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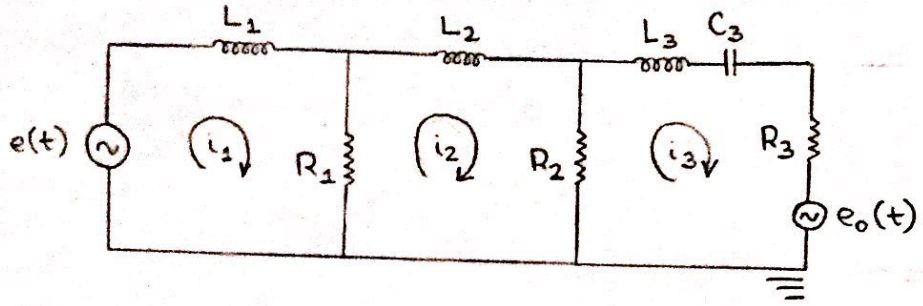
*PME3380 - Exercício do dia 22/09

a)



Malha I: $e(t) = L_1 i_1 D + R_1(i_1 - i_2) \Rightarrow C_{f_1} p_1 D + \frac{1}{R_{f_1}}(p_1 - p_2) = Q_i \Rightarrow \boxed{A_1 \dot{h}_1 + \frac{h_1}{R_{f_1}} - \frac{h_2}{R_{f_1}} = Q_i}$

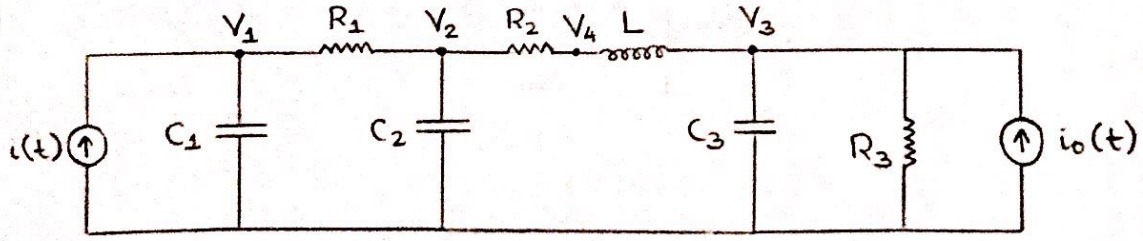
Malha II: $R_1(i_2 - i_1) + L_2 i_2 D + R_2(i_2 - i_3) = 0$

$$\Rightarrow \boxed{A_2 \dot{h}_2 + h_2\left(\frac{1}{R_{f_1}} + \frac{1}{R_{f_2}}\right) - \frac{h_1}{R_{f_1}} - \frac{h_3}{R_{f_2}} = 0}$$

Malha III: $R_2(i_3 - i_2) + \frac{1}{C_3 i_3 D} + L_3 i_3 D + R_3 i_3 = e_o(t)$

$$\Rightarrow \boxed{A_3 \dot{h}_3 + h_3\left(\frac{1}{R_{f_2}} + \frac{1}{R_{f_3}}\right) - \frac{h_2}{R_{f_2}} + \frac{1}{L_f p_3 D} = Q_o}$$

b)



Nó 1: $i(t) = V_1 C_1 D + \frac{V_1 - V_2}{R_1} = V_1\left(C_1 D + \frac{1}{R_1}\right) - \frac{V_2}{R_1} \Rightarrow P_1\left(C_{f_1} D + \frac{1}{R_{f_1}}\right) - \frac{P_2}{R_{f_2}} = Q_i \Rightarrow$

$$\Rightarrow \rho g h_1\left(\frac{A_1 D}{\rho g} + \frac{1}{\rho g R_{f_1}}\right) - \rho g h_2 \frac{1}{\rho g R_{f_2}} = Q_i \Rightarrow \boxed{A_1 \dot{h}_1 + \frac{h_1}{R_{f_1}} - \frac{h_2}{R_{f_2}} = Q_i}$$

Nó 2: $\frac{V_1 - V_2}{R_1} = V_2 C_2 D + \frac{V_2 - V_4}{R_2} \Rightarrow \frac{\rho g(h_1 - h_2)}{\rho g R_{f_1}} = \rho g h_2\left(\frac{A_2 D}{\rho g} + \frac{1}{\rho g R_{f_2}}\right) - \frac{P_4}{R_{f_2}}$

$$\Rightarrow \boxed{A_2 \dot{h}_2 + \frac{h_2}{R_{f_2}} - \frac{(h_1 - h_2)}{R_{f_1}} - \frac{P_4}{R_{f_2}} = 0}$$

Nó 3: $\frac{V_4 - V_3}{L D} + i_o(t) = V_3 C_3 D + \frac{V_3}{R_3} \Rightarrow \boxed{\frac{P_4 - P_3}{L_f D} + Q_o = A_3 \dot{h}_3 + \frac{h_3}{R_{f_3}}}$

Nó 4: $\frac{V_2 - V_4}{R_2} = \frac{V_4 - V_3}{L D} \Rightarrow \boxed{P_4\left(\frac{1}{L_f D} + \frac{1}{R_{f_2}}\right) - \frac{P_3}{L_f D} - \frac{h_2}{R_{f_2}} = 0}$