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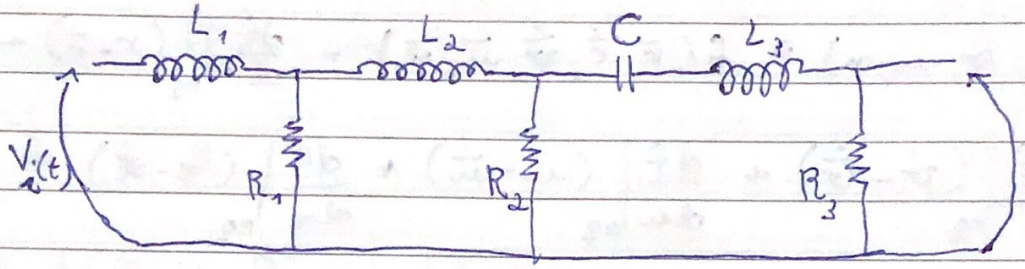
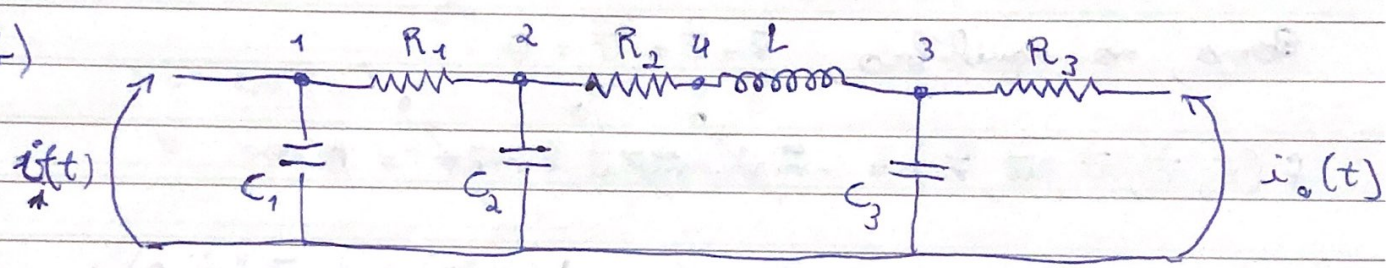
- Exercícios do dia 22/03 -

1- a)



b)



c) Lei das malhas:

$$\begin{cases} i_1 (L_1 D + R_1) - i_2 \cdot R_1 = V_i(t) \\ i_2 (L_2 D + R_1 + R_2) - i_1 \cdot R_1 - i_3 R_2 = 0 \\ i_3 \left(\frac{1}{CD} + L_3 D + R_2 + R_3\right) - i_2 \cdot R_2 = V_o(t) \end{cases}$$

Analogia do tipo 1: $Q \rightarrow V$; $p \rightarrow i$

$$p_1 \left(L_{f_1} D + \frac{1}{R_{f_1}}\right) - p_2 \cdot \frac{1}{R_{f_1}} = Q_i(t)$$

$$p_2 \left(L_{f_2} D + \frac{1}{R_{f_1}} + \frac{1}{R_{f_2}}\right) - p_1 \cdot \frac{1}{R_{f_1}} - p_3 \cdot \frac{1}{R_{f_2}} = 0$$

$$p_3 \left(\frac{1}{C_f D} + L_{f_3} D + \frac{1}{R_{f_2}} + \frac{1}{R_{f_3}}\right) - p_2 \cdot \frac{1}{R_{f_2}} = Q_o(t)$$

Analogia: $L_{f_i} = \frac{A_i}{\rho g} \quad | \quad \overline{R}_{f_i} = \rho g R_{f_i} \quad | \quad C_f = \frac{\rho \ell}{a}$

$$\begin{cases} p_1 \left(\frac{A_1}{\rho g} D + \frac{1}{\rho g R_{f_1}} \right) - p_2 \cdot \frac{1}{\rho g R_{f_1}} = Q_i(t) \\ p_2 \left(\frac{A_2}{\rho g} \cdot D + \frac{1}{\rho g R_{f_1}} + \frac{1}{\rho g R_{f_2}} \right) - p_1 \cdot \frac{1}{\rho g R_{f_1}} - p_3 \cdot \frac{1}{\rho g R_{f_2}} = 0 \\ p_3 \left(\frac{a}{\rho \ell D} + \frac{A_3}{\rho g} \cdot D + \frac{1}{\rho g R_{f_2}} + \frac{1}{\rho g R_{f_3}} \right) - p_2 \cdot \frac{1}{\rho g R_{f_2}} = Q_0(t) \end{cases}$$

$$\begin{cases} \frac{A_1}{\rho g} \cdot \frac{dp_1}{dt} + \frac{1}{\rho g R_{f_1}} \cdot p_1 - \frac{1}{\rho g R_{f_1}} \cdot p_2 = Q_i(t) \\ \frac{A_2}{\rho g} \cdot \frac{dp_2}{dt} + \frac{1}{\rho g R_{f_1}} \cdot p_2 + \frac{1}{\rho g R_{f_2}} \cdot p_2 - \frac{1}{\rho g R_{f_1}} \cdot p_1 - \frac{1}{\rho g R_{f_2}} \cdot p_3 = 0 \\ \frac{A_3}{\rho g} \cdot \frac{dp_3}{dt} + \left(\frac{1}{\rho g R_{f_2}} + \frac{1}{\rho g R_{f_3}} \right) p_3 + \frac{a}{\rho \ell} \cdot \int p_3 \, dt - \frac{1}{\rho g R_{f_2}} \cdot p_2 = Q_0(t) \end{cases}$$

Lei dos nós:

$$\begin{cases} V_1 \left(C_1 D + \frac{1}{R_1} \right) - V_2 \cdot \frac{1}{R_1} = i(t) & \leftarrow \text{nó 1} \\ V_2 \left(C_2 D + \frac{1}{R_1} + \frac{1}{R_2} \right) - V_1 \cdot \frac{1}{R_1} - V_4 \cdot \frac{1}{R_2} = 0 & \leftarrow \text{nó 2} \\ V_3 \left(\frac{1}{LD} + C_3 D + \frac{1}{R_3} \right) - V_4 \cdot \frac{1}{LD} = i_0(t) & \leftarrow \text{nó 3} \\ V_4 \left(\frac{1}{R_2} + \frac{1}{LD} \right) - V_2 \cdot \frac{1}{R_2} - V_3 \cdot \frac{1}{LD} = 0 & \leftarrow \text{nó 4} \end{cases}$$

Analogia do tipo 2 $L_{f_i} = \frac{\rho l}{a} \mid R_{f_i} = \rho g R_{f_i} \mid C_{f_i} = \frac{A_i}{\rho g}$

$$\begin{cases} \frac{A_1}{\rho g} \cdot \frac{dp_1}{dt} + \frac{1}{\rho g R_{f_1}} \cdot p_1 - \frac{1}{\rho g R_{f_1}} \cdot p_2 = Q_i(t) \\ \frac{A_2}{\rho g} \cdot \frac{dp_2}{dt} + \left(\frac{1}{R_{f_1}} + \frac{1}{R_{f_2}}\right) \frac{p_2}{\rho g} - \frac{1}{\rho g R_{f_1}} \cdot p_1 - \frac{1}{\rho g R_{f_2}} \cdot p_4 = 0 \\ \frac{A_3}{\rho g} \cdot \frac{dp_3}{dt} + \frac{1}{\rho g R_{f_3}} \cdot p_3 + \frac{a}{\rho l} \int p_3 dt - \frac{a}{\rho l} \int p_4 dt = Q_0(t) \\ \frac{A}{\rho g R_{f_2}} \cdot p_4 - \frac{1}{\rho g R_{f_2}} \cdot p_2 + \frac{a}{\rho l} \int p_4 dt - \frac{a}{\rho l} \int p_3 dt = 0 \end{cases}$$