Conservation of mass

$$\frac{\partial}{\partial t}\int_{cv}\rho\, dV + \int_{cs}\rho\vec{V}\cdot d\vec{A} = 0$$

Momentum Equation

$$\vec{F} = \vec{F}_S + \vec{F}_B = \frac{\partial}{\partial t}\int_{cv}\vec{V}\rho\, dV + \int_{cs}\vec{V}\rho\vec{V}\cdot d\vec{A}$$

Continuity Equation

$$\frac{\partial \rho u}{\partial x}+\frac{\partial \rho v}{\partial y}+\frac{\partial \rho w}{\partial z}+\frac{\partial \rho}{\partial t}=0$$

$$\nabla\cdot\rho\vec{V}+\frac{\partial\rho}{\partial t}=0$$

incompressible : ρ = Const.

S.S : $\frac{\partial\rho}{\partial t}=0$

$$\frac{1}{r}\frac{\partial(r\rho V_r)}{\partial r}+\frac{1}{r}\frac{\partial(\rho V_\theta)}{\partial\theta}+\frac{\partial(\rho V_z)}{\partial z}+\frac{\partial\rho}{\partial t}=0$$

$$\nabla\cdot\rho\vec{V}+\frac{\partial\rho}{\partial t}=0$$

Acceleration:

$$\frac{D\vec{V}}{Dt}=u\frac{\partial\vec{V}}{\partial x}+v\frac{\partial\vec{V}}{\partial y}+w\frac{\partial\vec{V}}{\partial z}+\frac{\partial\vec{V}}{\partial t}$$

$$a_{x_p}=\frac{Du}{Dt}=u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}+\frac{\partial u}{\partial t}$$

$$a_{y_p}=\frac{Dv}{Dt}=u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}+\frac{\partial v}{\partial t}$$

$$a_{z_p}=\frac{Dw}{Dt}=u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y}+w\frac{\partial w}{\partial z}+\frac{\partial w}{\partial t}$$

Navier-Stokes (incompressible, Constant viscosity):

$$\rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)=\rho g_x-\frac{\partial p}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right)$$

$$\rho\left(\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}\right)=\rho g_y-\frac{\partial p}{\partial y}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}+\frac{\partial^2 v}{\partial z^2}\right)$$

$$\rho\left(\frac{\partial w}{\partial t}+u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y}+w\frac{\partial w}{\partial z}\right)=\rho g_z-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 w}{\partial x^2}+\frac{\partial^2 w}{\partial y^2}+\frac{\partial^2 w}{\partial z^2}\right)$$

S.S : $\frac{\partial}{\partial t}=0$

incompressible flow ρ = Const.

fully developed : $\frac{\partial}{\partial x}=0$.

Bernoulli : $\frac{P}{\rho}+\frac{V^2}{2}+gz=$ Const.

1 slug = 32.2 lbm

$1\,\frac{ft\times slug}{s^2}=1$ lbf

$g = 9.81\ m/s^2 = 32.2\ ft/s^2$

$g = 9.81\ N/kg = 32.2\ lbf/slug$

1 slug = 32.2 lbm

°F = °C × 1.8 + 32

°R = °F + 495.69

°K = °C + 273.15

°K = °F + 460.18

1 psi = 1 lbf/in²

1 centipoise = 1 cP = $\frac{1}{100}$ poise

1 poise = $1\,\frac{g}{cm\times s}$

$1\,\frac{lbm}{ft^3}=16.02\,\frac{kg}{m^3}$

1 lbm = 0.454 kg

1 ft = 0.3048 m