- $\frac{-1}{s+3} + \frac{-3}{s+3} + \frac{1}{s}$ → Aplicando $\mathcal{L}^{-1}\{\}$

- $-e^{-3t} - 3e^{-3t} + 1$

Desarrollo Ejercicios corte 2

1) hallar la representacion en el espacio de estados de

Disco 1

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

Disco 2

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

- $q_1 = \theta_1$

$q_1 = \dot{q}_1 = \dot{\theta}_1$

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

$q_3 = \theta_2$

$q_4 = \dot{q}_3 = \dot{\theta}_2$

$\dot{q}_4 = \ddot{q}_3 = \ddot{\theta}_2$

$$\frac{T_c}{I_1} - \frac{k}{I_1}(\theta_1 - \theta_2) - \frac{b}{I_1}(\dot{\theta}_1 - \dot{\theta}_2) = \ddot{\theta}_1 \quad (1)$$

$$\frac{b}{I_2}(\dot{\theta}_1 - \dot{\theta}_2) + \frac{k}{I_2}(\theta_1 - \theta_2) = \ddot{\theta}_2 \quad (2)$$

Expandiendo

$$\frac{T_c}{I_1} - \frac{k}{I_1}\theta_1 + \frac{k}{I_1}\theta_2 - \frac{b}{I_1}\dot{\theta}_1 + \frac{b}{I_1}\dot{\theta}_2 = \ddot{\theta}_1 \quad (3)$$

$$\frac{b}{I_2}\dot{\theta}_1 - \frac{b}{I_2}\dot{\theta}_2 + \frac{k}{I_2}\theta_1 - \frac{k}{I_2}\theta_2 = \ddot{\theta}_2 \quad (4)$$

Sustituyendo de (3) en las variables de estado

$$\frac{Tc}{I_1} - \frac{u}{I_1} q_1 + \frac{u}{I_1} q_3 - \frac{b}{I_1} q_2 + \frac{b}{I_1} q_4 = \dot{q}_2$$

sustituyendo de (4)

$$\frac{b}{I_2} q_2 - \frac{b}{I_2} q_4 + \frac{u}{I_2} q_1 - \frac{u}{I_2} q_3 = \dot{q}_4$$

Planteo la matriz

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{\theta} \\ q_3 \\ \dot{} \\ q_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -\frac{u}{I_1} & \frac{-b}{I_1} & \frac{u}{I_1} & \frac{b}{I_1} \\ 0 & 0 & 0 & 1 \\ \frac{u}{I_2} & \frac{b}{I_2} & \frac{-u}{I_2} & \frac{-b}{I_2} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 1/I_1 \\ 0 \\ 0 \end{bmatrix} Tc$$

la salida

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