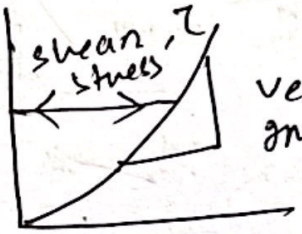
Q. What is fluid mechanics? State the Newton's law of viscosity. Write the differences b/w Dynamic & kinematic viscosity. Or, what is viscosity? Derive & discuss the Newton's law of viscosity.

→ Fluid mechanics: It is a branch of Engineering where deals with fluid motion (statics/dynamics).

Newton's law of viscosity: Shear stress is proportional to the negative value of the velocity gradient.

$$\tau \propto -\frac{du}{dy}$$

$$\tau = -\mu \frac{du}{dy}$$




Dynamic viscosity: $\mu = \frac{\text{shear stress}}{\text{velocity gradient}} = \frac{\tau}{du/dy}$

kinematic viscosity: $\nu = \frac{\mu}{\rho} = \frac{\text{dynamic viscosity}}{\text{density}}$

Q. Write down the effect of temperature on viscosity.

Temperature $\propto \frac{1}{(\text{viscosity})_{liquid}}$

Temp. ↑ viscosity of liquid ↓

" ↓ " ↑

Temperature $\propto$ (viscosity)$_{gas}$

Temp. ↑ (viscosity)$_{gas}$ ↑

" ↓ " ↓

Q. Write down the difference among pump, compressor, Blower and Fan.

| | Flow Rate (Q) | Pressure Rise ($\Delta P$) |
|---|---|---|
| Pump | High | High |
| Fan | High | Low |
| Blower | High | Moderate |
| Compressor | Low | High. |

Q. What is the basic difference b/w a pump and a turbine.

| Pump | Turbine |
|---|---|
| Mechanical Energy → Hydraulic energy | Hydraulic Energy → Mechanical energy |

Q. How do you measure flow rate in a closed pipe.

1. Velocity meter technology
   - Turbine meters
   - Propeller meters
   - Vortex meters
   - Magnetic flow meters
   - Ultrasonic flow meters
   - Calorimetric meters

2. Pressure meter technology
   - Elbow meters
   - Orifice meters
   - Venturi meters
   - Flow nozzle
   - Flow tubes
   - Pitot tubes
   - Target meters.

Q. Write down the application of following equipments: Anemometer, Dynamometer, Tachometer, Manometer, Pyrometer, Orifice meter, Rotameter, Pitot tube.

→ Anemometer: Used to measure the wind velocity & its direction.

Dynamometer: Used to measure the output power of an engine.

Tachometer: Used to measure the rpm of a shaft.

Manometer: Used to measure the pressure of the fluid.

Pyrometer: Used to measure the high temperature.

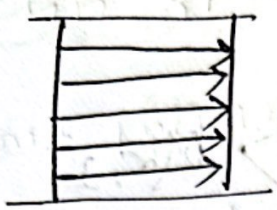
Rotameter, Orificemeter: Used to measure the flow rate of fluid.

Pitot tube: Used to measure the velocity of fluid.

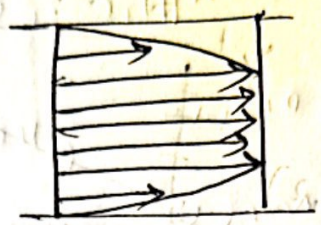
Q. Explain briefly the types of fluid flow.

→

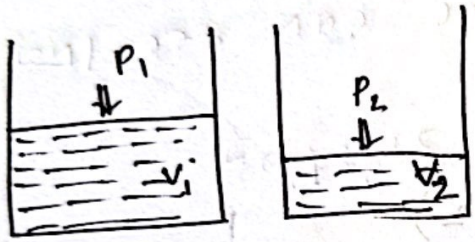
01. Ideal flow



02. Real flow

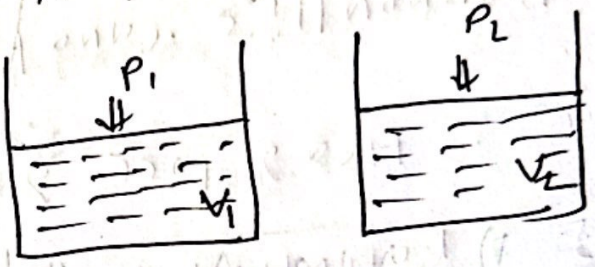


03. Compressible flow




$\rho \neq$ const

04. Incompressible flow




$\rho$ = const

05. Steady flow

$\frac{dv}{dt} = 0$ → no change in velocity with respect to time

06. Unsteady flow

$\frac{dv}{dt} \neq 0$ → change in velocity with respect to time.

07. Uniform flow

$\frac{dv}{ds} = 0$ → no change in velocity with respect to space

08. Non-Uniform flow

$\frac{dv}{ds} \neq 0$ → change in velocity with respect to space

07. Rotational flow

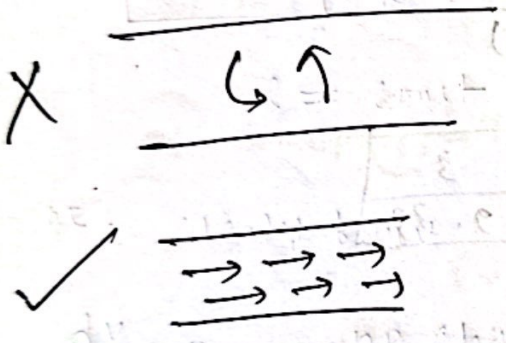
fluid rotates about its own axis

08. Irrotational flow

fluid rotates about its own axis.

09. Laminar flow

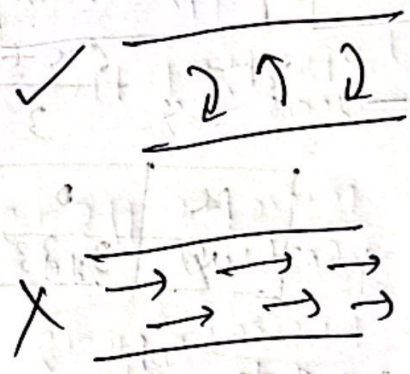
i) smooth, Regular, Organised flow



ii) streamlines are parallel

10. Turbulent flow

i) Happazard. Irregular, disorganised flow



ii) streamlines are not parallel.

Q. Define : Mass density, weight density. Specific volume, Specific gravity.

→ See Fluid mechanics pdf (page : 5, 6).

Q. Write Bernoulli's equation for ideal & real fluid, and indicate every term. Is it an energy equation you think? If yes, then explain.

→ Bernoulli's equations:

for ideal fluid: $\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$

for real fluid: $\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + h_f$.

$\frac{P_1}{\rho g}$ = Pressure Head

$\frac{V_1^2}{2g}$ = Kinetic Head

$Z$ = Potential Head

$h_f$ = Head loss due to friction

From Bernoulli's equation, we can see that,

Pressure head comes from pressure energy

Kinetic head comes from kinetic energy

Potential head comes from potential energy

That's why Bernoulli's equation is an energy equation.

—o—