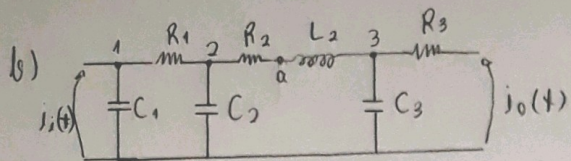


$$\begin{aligned} \bar{G} &\rightarrow V \\ C_b &\rightarrow i \\ \frac{1}{R_b} &\rightarrow R \end{aligned} \quad \frac{1}{L_b} \rightarrow \frac{1}{C}$$



c) tipo 1:

- malha 1:  $V_1(t) = (L_1 D + R_1) i_1 - R_1 i_2$
- malha 2:  $0 = (R_1 + L_2 D + R_2) i_2 - R_2 i_3 - R_1 i_1$
- malha 3:  $V_0(t) = (L_3 D + R_2 + R_3 + \frac{1}{C_2 D}) i_3 - R_2 i_2$

$$\begin{cases} \mathcal{U}_i(t) = C_{b1} \dot{p}_1 + \bar{R}_{b1} p_1 - \bar{R}_{b1} p_2 \\ 0 = \bar{R}_{b1} p_2 + C_{b2} \dot{p}_2 + \bar{R}_{b2} p_2 - \bar{R}_{b2} p_3 - R_{b1} p_1 \\ \mathcal{U}_0(t) = C_{b3} \dot{p}_3 + \bar{R}_{b3} p_3 + \bar{R}_{b2} p_3 + \frac{1}{L_{b2}} \int p_3 dt - R_{b2} p_2 \end{cases}$$

$$\bar{R}_b = \frac{1}{\rho g R_b}$$

$$C_b = \frac{A}{\rho g}; L_b = \frac{\rho l}{A}$$

$$\mathcal{U}_i(t) = \frac{A_1}{\rho g} \dot{p}_1 + \frac{1}{\rho g R_{b1}} p_1 - \frac{1}{\rho g R_{b1}} p_2 = \lambda_1 A_1 + \eta_1 \cdot \frac{1}{R_{b1}} - \eta_2 \cdot \frac{1}{R_{b1}}$$

$$0 = \frac{1}{\rho g R_{b1}} p_2 + \frac{A_2}{\rho g} \dot{p}_2 + \frac{1}{\rho g R_{b2}} p_2 - \frac{1}{\rho g R_{b2}} p_3 - \frac{1}{\rho g R_{b1}} p_1 = \lambda_2 \left( \frac{1}{R_{b1}} + \frac{1}{R_{b2}} \right) + \eta_2 A_2 - \eta_3 \cdot \frac{1}{R_{b2}} - \eta_1 \cdot \frac{1}{R_{b1}}$$

$$\mathcal{U}_0(t) = \frac{A_3}{\rho g} \dot{p}_3 + \frac{1}{\rho g R_{b3}} p_3 + \frac{1}{\rho g R_{b2}} p_3 + \frac{1}{\rho l} \int p_3 dt - \frac{1}{\rho g R_{b2}} p_2 = \lambda_3 A_3 + \frac{1}{R_{b3}} \eta_3 + \frac{1}{R_{b2}} (\lambda_3 - \lambda_2) + \mathcal{U}_2(t)$$

$$\begin{aligned} \mathcal{U}_i(t) &= \lambda_1 A_1 + \frac{1}{R_{b1}} (\lambda_1 - \lambda_2) \\ 0 &= \eta_2 A_2 + \frac{1}{R_{b1}} (\lambda_2 - \lambda_1) + \frac{1}{R_{b2}} (\lambda_2 - \lambda_3) \\ \mathcal{U}_0(t) &= \lambda_3 A_3 + \frac{1}{R_{b2}} (\lambda_3 - \lambda_2) + \frac{1}{R_{b2}} \lambda_3 + \mathcal{U}_2(t) \end{aligned}$$

tipo 2:

- Nó 1:  $i_1(t) = (C_1 D + \frac{1}{R_1}) V_1 - \frac{1}{R_1} V_2$
- Nó 2:  $0 = (C_2 D + \frac{1}{R_1} + \frac{1}{R_2}) V_2 - \frac{1}{R_1} V_1 - \frac{1}{R_2} V_0$
- Nó 3:  $0 = (\frac{1}{R_2} + \frac{1}{L_2 D}) V_0 - (\frac{1}{L_2 D}) V_3 - \frac{1}{R_2} V_2$
- Nó 4:  $i_0(t) = (C_3 D + \frac{1}{L_2 D} + \frac{1}{R_3}) V_3 - \frac{1}{L_2 D} V_0$

$$\begin{aligned} \mathcal{U}_i(t) &= C_{b1} \dot{p}_1 + \frac{1}{R_{b1}} (p_1 - p_2) & C_b &= \frac{A}{\rho g} \\ 0 &= C_{b2} \dot{p}_2 + \frac{1}{R_{b1}} (p_2 - p_1) + \frac{1}{R_{b2}} (p_2 - p_0) & \bar{R}_b &= \rho g R_b \\ 0 &= \frac{1}{R_{b2}} (p_0 - p_2) + \frac{1}{L_b D} (p_0 - p_3) & L_b &= \frac{\rho l}{A} \\ \mathcal{U}_0(t) &= C_{b3} \dot{p}_3 + \frac{1}{L_b D} (p_3 - p_0) + \frac{1}{R_{b3}} p_3 \end{aligned}$$

$$\begin{aligned} \mathcal{U}_i(t) &= A_1 \lambda_1 + \frac{1}{R_{b1}} (\lambda_1 - \lambda_2) \\ 0 &= A_2 \eta_2 + \frac{1}{R_{b1}} (\lambda_2 - \lambda_1) + \frac{1}{R_{b2}} (\lambda_2 - \lambda_0) \\ 0 &= \frac{1}{R_{b2}} (\lambda_0 - \lambda_2) + \mathcal{U}_0 - \mathcal{U}_2 \\ \mathcal{U}_0(t) &= A_3 \lambda_3 (\mathcal{U}_3 - \mathcal{U}_0) + \frac{1}{R_{b3}} \eta_3 \end{aligned}$$