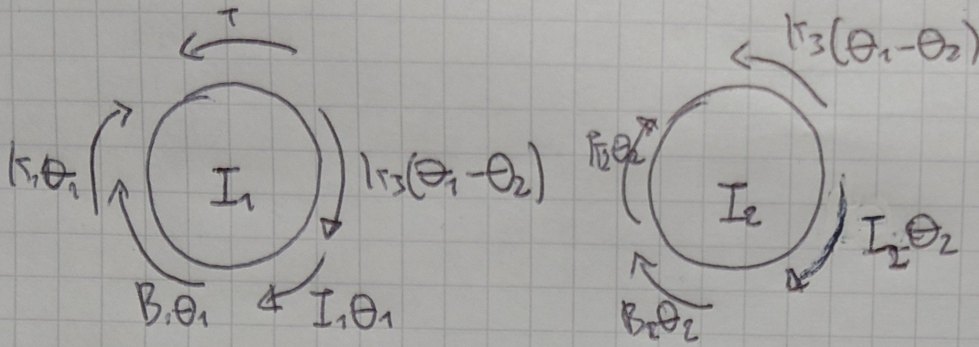
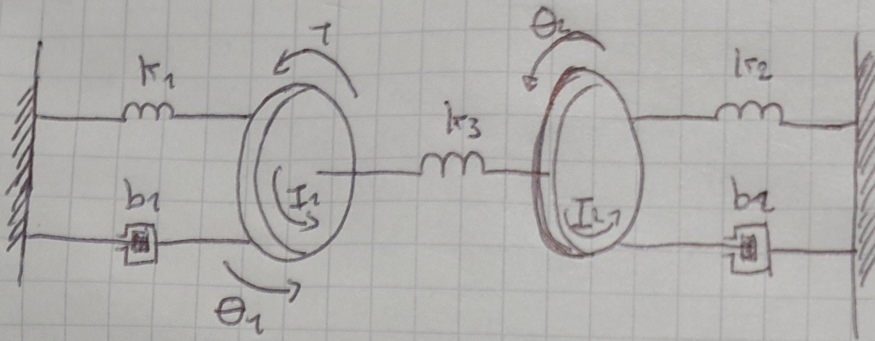


Tarea 2



$$\Rightarrow I_1 \ddot{\theta}_1 + B_1 \dot{\theta}_1 + k_1 \theta_1 + k_3 (\theta_1 - \theta_2) = T$$

$$\ddot{\theta}_1 = \frac{B_1 \dot{\theta}_1}{I_1} - \frac{k_1 \theta_1}{I_1} - \frac{k_3 \theta_1}{I_1} + \frac{k_3 \theta_2}{I_1} + \frac{T}{I_1}$$

$$\Rightarrow \ddot{\theta}_1 = \frac{B_1 \dot{\theta}_1}{I_1} - \frac{\theta_1 (k_3 + k_1)}{I_1} + \frac{k_3 \theta_2}{I_1} + \frac{T}{I_1} \quad (1)$$

$$0 = k_3 (\theta_1 - \theta_2) - k_2 \theta_2 - B_2 \dot{\theta}_2 - I_2 \ddot{\theta}_2$$

$$\Rightarrow \ddot{\theta}_2 = \frac{k_3 \theta_1}{I_2} - \frac{\theta_2 (k_3 + k_2)}{I_2} - \frac{B_2 \dot{\theta}_2}{I_2} \quad (2)$$

Para (1)

$$\left. \begin{aligned} q_1 &= \theta_1 \\ \dot{q}_2 &= \dot{q}_1 = \dot{\theta}_1 \\ \ddot{q}_2 &= \ddot{q}_1 = \ddot{\theta}_1 \end{aligned} \right\} \Rightarrow \dot{q}_2 = \frac{-B_1 q_2}{I_1} - \frac{q_1 (k_3 + k_1)}{I_1} + \frac{k_3 q_3}{I_1} + \frac{T}{I_1} \quad (1)$$

Para 2

$$\left. \begin{aligned} q_3 &= \theta_2 \\ q_4 &= \dot{\theta}_2 = \dot{q}_3 \\ \dot{q}_4 &= \dot{q}_3 = \ddot{\theta}_2 \end{aligned} \right\} \Rightarrow \ddot{q}_4 = \frac{l r_3 \phi_1}{I_2} - \frac{q_3 (l r_3 + l r_2)}{I_2} - \frac{B_2 q_4}{I_2} \quad (2)$$

$$\Rightarrow \begin{bmatrix} \ddot{q}_1 \\ \ddot{q}_2 \\ \ddot{q}_3 \\ \ddot{q}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{(l r_3 + k_1)}{I_1} & -\frac{B_1}{I_1} & \frac{l r_1}{I_1} & 0 \\ 0 & 0 & 0 & 1 \\ \frac{l r_1}{I_1} & 0 & -\frac{(l r_3 + k_2)}{I_2} & -\frac{B_2}{I_2} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{I_1} \\ 0 \\ 0 \end{bmatrix} [T]$$

$$\begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix}$$