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MATRIC NO: 15/SCI14/010

DEPARTMENT: CHEMICAL ENGINEERING

COURSE CODE: CHE 311

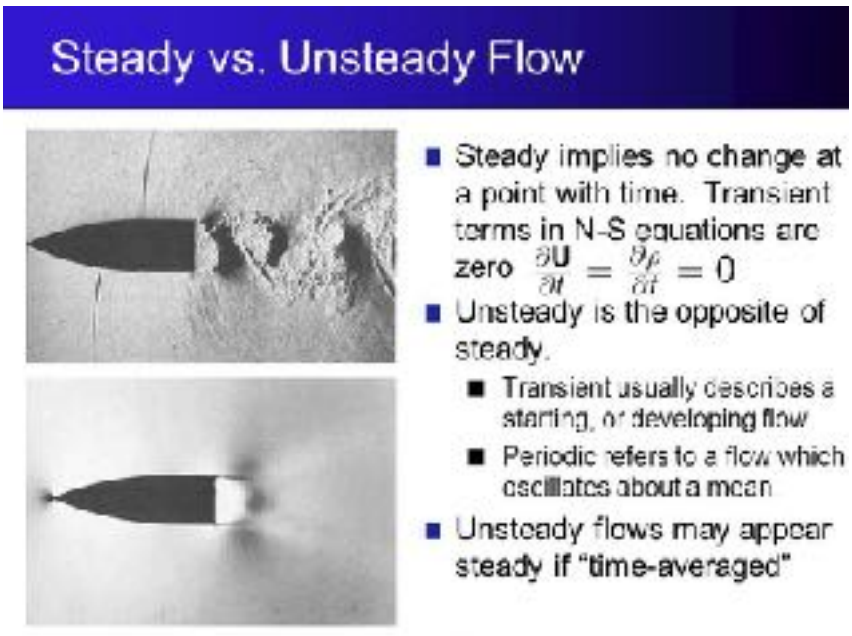
COURSE :TRANSPORT PHENOMENA I : FLUID FLOW

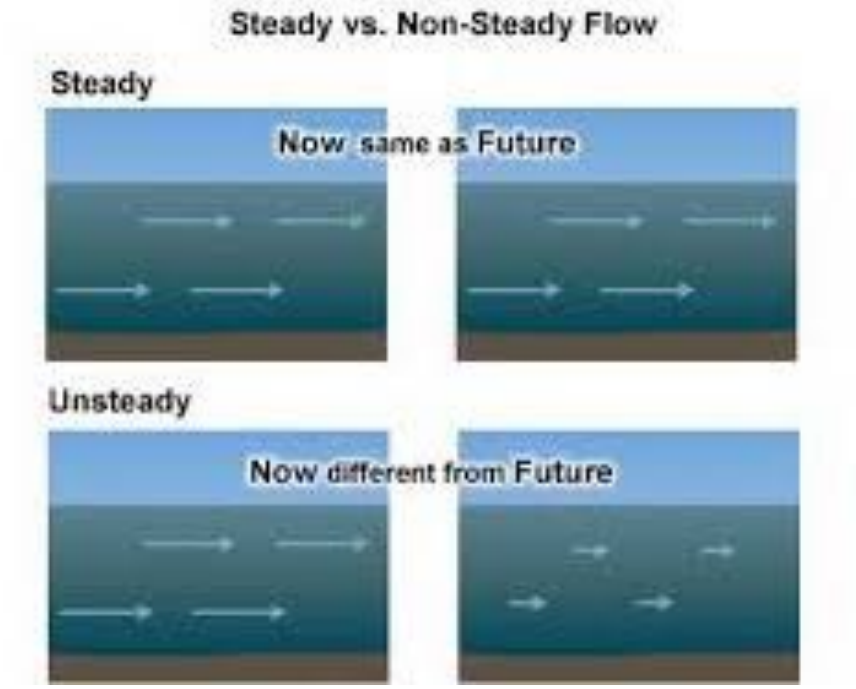
CLASSIFICATION OF FLOW

1. STEADY AND UNSTEADY FLOW

i. **Steady flow**: Steady flow is defined as that in which the various parameters at any point do not change with time. Steady flow is one in which all conditions at any point in a stream remain constant with respect to time.

ii. **Unsteady flow**: Unsteady flow is a transient phenomenon. Flow in which changes with time do occur is termed unsteady or non-steady. A flow in which quantity of liquid flowing per second is not constant, is called unsteady flow.

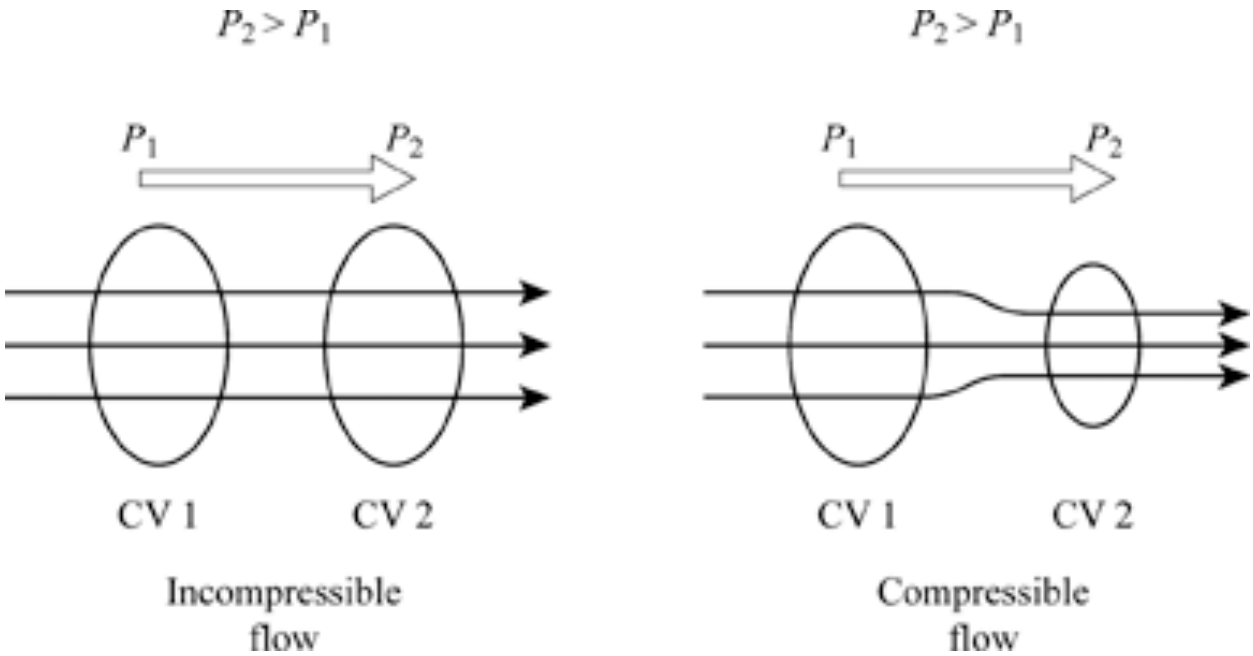


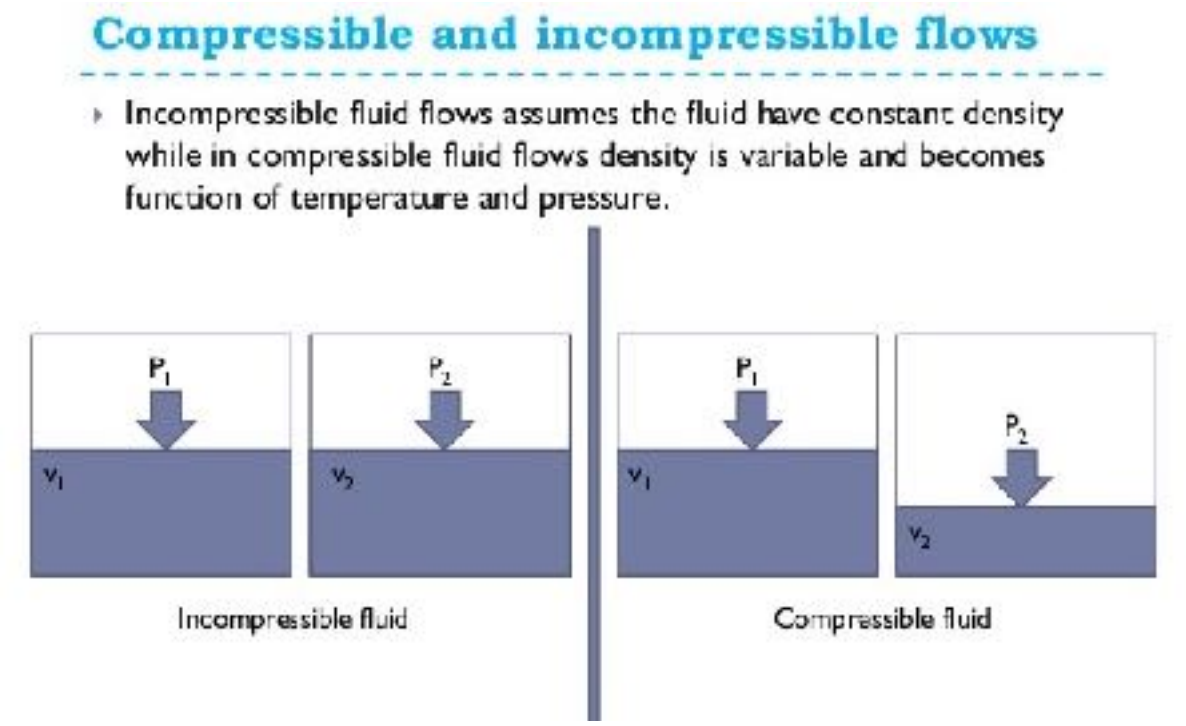


3. COMPRESSIBLE AND INCOMPRESSIBLE FLOW

i. **Compressible flow**: When a fluid flow is compressible, the fluid density varies with its pressure. Compressible flows are usually high speed flows

ii. **Incompressible flow**: Incompressible flows do not have a variation of density. Fluid density is constant and changes from point to point.

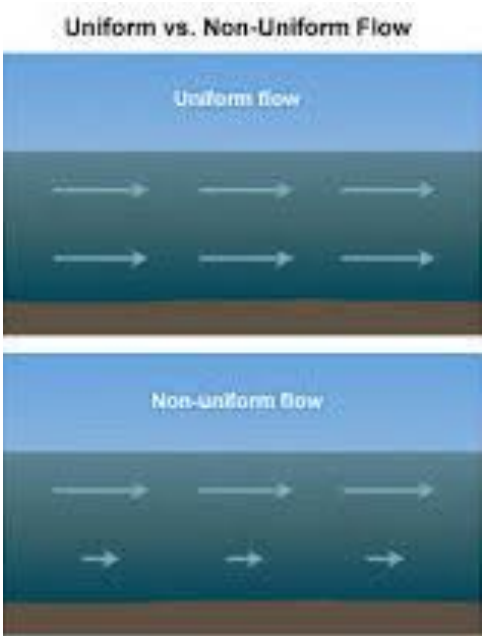




3. UNIFORM AND NON-UNIFORM FLOW

i. **Uniform flow:** Flow is said to be uniform, when the velocity of flow does not change either in magnitude or in direction at any point in a flowing fluid, for a given time. The flow is defined as uniform flow when in the flow field the velocity and other hydrodynamic parameters do not change from point to point at any instant of time.

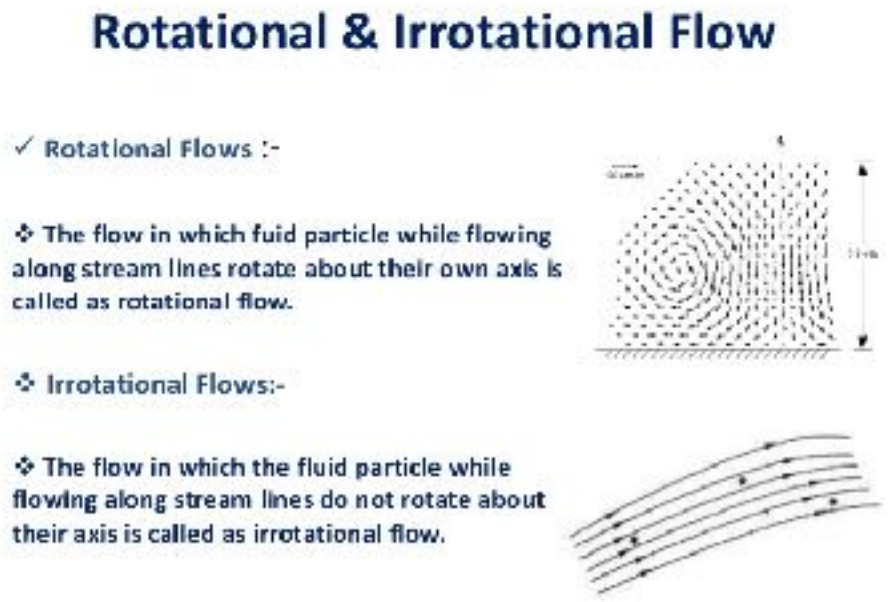
ii. **Non Uniform flow:** Flow is said to be non-uniform, when there is a change in velocity of the flow at different points in a flowing fluid, for a given time. For example, the flow of liquids under pressure through long pipelines of varying diameter is referred to as non-uniform flow.

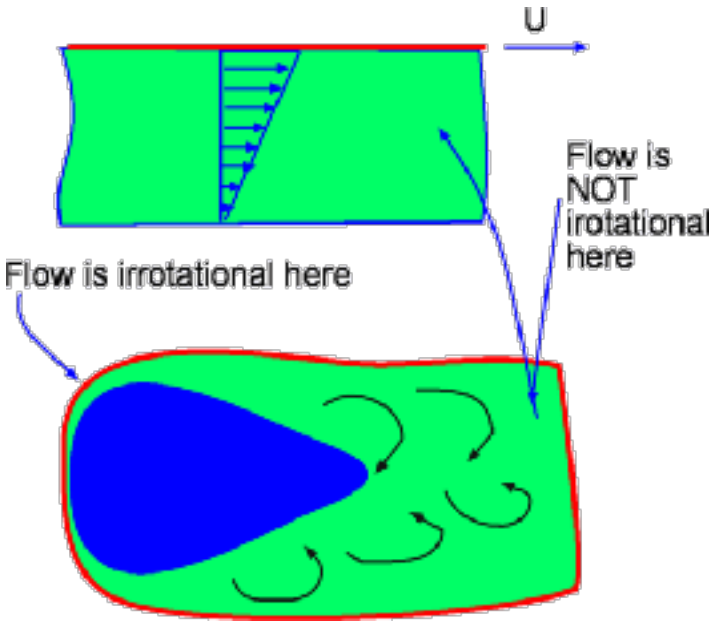


4. ROTATIONAL AND IRROTATIONAL FLOW

i. **Rotational flow**: The flow in which the fluid particles also rotate about their own axes while flowing, is called rotational flow. A flow in which net rotation of the fluid element is not equal to zero, is known as rotational flow.

ii. **Irrotational flow**: The flow in which fluid particles do not rotate about their own axes and retain their original orientations, is called an irrotational flow. If the net rotation of the fluid element is equal to zero, then the flow is known as irrotational flow.

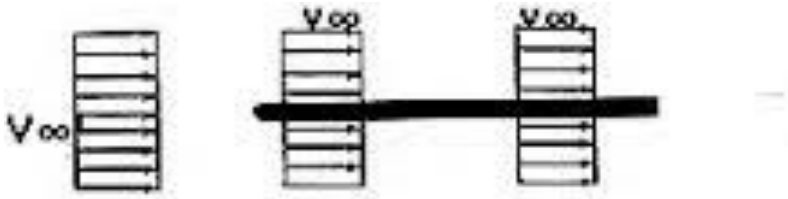




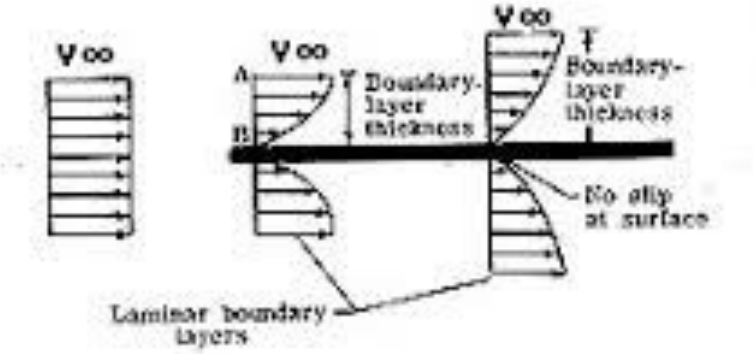
5. VISCOUS AND INVISCID FLOW

i. **Viscous flow**: A type of fluid flow in which there is a continuous steady motion of the particles, the motion at a fixed point always remaining constant.

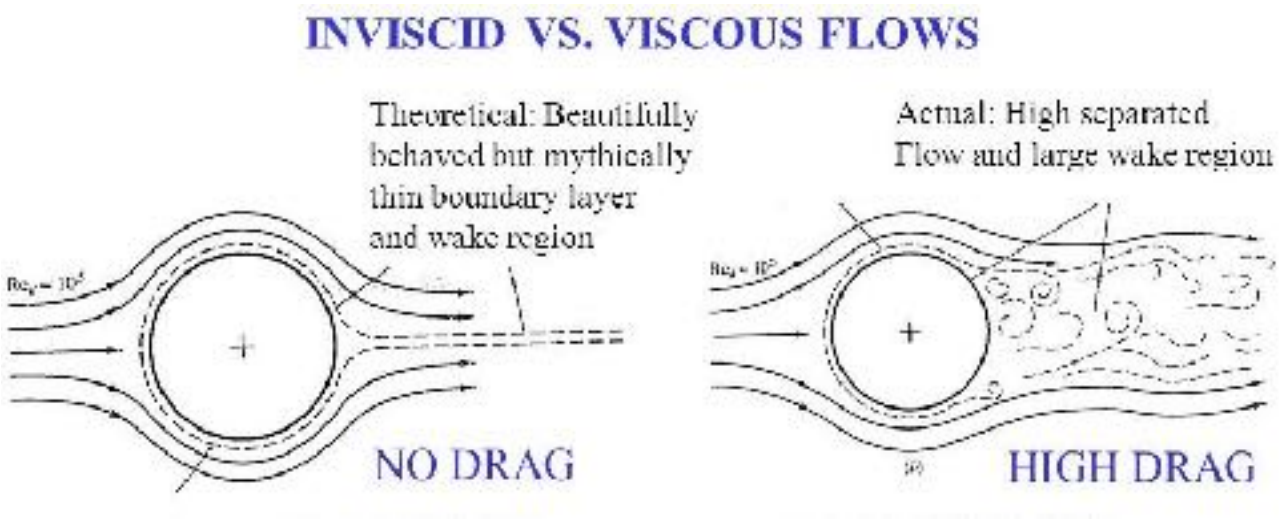
ii. **Inviscid flow**: Inviscid flow is the flow of an inviscid fluid, in which the viscosity of the fluid is equal to zero. The fluid itself need not have zero viscosity for inviscid flow to occur.



(a) Inviscid flow along a flat plate.



(b) Viscous flow along a flat plate.



6. SEPARATED AND UNSEPARATED FLOW

i. **Separated flow**: Flow separation occurs when the boundary layer travels far enough against an adverse pressure gradient that the speed of the boundary layer relative to the object falls almost to zero.

ii. **Unseparated flow**: It is also called Attached flow. Flow remains attached without separation. It occurs in mostly streamlined bodies.