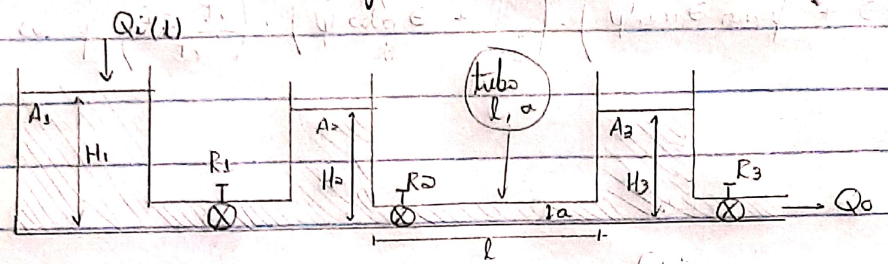
① $Q \to V$ $\quad \frac{1}{C_f} \to \frac{1}{C}$ $\quad p \to i$ $\quad \frac{1}{R_f} \to R$ $\quad C_f \to L$

② $p \to V$ $\quad L_f \to L$ $\quad Q \to i$ $\quad C_f \to C$ $\quad R_f \to R$

pg

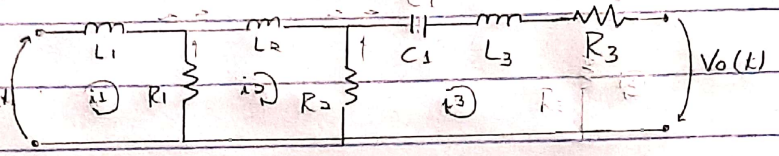
Gabriel Barbosa Paganini - 10772539 - Modelagem - ex 22/09

ex



• Regime laminar

a) Analogia tipo 1 :

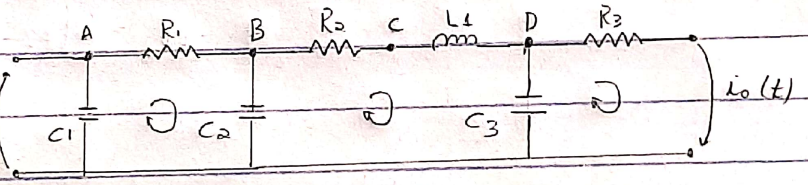


• Malha 1 : $(L_1 D) i_1 + R_1 (i_1 - i_2) = V_i(t)$

• Malha 2 : $(L_2 D) i_2 + R_2 (i_2 - i_3) + R_1 (i_2 - i_1) = 0$

• Malha 3 : $\left(\frac{1}{C_1 D} + L_3 D + R_3\right) i_3 + R_2 (i_3 - i_2) = V_0(t)$

b) Analogia tipo 2 :



• Nó A : $(C_1 D) V_A + \left(\frac{1}{R_1}\right) \cdot (V_A - V_B) = \dot{i}_i(t)$

• Nó B : $(C_2 D) V_B + \left(\frac{1}{R_1}\right) \cdot (V_B - V_A) + \frac{1}{R_2} \cdot (V_B - V_C) = 0$

• Nó C : $\left(\frac{1}{L_1 D}\right) (V_C - V_D) + \frac{1}{R_2} (V_C - V_B) = 0$

• Nó D : $\left(\frac{1}{R_3} + C_3 D\right) V_D + \left(\frac{1}{L_1 D}\right) \cdot (V_D - V_C) = \dot{i}_0(t)$

c) Modelo hidráulico : Tipo 1

$$\begin{cases} C_{f1} \cdot \dot{p}_1 + \frac{1}{\rho g R_{f1}} (p_1 - p_2) = Q_i(t) \\ C_{f2} \cdot \dot{p}_2 + \frac{1}{\rho g R_{f2}} (p_2 - p_3) + \frac{1}{\rho g R_{f1}} (p_2 - p_1) = 0 \\ C_{f3} \cdot \dot{p}_3 + \frac{1}{\rho g R_{f3}} \cdot p_3 + \frac{1}{L_{f1}} \int p_3 \, dt + \frac{1}{\rho g R_{f2}} (p_3 - p_2) = Q_0(t) \end{cases}$$

$$\therefore \begin{cases} h_1 A_1 + \frac{1}{R_{f1}} (h_1 - h_2) = Q_i(t) \\ h_2 A_2 + \frac{1}{R_{f2}} (h_2 - h_3) + \frac{1}{R_{f1}} (h_2 - h_1) = 0 \\ h_3 A_3 + \frac{1}{R_{f3}} (h_3) + \frac{1}{R_{f2}} (h_3 - h_2) = Q_0(t) - Q_2 \end{cases}$$

Tipo 2

$$\begin{cases} C_{f1} \cdot \dot{p}_1 + \frac{1}{\rho g R_{f1}} (p_1 - p_2) = Q_i(t) \\ C_{f2} \cdot \dot{p}_2 + \frac{1}{\rho g R_{f1}} (p_2 - p_1) + \frac{1}{\rho g R_{f2}} (p_2 - p_c) = 0 \\ Q_c - Q_3 + \frac{1}{\rho g R_{f2}} (p_c - p_2) = 0 \\ C_{f3} \dot{p}_3 + \frac{1}{\rho g R_{f3}} p_3 + Q_3 - Q_c = Q_0(t) \end{cases} \Rightarrow \begin{cases} A_1 \dot{h}_1 + \frac{1}{R_{f1}} (h_1 - h_2) = Q_i(t) \\ A_2 \dot{h}_2 + \frac{1}{R_{f1}} (h_2 - h_1) + \frac{1}{R_{f2}} (h_2 - h_c) = 0 \\ Q_c - Q_3 + \frac{1}{R_{f2}} (h_c - h_2) = 0 \\ A_3 \dot{h}_3 + \frac{1}{R_{f3}} \cdot h_3 + Q_3 - Q_c = Q_0(t) \end{cases}$$