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SUBJECT : APPLIED FLUID MECHANICS

★ Reynolds Number based Flow Regimes :

Reynolds Number is defined as the ratio of inertial forces to viscous forces of a fluid.

$$Re = \frac{\text{Inertial Forces}}{\text{Viscous Forces}} = \frac{VL}{\nu}$$

where V = Velocity of the fluid
L = Characteristic length
ν = Kinematic viscosity of the fluid.

* Flow Regimes based on Reynolds number :

1] Creeping Flow ($0 < Re < 1$) :

At very low Reynolds number, the viscous forces dominate and the flow is smooth, creeping and laminar.

2] Laminar Flow ($1 < Re < 100$) (Strong Reynolds Number dependence) :

In this regime, fluid particles move in parallel layers with no disruption between them. The flow is predictable and steady. Laminar flow is characterized by smooth streamlines, with fluid velocity being the same at any given point over time.

3] Boundary Layer Laminar Flow ($100 < Re < 1000$):

In this regime, the laminar boundary layer concept is useful. The fluid still flows smoothly, but the interaction with surfaces starts to affect the flow. Velocity gradients develop near solid boundaries.

4] Transition Region ($1000 < Re < 10{,}000$):

As Reynolds Number increases, the flow becomes unstable, and small disturbances can grow. This marks the transition from laminar to turbulence. The flow becomes unpredictable, showing bursts of turbulent fluctuations, especially near solid boundaries.

5] Turbulent (Moderate Reynolds Number Dependence) ($10,000 < Re < 1,000,000$):

The flow is now fully turbulent, characterized by random, chaotic fluctuations. Turbulence appears, with swirling eddies and vortices. While the flow is erratic at any given movement, time-averaged values become stable and predictable.

6] Fully Developed Turbulent Flow ($Re > 1,000,000$):

At very high Reynolds number, ~~than~~ the flow remains turbulent but is less dependent on the Reynolds number.