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1) Por sistema mecânico: $\begin{cases} J_1\dot{\omega}_1 + B_1\omega_1 = T_m - T_1 \\ J_2\dot{\omega}_2 + B_2\omega_2 = \underbrace{T_2}_{\eta T_1} - T_c \end{cases}$

$P_1 = P_2$; $T_1\omega_1 = T_2\omega_2$

$T_2 = \frac{T_1\omega_1}{\omega_2} \rightarrow \underline{T_2 = \eta T_1}$

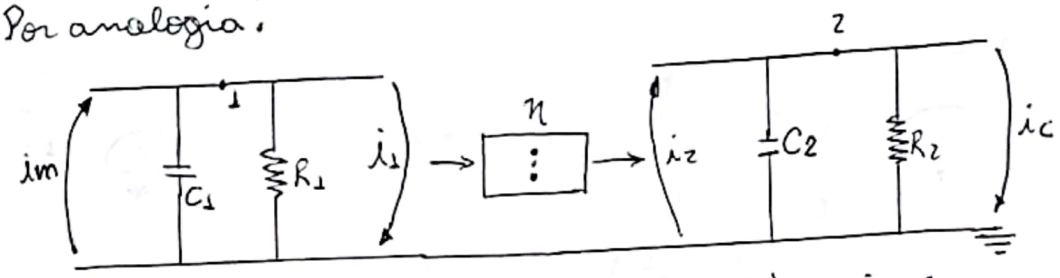
$J_2\dot{\omega}_2 + B_2\omega_2 + T_c = \eta(T_m - J_1\dot{\omega}_1 - B_1\omega_1)$

$J_2\dot{\omega}_2 + B_2\omega_2 + T_c = \eta(T_m - J_1\eta\dot{\omega}_2 - B_1\eta\omega_2)$

$\dot{\omega}_2(J_2 + \eta^2 J_1) + \omega_2(B_2 + \eta^2 B_1) + T_c = \eta T_m$

$\boxed{J_{eq,2}\dot{\omega}_2 + B_{eq,2}\omega_2 + T_c = T_m \cdot \eta}$

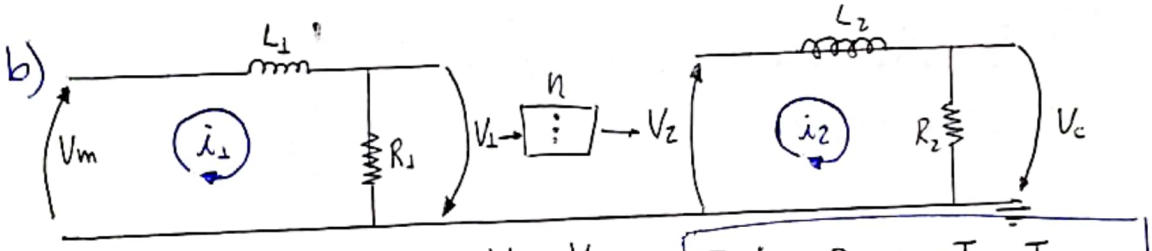
2a) Por analogia:



Nó 1: $(C_1 D + \frac{1}{R_1})V_1 = i_m - i_1$; Nó 2: $(C_2 D + \frac{1}{R_2})V_2 = i_2 - i_c$

$\boxed{\begin{aligned} J_1\dot{\omega}_1 + B_1\omega_1 &= T_m - T_1 \\ J_2\dot{\omega}_2 + B_2\omega_2 &= T_2 - T_c \end{aligned}}$

b)

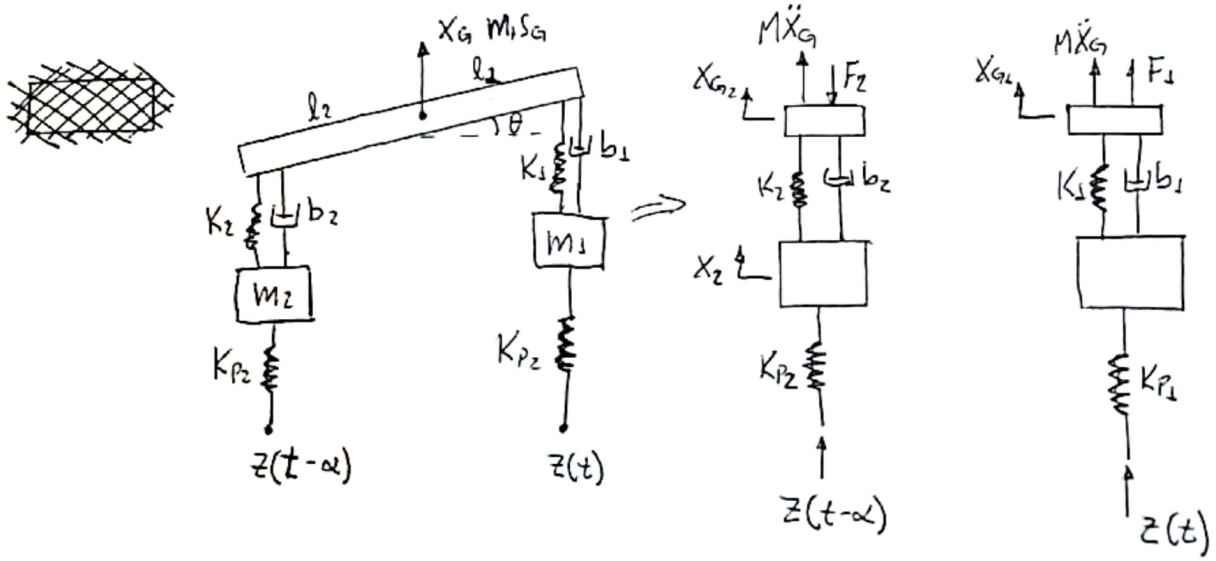


Malha 1: $L_1 D.i_1 + R_1.i_1 = V_m - V_1$

Malha 2: $L_2 D i_2 + R_2.i_2 = V_2 - V_c$

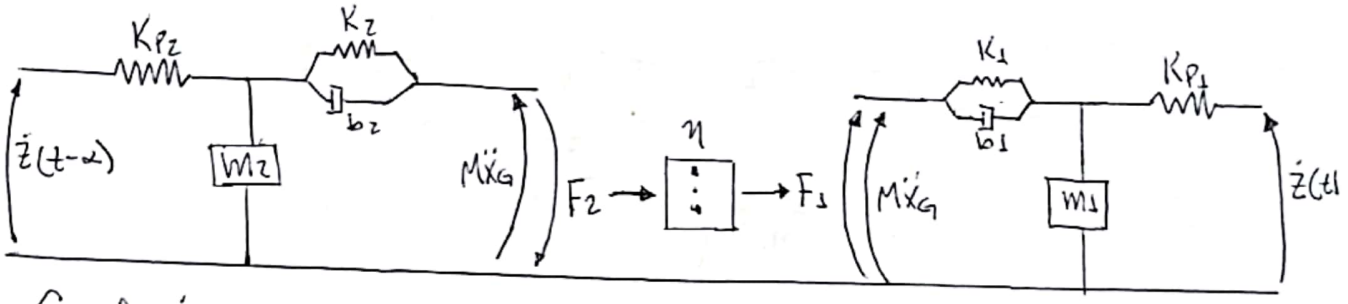
$\boxed{\begin{aligned} J_1\dot{\omega}_1 + B_1\omega_1 &= T_m - T_1 \\ J_2\dot{\omega}_2 + B_2\omega_2 &= T_2 - T_c \end{aligned}}$

3)

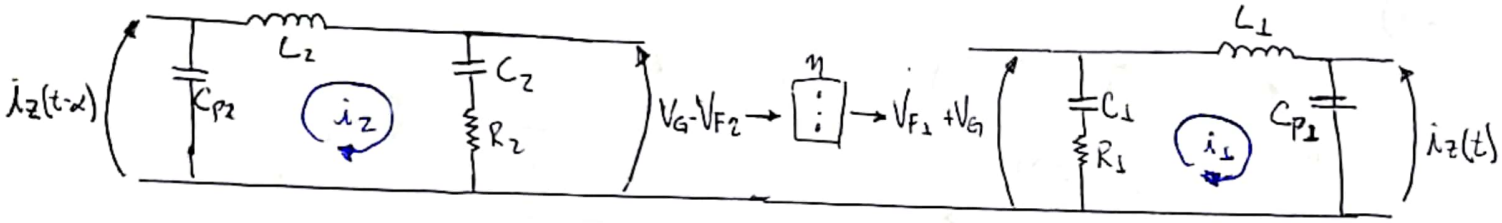


$\eta = l_2/l_1$ $\quad F_2 l_2 = F_1 l_1 \rightarrow \eta = F_1/F_2$

• Por hipótese: $\theta \approx 0° \therefore \operatorname{sen}\theta \approx \theta$; $\cos\theta = \alpha$



Analogia



Malha 1: $i_1\left(L_1 D + R_1 + \frac{1}{C_1 D} + \frac{1}{C_{p_1} D}\right) - i_2(t)\left(\frac{1}{C_{p_1} D}\right) = V_{F_1} - V_G$

Malha 2: $i_2\left(L_2 D + R_2 + \frac{1}{C_2 D} + \frac{1}{C_{p_2} D}\right) - i_2(t-\alpha)\left(\frac{1}{C_{p_2} D}\right) = V_G - V_{F_2}$

$$m_1 \ddot{x}_1 + b_1 \dot{x}_1 + K_1 x_1 + K_{p_1} x_1 - K_{p_1} z(t) = F_1 + M\ddot{x}_G$$

$$m_2 \ddot{x}_2 + b_2 \dot{x}_2 + K_2 x_2 + K_{p_2} x_2 - K_{p_2} z(t-\alpha) = -F_2 + M\ddot{x}_G$$