Reference Sheet I

Shear stress for 2D flow

$$\tau_{yx} = \mu\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)$$

Hydrostatics

$$\nabla p = \rho \vec{g}$$

$$\begin{aligned} \vec{F}_R &= \int_A -p\, d\vec{A} \\ \vec{r}\,' \times \vec{F}_R &= \int \vec{r} \times d\vec{F} = -\int_A \vec{r} \times p\, d\vec{A} \end{aligned}$$

Conservation of Mass - Integral Form

$$0 = \frac{\partial}{\partial t}\int_{C\forall} \rho\, d\forall + \int_{CS} \rho\, \vec{V} \cdot d\vec{A}$$

Conservation of Momentum - Integral Form

$$\vec{F} = \vec{F}_S + \vec{F}_B = \frac{\partial}{\partial t}\int_{C\forall} \vec{V} \rho\, d\forall + \int_{CS} \vec{V} \rho\, \vec{V} \cdot d\vec{A}$$

Euler's Equations in streamline coordinates (steady inviscid flow)

$$-\frac{1}{\rho}\frac{\partial p}{\partial s} - g\frac{\partial z}{\partial s} = V\frac{\partial V}{\partial s}$$

$$-\frac{1}{\rho}\frac{\partial p}{\partial n} - g\frac{\partial z}{\partial n} = \frac{V^2}{R} \quad \text{(where n is positive towards center of curvature)}$$

Bernoulli Equation

$$\frac{p}{\rho} + \frac{V^2}{2} + gz = \text{constant}$$

Reference Sheet II

Conservation of Mass - Differential Form

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

Conservation of Momentum - Differential Form

$$\rho \frac{\partial \vec{V}}{\partial t} + \rho (\vec{V} \cdot \nabla) \vec{V} = -\nabla p + \mu \nabla^2 \vec{V} + \rho \vec{g}$$

Vorticity

$$\vec{\zeta} = \nabla \times \vec{V}$$