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(1)

Sem perdas na transmissão ⇒ $T_2 = \frac{T_1 \cdot \omega_1}{\omega_2} = n T_1$ (I)

e sabendo que:

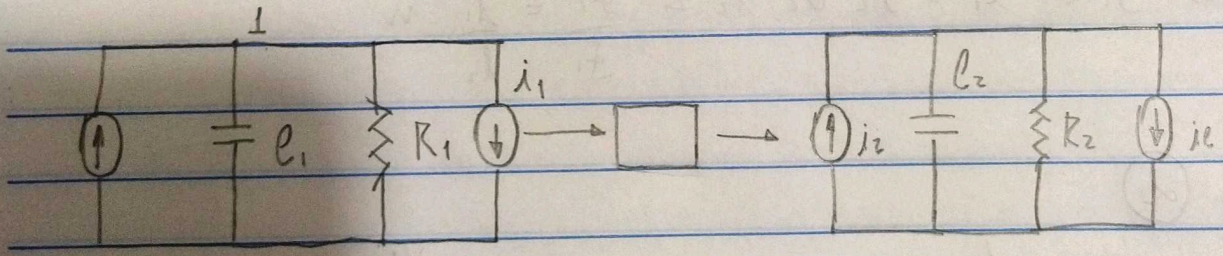
$$\begin{cases} J_1 \cdot \dot{\omega}_1 + B_1 \cdot \omega_1 + T_1 = T_m & \text{(II)} \\ J_2 \cdot \dot{\omega}_2 + B_2 \cdot \omega_2 + T_c = T_2 & \text{(III)} \end{cases}$$

juntando as três equações:

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

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

A) Analogia tipo (2)

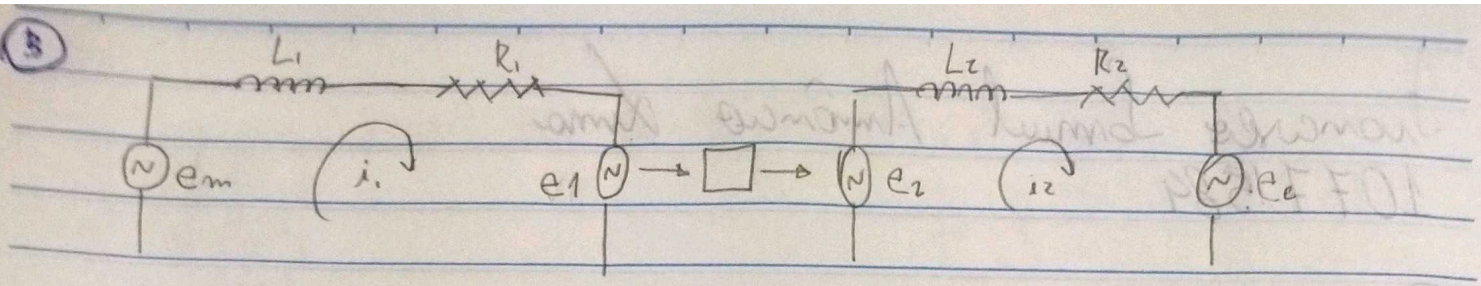


nó 1: $i_n - V_1\left(C_1 D + \frac{1}{R_1}\right) = i_1 \Rightarrow J_1 \cdot \ddot{\theta}_1 + B_1 \cdot \dot{\theta}_1 = T_m - T_1$

nó 2: $i_2 - V_2\left(C_2 D + \frac{1}{R_2}\right) = i_C \Rightarrow T_2 = J_2 \ddot{\theta}_2 + B_2 \cdot \dot{\theta}_2 + T_c$

transformador: $V_1 \cdot i_1 = V_2 \cdot i_2 \Rightarrow \frac{\dot{\theta}_1}{\dot{\theta}_2} = n$

(3)

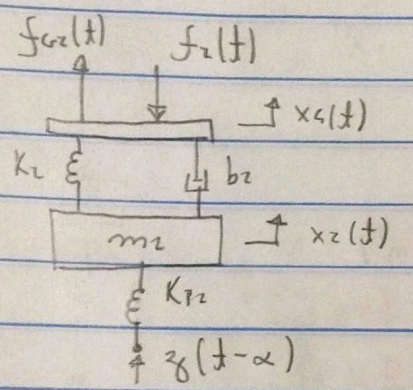


malha i_1: $e_m = e_1 + i_1(L_1 D + R_1) = 0 \Rightarrow J_1 \cdot \ddot{\theta}_1 + B_1 \cdot \dot{\theta}_1 = T_m - T_1$

malha i_2: $e_2 = e_c + i_2(L_2 D + R_2) = 0 \Rightarrow J_2 \cdot \ddot{\theta}_2 + R_1 \dot{\theta}_2 = T_2 - T_c$

transfor.: $e_1 i_1 = e_2 \cdot i_2 \Rightarrow \dfrac{\dot{\theta}_1}{\dot{\theta}_2} = n$

(2)

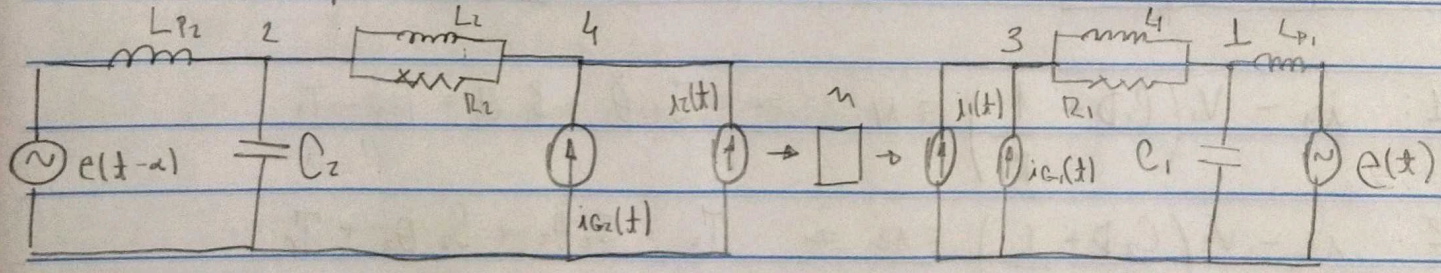


$$\begin{cases} f_1 = l_1(k_1\theta + b_1\dot{\theta}) \\ f_2 = l_2(k_2\theta + b_2\dot{\theta}) \\ q_1 = b_1(\dot{x}_G - \dot{x}_1) + k_1(x_G - x_1) \\ q_2 = b_2(\dot{x}_G - \dot{x}_2) + k_2(x_G - x_2) \end{cases}$$

Com $P = F \cdot V$

e $P_1 = P_2 \Rightarrow f_1 \cdot \theta_1 \, l_1 = f_2 \, \theta_2 \, l_2 \Rightarrow \dfrac{f_2}{f_1} = \dfrac{l_1}{l_2} = n$

Analogia tipo (2)



nó 1: $V_1\left(C_1 D + \dfrac{1}{R_1} + \dfrac{1}{L_1 D} + \dfrac{1}{L_{1P} D}\right) - V_3\left(\dfrac{1}{R_1} + \dfrac{1}{L_1 D}\right) = e(t)\dfrac{1}{L_{1P} D}$

nó 2: $V_2\left(C_2 D + \dfrac{1}{R_2} + \dfrac{1}{L_2 D} + \dfrac{1}{L_{2P}}\right) - e(t-\alpha)\dfrac{1}{L_{2P} D} - V_4\left(\dfrac{1}{L_2 D} + \dfrac{1}{R_2}\right) = 0$

nó 3: $i_1(t) + i_{G_1}(t) = V_3\left(\dfrac{1}{R_1} + \dfrac{1}{L_2 D}\right)$

nº 4:

$$i_{L2}(t) + V_4\left(\frac{1}{R_2} + \frac{1}{L_2 D}\right) = i_{G2}(t)$$

Da eq. 2 em 4: $m_2 \ddot{x}_2 + b_2 \dot{x}_2 + (K_2 + K_{2P}) = K_{2P} \cdot z_1(t) - f_{r2}(t) + f_{o2}(t)$

Da eq. 3 em 1: $m_1 \ddot{x}_1 + b_1 \dot{x}_1 + (K_1 + K_{1P}) x_1 = K_{1P} \cdot z_1(t) + f_{r1}(t) + f_{o1}(t)$