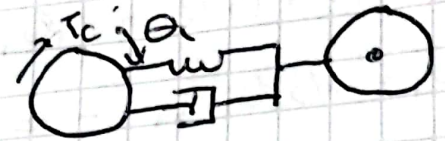
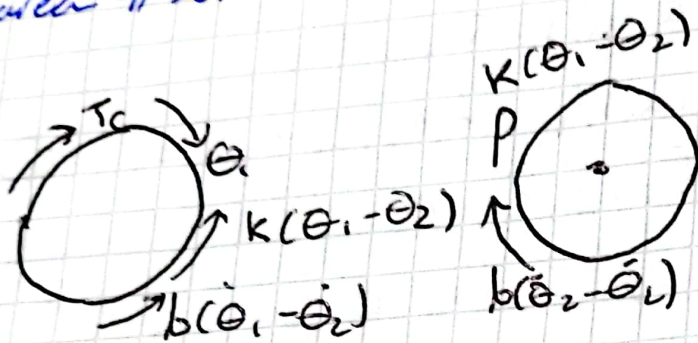


$$\begin{bmatrix} \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} = \begin{bmatrix} \frac{k_1}{I_1} \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \begin{bmatrix} 10 & 0 \\ 00 & 10 \end{bmatrix}$$

Tower #2.



- 1) $T_c - k(\theta_1 - \theta_2) - b(\dot{\theta}_1 - \dot{\theta}_2) = I_1 \ddot{\theta}_1$
- 2) $b(\dot{\theta}_1 - \dot{\theta}_2) + k(\theta_1 - \theta_2) = I_2 \ddot{\theta}_2$

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

$$\frac{T_c}{I_1} = \frac{k_1}{I_1} q_1 + \frac{k q_3}{I_1} - \frac{b q_2}{I_1} + \frac{b q_4}{I_1} - \ddot{q}_2$$

$$q_1 = \theta_1$$

$$q_3 = \theta_2$$

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

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

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

$$q_1 = \dot{q}_3 = \dot{\theta}_2$$

$$\frac{b \dot{q}_1}{I_2} - \frac{b \dot{q}_2}{I_2} + \frac{k q_1}{I_2} - \frac{k q_2}{I_2} = \ddot{\theta}_2$$

$$\frac{b q_2}{I_2} - \frac{b q_4}{I_2} + \frac{k q_2}{I_2} - \frac{k q_3}{I_2} = \ddot{q}_4$$

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -\frac{k}{I_1} & -\frac{b}{I_1} & \frac{k}{I_1} & \frac{b}{I_1} \\ 0 & 0 & 0 & 1 \\ 0 & (\frac{k+b}{I_2}) & -\frac{k}{I_2} & -\frac{b}{I_2} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{I_1} \\ 0 \\ 0 \end{bmatrix} T_c$$

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