

Flow of Fluids

Flow of Fluids: Introduction

- Fluid flow is the movement of a fluid (liquid or gas) from one location to another.
- It can be characterized based on various parameters such as velocity, pressure, and the type of fluid.
- Understanding fluid flow is essential in numerous engineering applications, including hydraulics, aerodynamics, and process engineering.
- Fluid flow refers to the movement of liquids and gases.
- **It can be classified into:**
 1. **Laminar Flow:** Smooth, orderly flow where fluid particles move in parallel layers.
 2. **Turbulent Flow:** Chaotic, irregular flow with mixing of fluid particles.
 3. **Transitional Flow:** Between laminar and turbulent, with characteristics of both.

Fluid Pressure

- Fluid pressure is the force exerted by a fluid per unit area.
- It's a scalar quantity and acts equally in all directions.
 1. **Static Pressure:** The pressure exerted by a fluid at rest.
 2. **Dynamic Pressure:** The pressure due to fluid motion, related to the fluid's kinetic energy.
 3. **Total Pressure:** The sum of static and dynamic pressures.

Types of Manometers

- Manometers are devices used to measure the pressure of fluids by balancing the fluid column against a known pressure.



1. Simple Manometer:

A. Piezometer:

- Measures the pressure of a liquid column, usually open to the atmosphere.

B. U-tube Manometer:

- Comprises a U-shaped tube filled with a liquid (often mercury or water) where one end is connected to the fluid whose pressure is to be measured, and the other is open to the atmosphere or connected to another pressure source.

2. Differential Manometer:

- Used to measure the difference in pressure between two points in a fluid system.

A. U-tube Differential Manometer:

- Similar to the U-tube manometer but both ends are connected to different points in the system.

B. Inverted U-tube Manometer:

- Inverted U-shape used for measuring small pressure differences in gases.

3. Inclined Manometer:

- A U-tube manometer with one leg inclined to increase sensitivity and accuracy in measuring small pressure differences.

Reynolds Number and Its Significance

- **Reynolds number (Re)** is a dimensionless number that predicts flow patterns in different fluid flow situations.
- It is defined as:

$$Re = \frac{\rho v L}{\mu} = \frac{v L}{\nu}$$

Where:

- ρ = fluid density
- v = fluid velocity
- L = characteristic length (e.g., diameter of a pipe)
- μ = dynamic viscosity of the fluid
- ν = kinematic viscosity of the fluid

Significance:

- **Re < 2000:** Laminar flow (smooth and orderly flow).
- **2000 < Re < 4000:** Transitional flow (mix of laminar and turbulent flow).
- **Re > 4000:** Turbulent flow (chaotic and irregular flow).

Bernoulli's Theorem and Its Applications

- **Bernoulli's Theorem** states that for an incompressible, frictionless fluid, the total mechanical energy along a streamline is constant.
- Mathematically,

$$P + \frac{1}{2} \rho v^2 + \rho g h = \text{constant}$$

where:

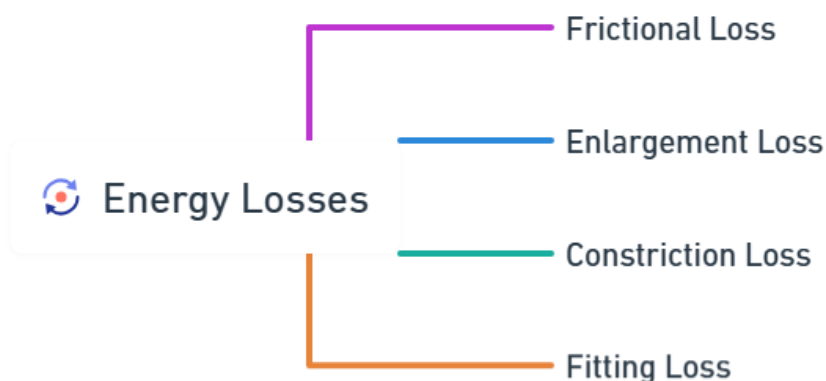
- P = static pressure
- ρ = fluid density
- v = fluid velocity
- g = acceleration due to gravity
- h = height above a reference point

Applications:

1. **Venturi meter:** Measures fluid flow rate by using a constriction in the pipe.
2. **Orifice Meter:** Measures flow rate by reducing the cross-sectional area.
3. **Pitot Tube:** Measures fluid flow velocity by converting kinetic energy into potential energy.
4. **Aircraft Design:** Determines pressure distribution over wings.

Energy Losses

- Energy losses during the flow of fluid through a system occur due to various factors.
- Here are the main types of losses:



1. Frictional Loss:

- Occurs due to the friction between the fluid and the pipe walls.
- Depends on the flow velocity, pipe diameter, fluid viscosity, and pipe roughness.
- Calculated using the Darcy-Weisbach equation:



FREE PREVIEW

[Click here to visit our website](#)

PHARMACY PREMIUM NOTES

Complete subject
and semesters are
available on
FirstHope app only.



[Scan or click here](#)

Click here to get the app



Available on Google Play

JOIN THE FIRSTHOPE COMMUNITY

Join our Telegram channel

Click here to join Telegram



[Scan or click here](#)

@FirstHopeNotes

Instagram

@firsthope.official

[Click here to follow >](#)

YouTube channel

FirstHope-Pharmacy / Live streams

[Click here to watch >](#)

WhatsApp channel

Follow FirstHope on WhatsApp

[Click here to join >](#)

FirstHope website

firsthopenotes.com

[Click here to visit >](#)

B.Pharm / D.Pharm / M.Pharm / Pharm.D

Preview notes. Complete subjects and semesters in the FirstHope app.