

TEP4156 Formula sheet

$$\frac{\partial u_i}{\partial x_j} = \dot{\epsilon}_{ij} + \dot{\Omega}_{ij}$$

$$\dot{\epsilon}_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right)$$

$$\dot{\Omega}_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i} \right)$$

$$(\dot{\vec{\Omega}})_k = \frac{1}{2} \epsilon_{ijk} \dot{\Omega}_{ij}$$

$$\dot{\vec{\Omega}} = \frac{1}{2} \vec{\nabla} \times \vec{u}$$

$$\frac{D\rho}{Dt} + \rho \vec{\nabla} \cdot \vec{u} = 0$$

$$\rho \frac{Du_i}{Dt} = \frac{\partial \sigma_{ij}}{\partial x_j} + \rho f_i$$

$$\rho \frac{DE}{Dt} = \frac{\partial}{\partial x_j} (\sigma_{ij} u_i) + \rho f_i u_i - \frac{\partial q_k}{\partial x_k}$$

$$E = e + \frac{1}{2} u_i u_i$$

$$\sigma_{ij} = -p \delta_{ij} + \sigma'_{ij}$$

$$\rho \frac{De}{Dt} + p \frac{\partial u_k}{\partial x_k} = \sigma'_{ij} \frac{\partial u_i}{\partial x_j} - \frac{\partial q_k}{\partial x_k}$$

$$\rho \frac{Dh}{Dt} - \frac{Dp}{Dt} = \sigma'_{ij} \frac{\partial u_i}{\partial x_j} - \frac{\partial q_k}{\partial x_k}$$

$$\sigma'_{ij} \frac{\partial u_i}{\partial x_j} \geq 0$$

$$q_k = -k \frac{\partial T}{\partial x_k}$$

$$\sigma'_{ij} = \mu \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} - \frac{2}{3} \delta_{ij} \frac{\partial u_k}{\partial x_k} \right) + \mu_B \delta_{ij} \frac{\partial u_k}{\partial x_k}$$

$$\text{Re} \rightarrow 0 : \quad \vec{\nabla} p = \mu \vec{\nabla}^2 \vec{u}$$

$$u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = U \frac{dU}{dx} + \nu \frac{\partial^2 u}{\partial y^2}$$

$$u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} = \frac{k}{\rho c_p} \frac{\partial^2 T}{\partial y^2}$$

Displacement thickness

$$\delta^* = \int_0^\infty \left(1 - \frac{u}{U} \right) dy$$

Momentum thickness

$$\theta = \int_0^\infty \frac{u}{U} \left(1 - \frac{u}{U} \right) dy$$

$$\psi(x, y) = \sqrt{\frac{2}{m+1}} \nu x U f(\eta)$$

$$\eta = y \sqrt{\frac{m+1}{2}} \frac{U}{\nu x}$$

$$f''' + f f'' + \frac{2m}{m+1} (1 - f'^2) = 0$$

$$\frac{d\theta}{dx} + \left(2 + \frac{\delta^*}{\theta} \right) \frac{\theta}{U} \frac{dU}{dx} = \frac{C_f}{2}$$