Clase 18 Abril

libro: Feedback Control of Dynamic Sistems

8th edición

Franklin

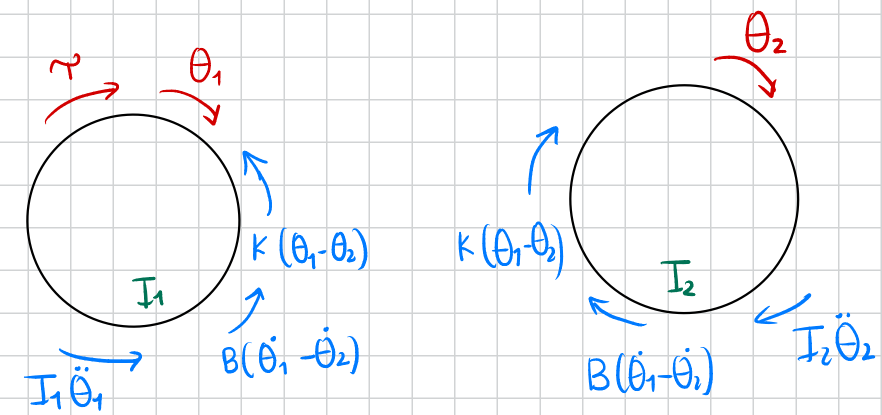
aceleración angular (rad/s^2)

Sumatoria $\leftarrow \sum = I_0 \alpha$

$[N \cdot m]$

momento inercial (kg/m^2)

ejercicio del libro:



$$\tau_c - k(\theta_1-\theta_2) - b(\dot{\theta}_1-\dot{\theta}_2) = I_1\ddot{\theta}_1 \qquad \ddot{\theta}_1 = ?$$

$$b(\dot{\theta}_1-\dot{\theta}_2) + k(\theta_1-\theta_2) = I_2\ddot{\theta}_2 \qquad \ddot{\theta}_2 = ?$$

Tarea: Corrección parcial

Tarea: hacerlo en SS

$q_1 = \theta_1$

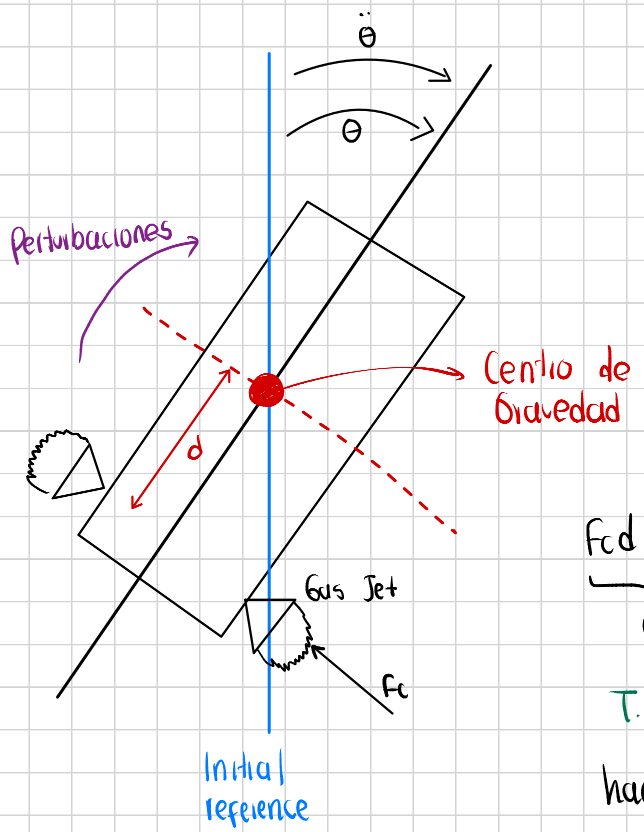
$q_2 = \dot{q}_1 = \dot{\theta}_1$

$q_3 = \dot{q}_2 = \ddot{\theta}_1$

$q_4 = \theta_2$

$q_5 = \dot{q}_4 = \dot{\theta}_2$

$q_6 = \dot{q}_5 = \ddot{\theta}_2$



$$\underbrace{F_c d + M_D}_{u} = I\ddot{\theta}$$

$$u = I\ddot{\theta}$$

T. function

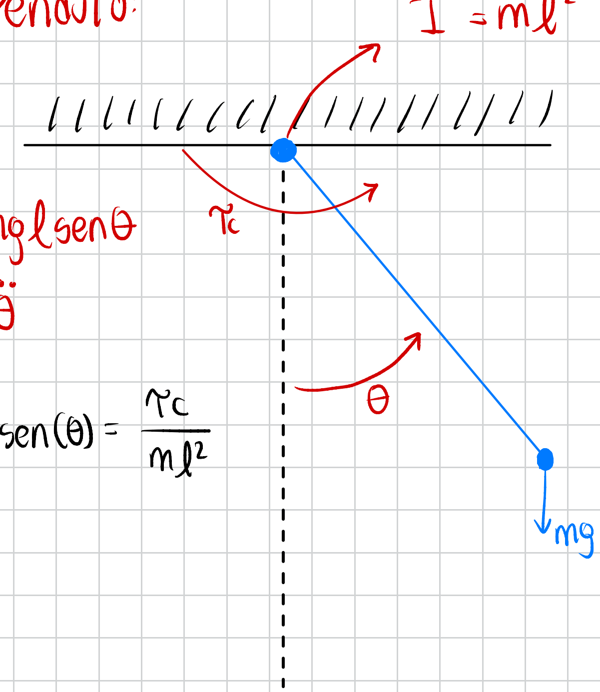
haciendo laplace

$$U(s) = Is^2\,\theta(s)$$

$$\frac{\theta(s)}{U(s)} = \frac{1}{Is^2}$$

Pendulo:

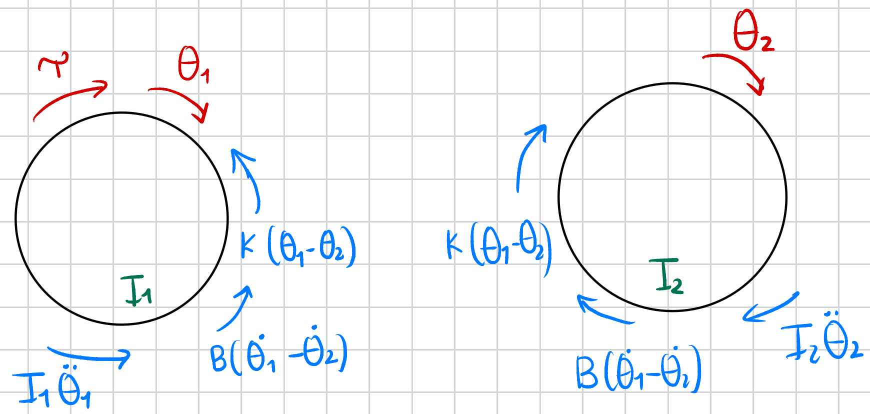
$I = ml^2 \rightarrow$ momento inercial



$\tau_c = -mgl\,\text{sen}\,\theta$

$\tau_c = I\ddot{\theta}$

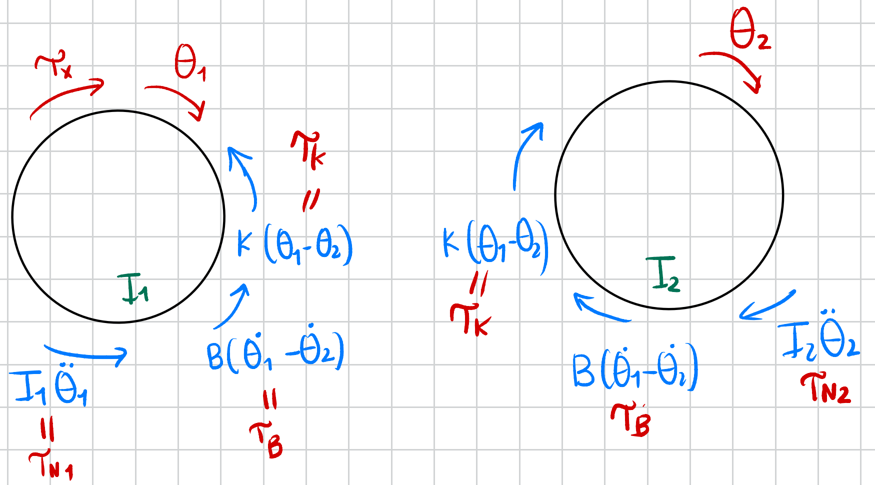
$$\ddot{\theta} + \frac{g}{l}\text{sen}(\theta) = \frac{\tau_c}{ml^2}$$



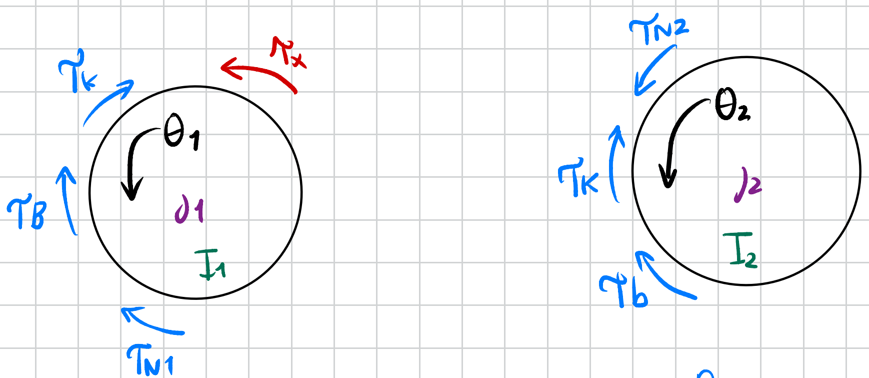
Solución Tarea 2:

$$\tau_c - k(\theta_1-\theta_2) - b(\dot\theta_1-\dot\theta_2) = I_1\ddot\theta_1 \qquad \ddot\theta_1 = ?$$

$$b(\dot\theta_1-\dot\theta_2) + k(\theta_1-\theta_2) = I_2\ddot\theta_2 \qquad \ddot\theta_2 = ?$$



Definiendo: $\theta_1 > \theta_2$



Definimos estados.

Definimos la salida $u = \tau_x$

$x_1 = \theta_1$

$x_2 = \dot x_1$

$x_3 = \theta_2$

$x_4 = \dot x_3$

$\tau_k = k(x_1-x_3)$ $\quad \tau_{b1} = b(x_2-x_4)$ $\quad \tau_{N1} = J_1\dot x_2$, $\tau_{N2} = J_2\dot x_4$

$$u = k(x_1-x_3) + b(x_2-x_4) + J_1\dot x_2$$

$$J_2\dot x_4 = b(x_2-x_4) + k(x_1-x_3)$$

$$\Longrightarrow \quad \dot x_2 = \frac{-k}{J_1}x_1 - \frac{b}{J_1}x_2 + \frac{k}{J_1}x_3 + \frac{b}{J_1}x_4 + \frac{u}{J_1}$$

$$\dot x_4 = \frac{k}{J_2}x_1 + \frac{b}{J_2}x_2 - \frac{k}{J_2}x_3 - \frac{b}{J_2}x_4$$

$$\dot{\vec{x}} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -k/J_1 & -b/J_1 & \frac{k}{J_1} & \frac{b}{J_1} \\ 0 & 0 & 1 & 0 \\ k/J_2 & b/J_2 & -k/J_2 & -b/J_2 \end{bmatrix} \vec{x} + \begin{bmatrix} 0 \\ 1/J_1 \\ 0 \\ 0 \end{bmatrix} u$$

las salidas son $x_1 \to \ddot\theta_1$ y $x_2 \to \ddot\theta_2$

$$\vec{y} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}\vec{x} + \vec{0}u$$