Formulário:

$q_{rad} = \varepsilon A \sigma\left(T_1^4 - T_2^4\right)$, $\sigma = 5{,}67.10^{-8}$ $q_{latente} = \dot{m}h$ $q_{sensível} = mc_p \dfrac{dT}{dt}$ $q_{cond} = kA\dfrac{(T_a - T_b)}{L}$ $q_{conv} = hA(T_s - T_\infty)$

$\tau_{yx} = \mu \dfrac{du}{dy}$ $\dfrac{dp}{dh} = \rho g$ Torque : $dT = r\,dF$ Potência= F.v ou F.ω

CM: $0 = \dfrac{\partial}{\partial t}\int_{VC} \rho d\forall + \int_{SC} \rho \vec{V} \cdot d\vec{A}$ QM: $\vec{F}_S + \vec{F}_B - \int_{VC} \vec{a}_{rf}\, \rho d\forall = \dfrac{\partial}{\partial t}\int_{VC} \vec{V}_{xyz} \rho d\forall + \int_{SC} \vec{V}_{xyz} \rho \vec{V}_{xyz} \cdot d\vec{A}$:

$e = u + \dfrac{V^2}{2} + gz$ $\phi = \dfrac{p_A}{p_{A,sat}}$ (umidade relativa − hip. gás ideal) $PV = mRT$

$N''_A = -D_{AB}\dfrac{\partial C_A}{\partial y}$ $h_m = \dfrac{-D_{AB}\, \partial C_A/\partial y|_{y=0}}{C_{A,S} - C_{A,\infty}}$ $n''_A = -D_{AB}\dfrac{\partial \rho_A}{\partial y}$ $h_m = \dfrac{-D_{AB}\, \partial \rho_A/\partial y|_{y=0}}{\rho_{A,S} - \rho_{A,\infty}}$

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$

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

$$\rho\left(u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}\right) = -\frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) + \rho g_y \qquad Re = \frac{\rho VL}{\mu} = \frac{VL}{\nu}$$

$$\rho c_p\left(u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}\right) = k\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) + \mu\left\{\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)^2 + 2\left[\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial v}{\partial y}\right)^2\right]\right\} + \dot{q}$$

$$u\frac{\partial C_A}{\partial x} + v\frac{\partial C_A}{\partial y} = D_{AB}\left(\frac{\partial^2 C_A}{\partial x^2} + \frac{\partial^2 C_A}{\partial y^2}\right) + \dot{N}_A$$

$Pr = \dfrac{\nu}{\alpha}$ $Sc = \dfrac{\nu}{D_{AB}}$ $Le = \dfrac{Sc}{Pr}$ $Nu = \dfrac{hL}{k_f}$ $Sh = \dfrac{h_m L}{D_{AB}}$ $\dfrac{Nu}{Pr^n} = \dfrac{Sh}{Sc^n}$, ou $\dfrac{h}{h_m} = \dfrac{k}{D_{AB}Le^n} = \rho c_p Le^{1-n}$, n≈1/3

<u>**Correlações para escoamento externo**</u> PLACA PLANA: Re_c= 5x10[5] Transição laminar/turbulento

Laminar, T_f	$\delta = 5x\,Re_x^{-1/2}$
Laminar, T_f	$\delta_t = \delta\, Pr^{-1/3}$
Laminar local, T_f, 0.6<Pr<50	$Nu = 0.332 Re_x^{1/2} Pr^{1/3}$
Laminar médio, T_f, 0.6<Pr<50	$\overline{Nu}_x = 0.664\, Re_x^{1/2}\, Pr^{1/3}$
Turbulento local, T_f, $Re_x<10^8$, 0.6<Pr<60	$Nu_x = 0.0296\, Re_x^{4/5}\, Pr^{1/3}$
Turbulento	$\delta = 0{,}37x\, Re_x^{-1/5}$
Mistura média, T_f, $Re_x<10^8$, 0.6<Pr<60	$\overline{Nu}_L = \left(0.037\, Re_L^{4/5} - 871\right) Pr^{1/3}$
CILINDRO com escoamento cruzado, $Re_D Pr>0.2$	$\overline{Nu}_L = \dfrac{\overline{h}_D D}{k} = 0.3 + \dfrac{0.62\, Re_D^{1/2} Pr^{1/3}}{\left[1+(0.4/Pr)^{2/3}\right]^{1/4}}\left[1+\left(\dfrac{Re_D}{282{,}000}\right)^{5/8}\right]^{4/5}$
ESFERA com condições média, T_∞ 3.5<Re_D<4x10[4], 0.71<Pr<380, 1<(μ/μs)<3.2	$\overline{Nu}_D = 2 + \left[0.4 Re_D^{1/2} + 0.06 Re_D^{2/3}\right] Pr^{0.4} (\mu/\mu_s)^{1/4}$
ESFERA para gotas em queda livre	$\overline{Nu}_D = 2 + 0.6 Re_D^{1/2} Pr^{1/3}$