

Exercício aula 15/09

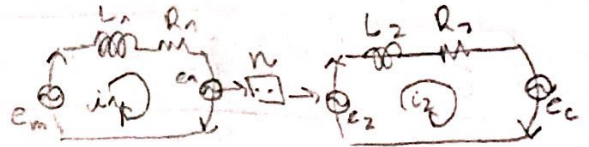
① Analogia do tipo 1:

- Equações do circuito elétrico:

$$e_m(t) = (L_1 D + R_1) i_1 + e_1(t)$$

$$e_2(t) = (L_2 D + R_2) i_2 + e_c(t)$$

$$e_2(t) = n e_1(t)$$



- Por analogia equações do sistema mecânico:

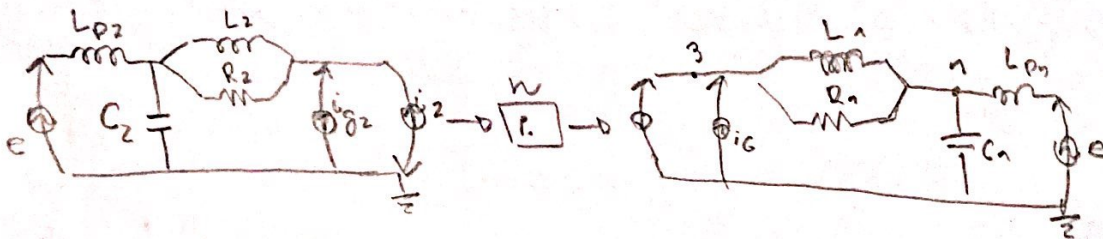
$$(J_1 D + B_1) \omega_1 = T_m - T_1$$

$$(J_2 D + B_2) \omega_2 = T_2 - T$$

$$J_1 \ddot{\theta}_1 + B_1 \dot{\theta}_1 = T_m - T_1 \quad J_2 \ddot{\theta}_2 + B_2 \dot{\theta}_2 = T_2 - T_c$$

$$T_2 = n \cdot T_1 \quad \therefore \dot{\theta}_2 = \dot{\theta}_1 / n$$

② Analogia tipo 2:



$$\text{Nó 1: } V_1 \left(C_2 D + \frac{n}{R_1} + \frac{1}{L_1 D} + \frac{1}{L_2 D} \right) - e(t) \cdot \frac{1}{L_2 D} - V_3 \left(\frac{1}{R_1} + \frac{1}{L_1 D} \right) = 0$$

$$\text{Nó 2: } V_2 \left(C_2 D + \frac{1}{R_2} + \frac{1}{L_2 D} + \frac{1}{L_2 D} \right) - e(t) \cdot \frac{1}{L_2 D} - V_4 \left(\frac{1}{R_2} + \frac{1}{L_2 D} \right) = 0$$

$$\text{Nó 3: } V_3 \left(\frac{1}{R_1} + \frac{1}{L_1 D} \right) = i(t) + i_3(t)$$

$$\text{Nó 4: } V_4 \left(\frac{1}{R_2} + \frac{1}{L_2 D} \right) = i_2(t) + i_3(t)$$

→ Rearranjando:

$$m_1 \ddot{x}_1 + b_1 \dot{x}_1 + (K_1 + K_{1p}) x_1 = K_{1p} z(t) + f_1(t) + f_{g1}(t)$$

$$m_2 \ddot{x}_2 + b_2 \dot{x}_2 + (K_2 + K_{2p}) x_2 = K_{2p} z(t - \alpha) - f_2(t) + f_{g2}(t)$$

3) $J_1 \cdot \dot{\omega}_1 + B_1 \cdot \omega_1 + T_1 = T_m$

$$J_2 \cdot \dot{\omega}_2 + B_2 \cdot \omega_2 + T_c = T_2 = n T_1$$

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

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

$$\dot{\omega}_2 \underbrace{(J_2 + n^2 J_1)}_{J_{eq2}} + \omega_2 \underbrace{(B_2 + n^2 B_1)}_{B_{eq2}} + T_c = n T_m$$

$$J_{eq2} \cdot \dot{\omega}_2 + B_{eq2} \cdot \omega_2 = T_m \cdot n - T_c$$