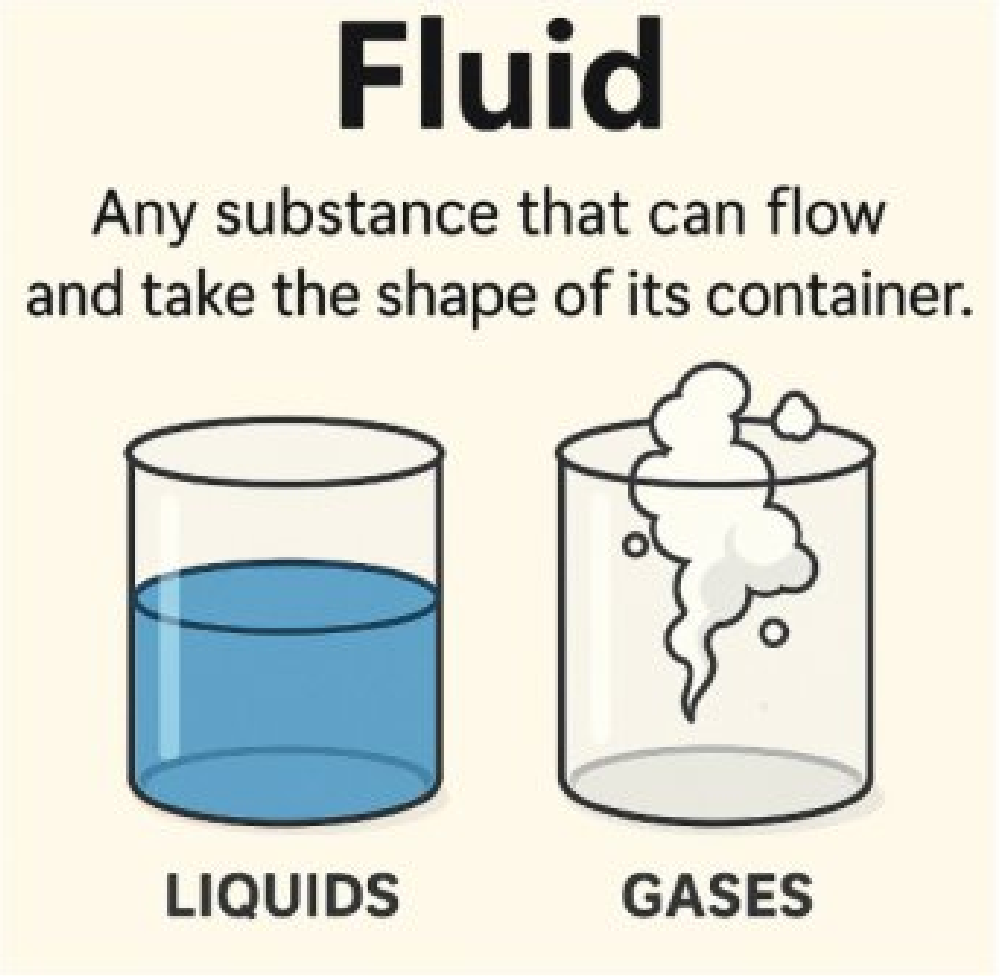
- Velocity and acceleration of fluids
- Conservation of mass, momentum, and energy
- Viscous vs inviscid flow, laminar vs turbulent flow

What is a fluid?

Definition: A fluid is any substance that deforms continuously under the application of a shear stress, no matter how small.

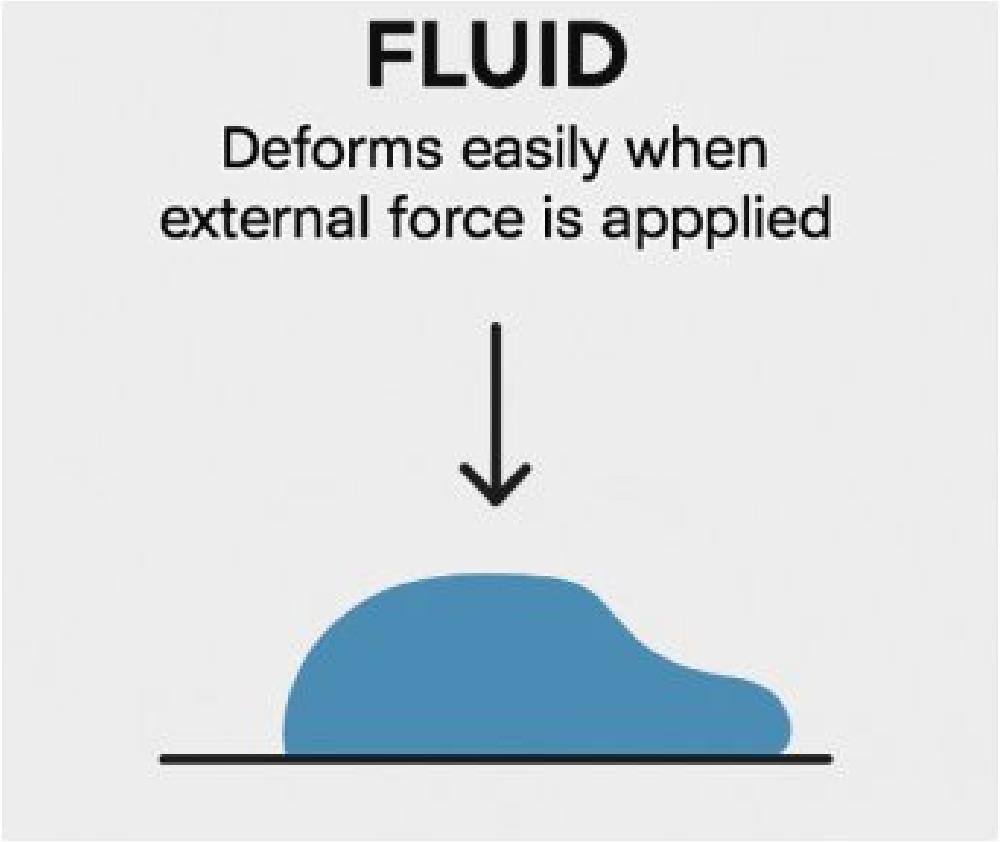
Examples:

- Liquids (e.g., water, oil)
- Gases (e.g., air, steam)



Fluids conform to the shape of containers

Fluid Deformation Under Force



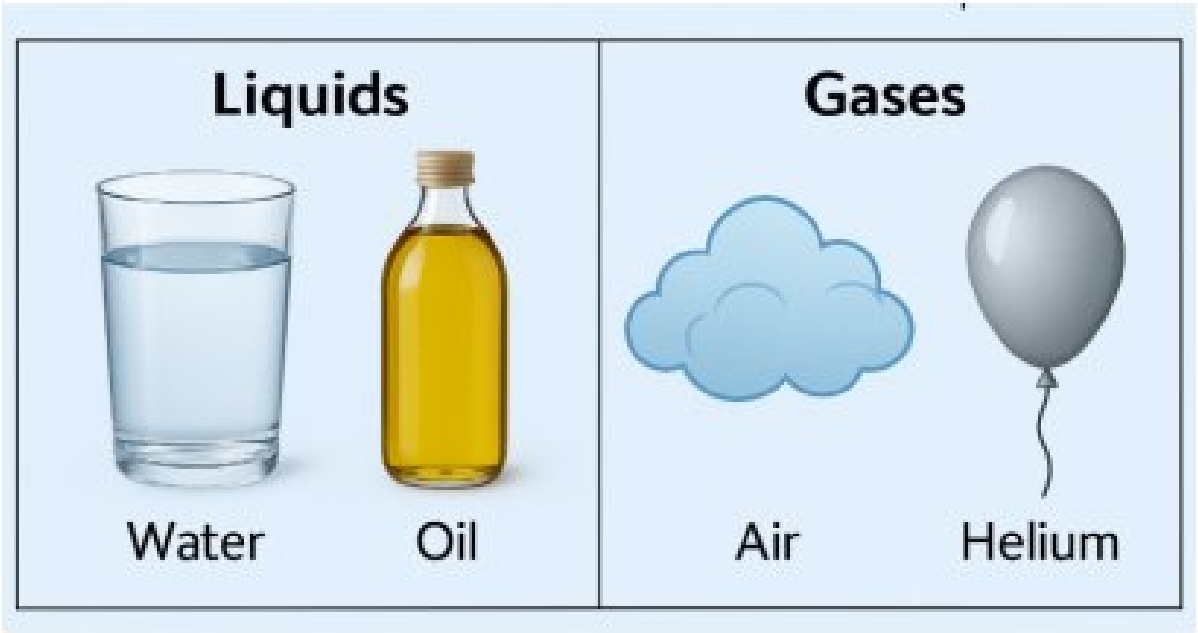
Fluids spread or flow under force

Concept: Fluids cannot sustain shear force.

Applications:

- Fluid flow modeling
- Biomedical fluids
- Nanofluid design in heat transfer

Examples of Fluids



Natural and engineered fluids

- Air, Oxygen, Carbon dioxide
- Water, Oil, Milk
- Blood, Plasma
- Nanofluids (engineered fluids)

Basic Properties of Fluids

- **Density (ρ):** Mass per unit volume [kg/m^3]
- **Viscosity (μ):** Resistance to flow, internal friction
- **Surface Tension (σ):** Force at liquid surface
- **Compressibility:** Ability to change volume under pressure
- **Temperature:** Affects viscosity and density

Why Study Fluids?

- Essential in designing efficient systems (pipes, engines, HVAC)
- Used in medical modeling (e.g., blood flow, cancer treatment)
- Helps in weather prediction and oceanography
- Important in renewable energy (solar, wind, hydro)

Thank You!

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