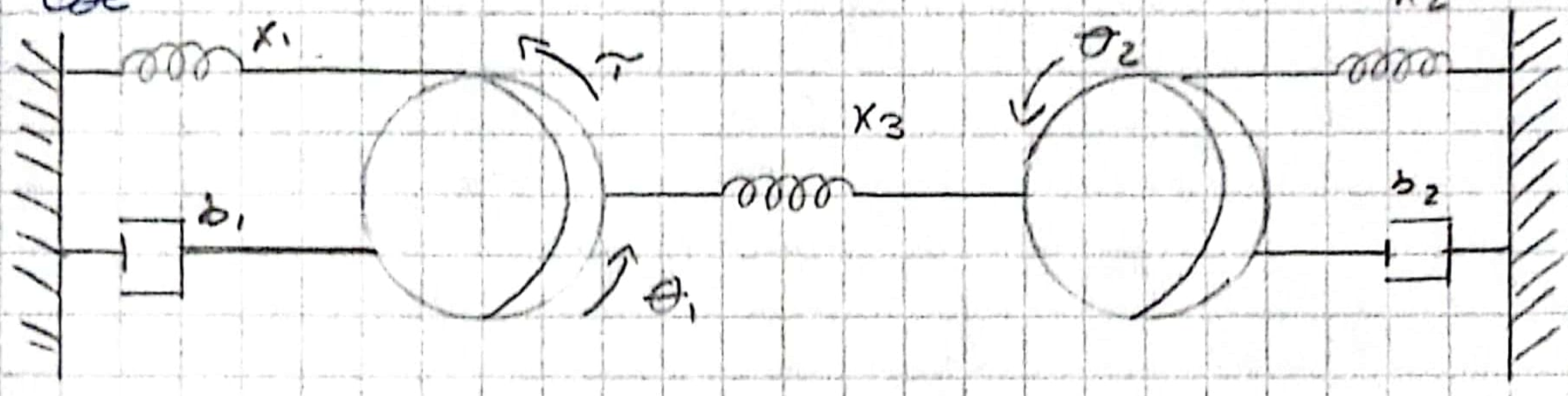
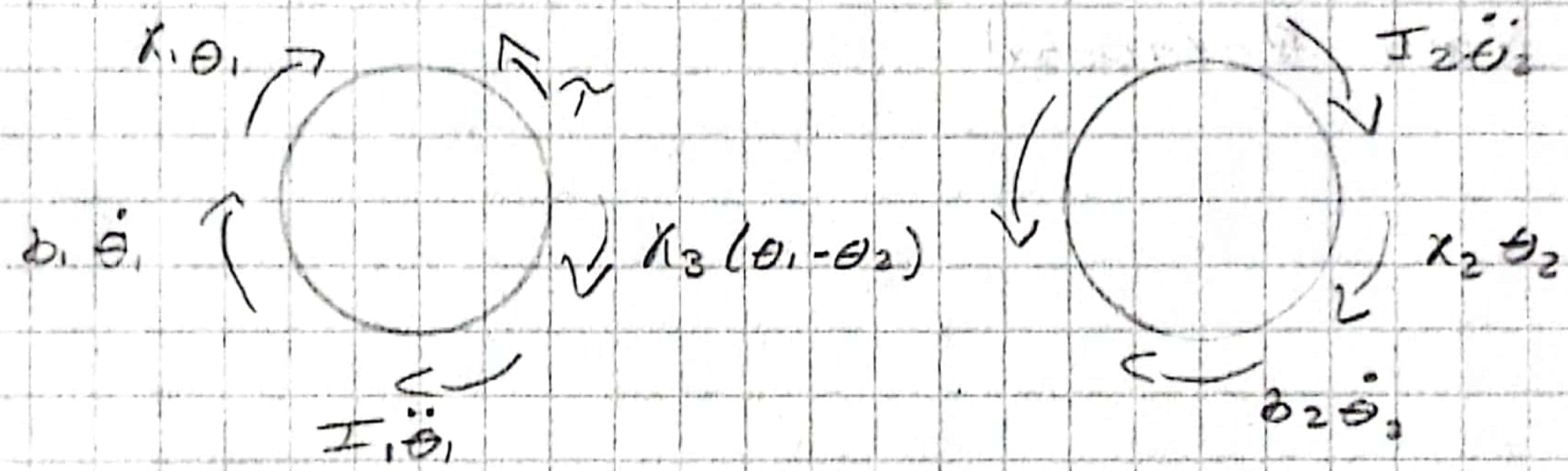
Eje



✓ Al realizar el diagrama de cuerpo libre



✓ Para la masa rotacional 1

$$\tau = K_1\theta_1 + b_1\dot{\theta}_1 + I_1\ddot{\theta}_1 + K_3(\theta_1-\theta_2)$$
$$\tau = K_1\theta_1 + K_3\theta_1 - K_3\theta_2 + b_1\dot{\theta}_1 + I\ddot{\theta}_1$$

$$\ddot{\theta}_1 = -\frac{\tau}{I} - \frac{b_1}{I}\dot{\theta}_1 + \frac{K_3}{I}\theta_2 - \frac{(K_1+K_3)}{I}\theta_1 \qquad (1)$$

✓ Para la masa rotacional 2

$$0 = K_3(\theta_1-\theta_2) - b_2\dot{\theta}_2 - K_2\theta_2 - I_2\ddot{\theta}_2$$

$$\ddot{\theta}_2 = \frac{K_3}{I}(\theta_1-\theta_2) - \frac{b_2}{I}\dot{\theta}_2 - \frac{K_2}{I}\theta_2$$

$$\ddot{\theta}_2 = \frac{K_3}{I}\theta_1 - \frac{K_3}{I}\theta_2 - \frac{b_2}{I}\dot{\theta}_2 - \frac{K_2}{I}\theta_2 \qquad (2)$$

$$\ddot{\theta}_2 = \frac{K_3}{I}\theta_1 - \frac{(K_3+K_2)}{I}\theta_2 - \frac{b_2}{I}\dot{\theta}_2$$

✓ Si se consideran las variables de estado así

$q_1 = \theta_1$; $q_2 = \dot{\theta}_1$; $\dot{q}_2 = \ddot{\theta}_1$

$q_3 = \theta_2$; $q_4 = \dot{\theta}_2$; $\dot{q}_4 = \ddot{\theta}_2$

✓ Reemplazando en (1) y (2)

$$\dot{q}_2 = -\frac{b_1}{I} q_2 + \frac{K_3}{I} q_3 - \frac{(K_1+K_3)}{I} q_1 - \frac{T}{I} \quad (3)$$

$$\dot{q}_4 = \frac{K_3}{I} q_1 - \frac{(K_3+K_2)}{I} q_3 - \frac{b_2}{I} q_4 \quad (4)$$

✓ Para la matriz de estados

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 1 \\ -(K_1+K_3)/I & -b_1/I & K_3/I & 0 \\ 0 & 0 & 1 & 0 \\ K_3/I & 0 & -(K_3+K_2)/I & -b_2/I \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ -1/I \\ 0 \\ 0 \end{bmatrix} T$$

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