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Fluids in Motion

* Hydrodynamics :- The branch of physics which deals with the study of properties of fluids in motion is called hydrodynamics.

* steady flow :- Measurable property, such as pressure or velocity of the fluid at a given point is constant over time.

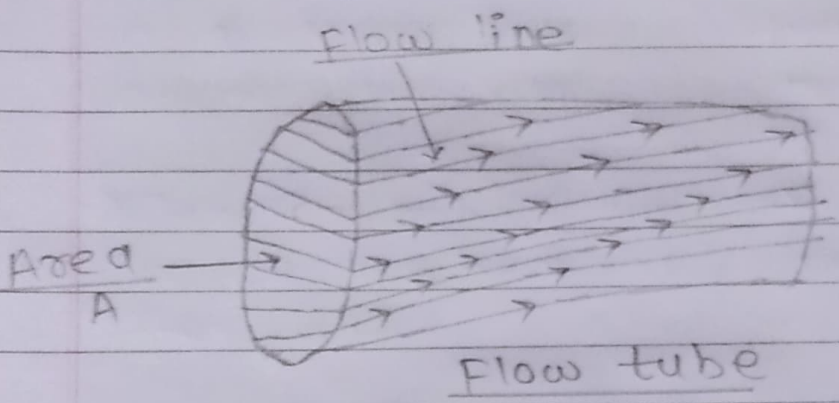

Fig Flow lines and flow tube

* Flow line :- It is the path of an individual particle in a moving fluid.

* streamline : It is a curve whose tangent at any point in the flow is in the direction of the velocity of the flow at that point. Streamlines and flow lines are identical ~~for~~ a steady flow.

* Flow tube :- It is an imaginary bundle of flow lines bound by an imaginary wall. For a steady flow, the fluid cannot cross cross the walls of a flow tube. Fluids in adjacent flow tubes cannot mix.

* Laminar flow/ streamline flow :- It is a steady flow in which adjacent layers of a fluid move smoothly over each other A steddy flow of river can be assumed to be a laminar flow.

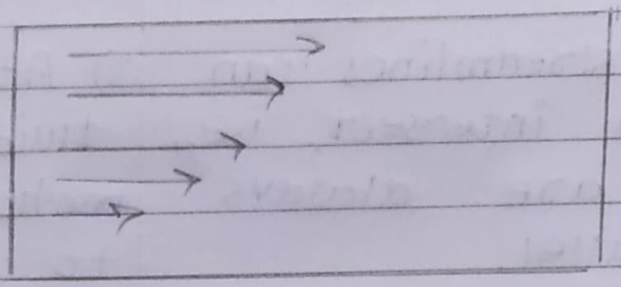

Fig streamline flow

* Turbulent flow :- It is a flow at a very high flow rate so that there is no steady flow and the flow pattern changes continously A flooded river flow or a tap running very fast is a turbulent flow.

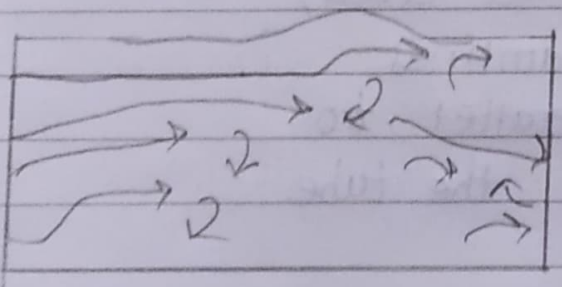

Fig Turbulent flow

Streamline flow	Turbulent flow
1) The smooth flow of a fluid, with velocity smaller than certain critical velocity is called streamline flow.	1) The irregular and unsteady flow of a fluid when its velocity increases beyond critical velocity is called turbulent flow.
2) velocity of a fluid at a given point is always constant	2) The velocity of a fluid at any point do not remain constant
3) Two streamlines can never intersect, i.e., they are always parallel.	3) At some points, the fluid may have rotati motion which gives ri to eddies.
4) Streamline flow over a plane surface can be assumed to be divided into a number of plane layers. In a flow of liquid through a pipe of uniform cross sectional area, all the streamlines will be parallel to the axis of the tube.	4) A flow tube loses its order and particles move in random direction.

Critical velocity and Reynolds numbers :-

The velocity beyond which a streamline flow becomes turbulent is called critical velocity.

critical velocity is given by

$$v_c = \frac{R_n \eta}{\rho d} \qquad \text{——— (1)}$$

where,

v_c = critical velocity of the fluid
R_n = Reynolds numbers
η = coefficient of viscosity
ρ = density of fluid
d = diameter of tube

$$v_c = \frac{R_n \eta}{\rho d}$$

$$v_c \rho d = R_n \eta$$

$$\frac{v_c \rho d}{\eta} = R_n$$

$$\boxed{R_n = \frac{v_c \rho d}{\eta}} \qquad \text{——— (II)}$$