

TAREA #2. FABIAN LEONARDO CAMARGO BERNACE 20211005048

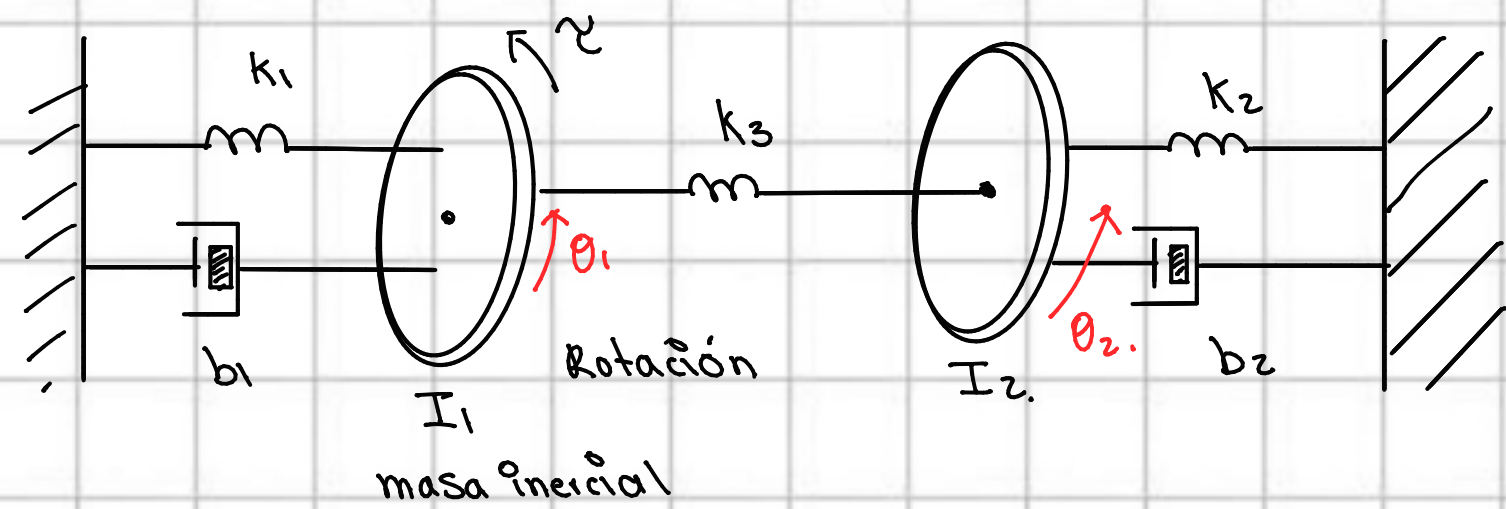
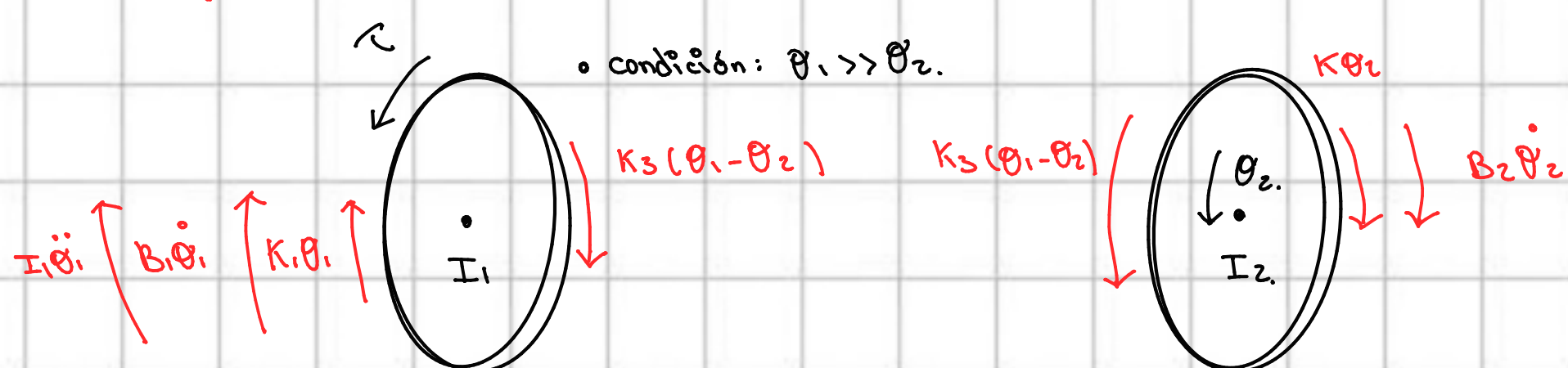


Diagrama de cuerpo libre



Ecuaciones:

$$① \quad I_1 \ddot{\theta}_1 + B_1 \dot{\theta}_1 + K_1 \theta_1 + K_3 (\theta_1 - \theta_2) = \tau$$

$$② \quad K_3 (\theta_1 - \theta_2) - B_2 \dot{\theta}_2 - K_2 \theta_2 - I_2 \ddot{\theta}_2 = 0$$

ecuaciones

$$1. \quad I_1 \ddot{\theta}_1 + B_1 \dot{\theta}_1 + K_1 \theta_1 + K_3 \theta_1 - K_3 \theta_2 = \tau$$

$$\underline{I_1 \ddot{\theta}_1 + B_1 \dot{\theta}_1 + \theta_1 (K_1 + K_3) - K_3 \theta_2 = \tau}$$

$$2. \quad I_2 \ddot{\theta}_2 + B_2 \dot{\theta}_2 + K_2 \theta_2 - K_3 \theta_1 + K_3 \theta_2 = 0$$

$$\underline{I_2 \ddot{\theta}_2 + B_2 \dot{\theta}_2 + (K_2 + K_3) \theta_2 - K_3 \theta_1 = 0}$$

→ Ecuaciones Resultantes expresar en el diagrama de estados.

→ Torque.

$$1. \quad \tau = \ddot{\theta}_1 I_1 + B_1 \dot{\theta}_1 + \theta_1 (K_1 + K_3) - \theta_2 K_3$$

$$2. \quad \ddot{\theta}_2 I_2 + B_2 \dot{\theta}_2 + \theta_2 (K_2 + K_3) - K_3 \theta_1 = 0$$

Definir variables de estado

$$\begin{aligned} q_1 &= \theta_1 & q_3 &= \theta_2 & y_1 &= q_1 = \theta_1 \\ q_2 &= \dot{\theta}_1 = \dot{q}_1 & q_4 &= \dot{\theta}_2 = \dot{q}_3 & y_2 &= q_3 = \theta_2 \\ \dot{q}_1 &= \dot{\theta}_1 & \dot{q}_4 &= \dot{\theta}_2 \end{aligned}$$

→ Reemplazando las variables de estado

$$1. \quad \tau = q_2 I_1 + B_1 q_2 + q_1 (K_1 + K_3) - q_3 K_3$$

$$\bullet \quad \dot{q}_2 = 1/I_1 (\tau - B_1 q_2 - q_1 (K_1 + K_3) + q_3 K_3)$$

$$2. \quad I_2 \dot{q}_4 + B_2 q_4 + q_3 (K_2 + K_3) - q_1 K_3 = 0$$

$$\bullet \quad \dot{q}_4 = q_1 \frac{K_3}{I_2} - q_3 \frac{K_2 + K_3}{I_2} - q_4 \frac{B_2}{I_2}$$

→ Representación del espacio de estados

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{-K_1 - K_3}{I_1} & \frac{-B_1}{I_1} & \frac{K_3}{I_1} & 0 \\ 0 & 0 & 0 & 1 \\ \frac{K_3}{I_2} & 0 & \frac{-K_2 - K_3}{I_2} & \frac{-B_2}{I_2} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 1/I_1 \\ 0 \\ 0 \end{bmatrix} \tau.$$

Salida

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$