Property → Mass, Energy & Momentum

Convective flux = (vol. conc. of Property) × (velocity in dir^{n} of flow)

✓ Momentum = mv

vol. conc = $\frac{mv}{V} = \rho v$

→ $= (\rho v) V_z$

Energy → K.E → $\frac{1}{2}mv^2 = \frac{1}{2}\rho v^2 \Rightarrow \left(\frac{1}{2}\rho v^2\right) V_z$

Enthalpy = $mc_p\Delta T \Rightarrow \rho c_p \Delta T \Rightarrow (\rho c_p \Delta T) V_z$

Mass → $m \rightarrow \rho \rightarrow \rho V_z$

$\Longrightarrow V_z$

← Fluid Mechanics

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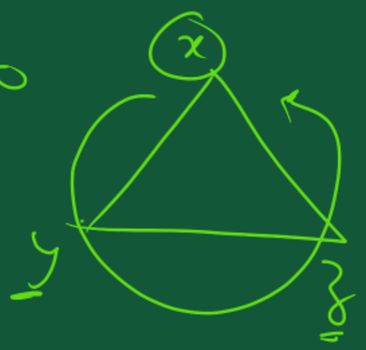
Momentum

- Rate of Translation → v_x, v_y, v_z
- Rate of stretching / Elongation / Extension $\dot{\epsilon}_x = \frac{\partial v_x}{\partial x}, \frac{\partial v_y}{\partial y}, \frac{\partial v_z}{\partial z}$

Incompressible fluid → $\frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y} + \frac{\partial v_z}{\partial z} = 0$, $\nabla \cdot v = 0$

Rate of Rotation $\omega_x = \frac{1}{2}\left(\frac{\partial v_z}{\partial y} - \frac{\partial v_y}{\partial z}\right)$

$\omega_y = \frac{1}{2}\left(\frac{\partial v_x}{\partial z} - \frac{\partial v_z}{\partial x}\right)$, $\omega_z = \frac{1}{2}\left(\frac{\partial v_y}{\partial x} - \frac{\partial v_x}{\partial y}\right)$ =



$$\omega = \frac{1}{2}\left(\vec{\nabla} \times \vec{v}\right) \Rightarrow \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ v_x & v_y & v_z \end{vmatrix}$$

$$+ i\left(\frac{\partial v_z}{\partial y} - \frac{\partial}{\partial z} v_y\right)$$

$$- j\left(\quad\right)$$

$$+ k\left(\quad\right)$$

$= 0$ Curl

$\Downarrow$

Irrotational flow

Vorticity $= 2\omega = (\vec{\nabla} \times v)$

Psi Ψ ψ

χ_i ξ

μ

ν

zeta

Greek word

Capital

A

Z

small

α

M
E
Mom

Reynold Transport theorem (Control volume)

η Accumulation = growth + in − out

Relation b/w $\frac{\partial}{\partial t}$ and $\frac{D}{Dt}$

$\frac{\partial}{\partial t}$ → from fixed position $\frac{\partial N}{\partial t} = \frac{DN}{Dt} - \left(\eta \rho \vec{v} \cdot \vec{dA}\right)_1 - \left(\eta \rho \vec{v} \cdot \vec{dA}\right)_2$ (Reynolds)

$\frac{d}{dt}$ → total time derivative $\frac{N}{V} = \eta$

$\frac{D}{Dt}$ → Substential derivative $\frac{\partial}{\partial t}\iiint_{CV} \eta \rho \, dV = \frac{DN}{Dt} - \oint_{CS} \eta (\rho \vec{v} \cdot \vec{dA})$

$\frac{DM}{Dt} = 0$

Property
- Intensive → Independent (η)
- Extensive → dependent of mass (N)

M $\quad M \cdot \eta \rightarrow$

mass → $\eta = 1$ → Intensive

→ $\frac{{}^{M}DN}{Dt} = 0$

moment $\quad \eta = v$

Energy $\quad \eta = \frac{1}{2}\rho v^2$

Aero ← Vijay gupta

Chem ← S.K. gupta

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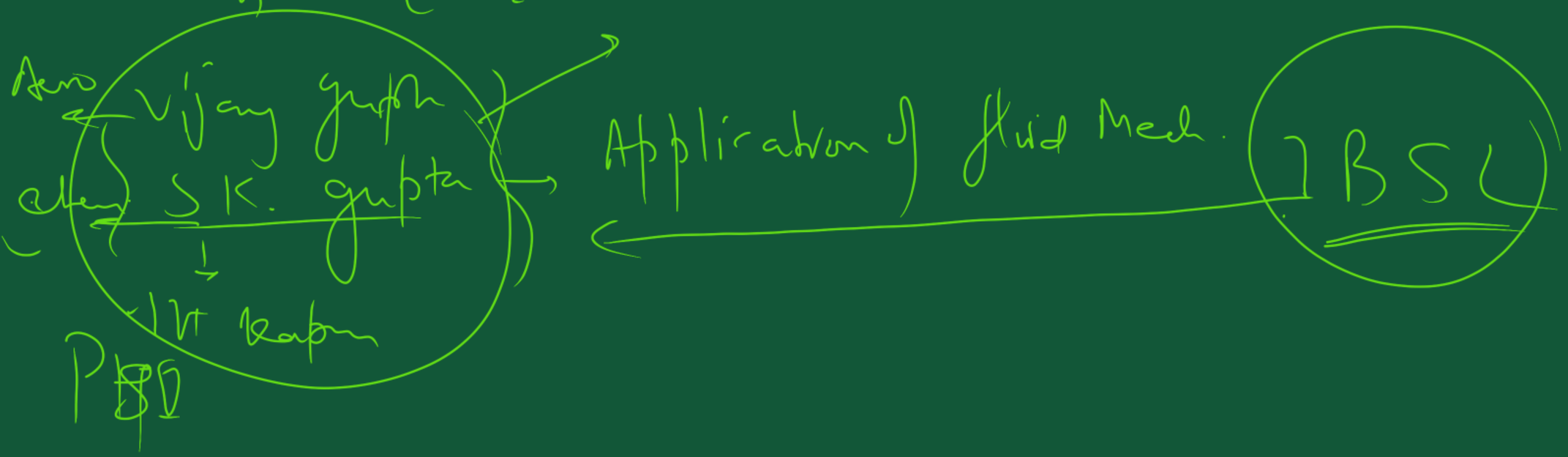
→ Application of fluid Mech. → IBSL