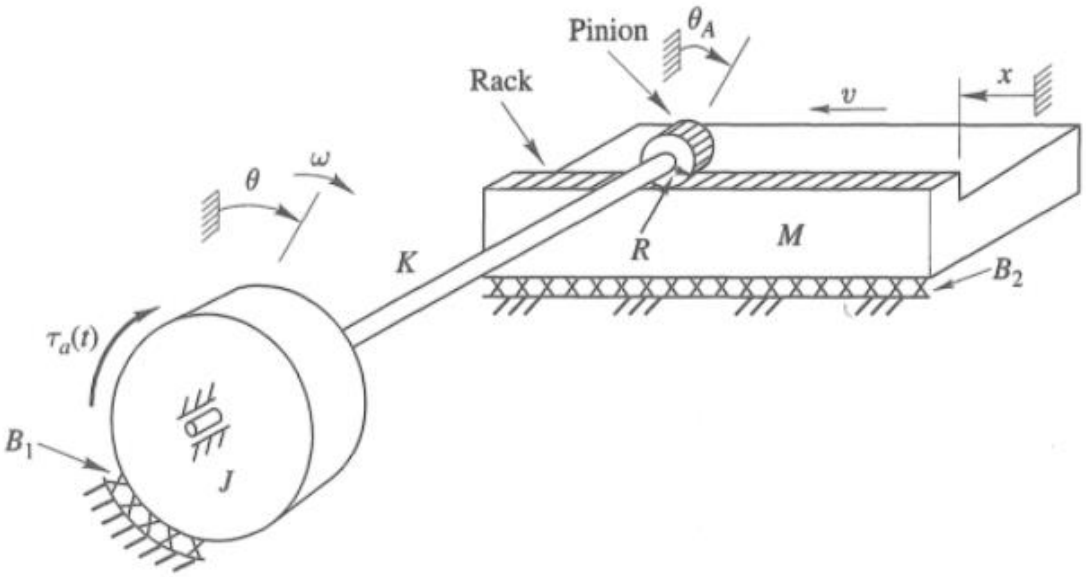
Ejercicio 2 (Taller 2 de sistemas mecánicos)



$$J\ddot{\theta} = \tau_a - B_1\dot{\theta} - K(\theta - \theta_A)$$

$$0 = -K(\theta_A - \theta) - FR$$

$$M\ddot{x} = F - B_2\dot{x}$$

$$\theta_A R = x$$

Salida:

$$y = x$$

$$\ddot{\theta} = \frac{\tau_a - B_1\dot{\theta} - K(\theta - \theta_A)}{J}$$

$$FR = K(\theta - \theta_A)$$

$$F = \frac{K(\theta - \theta_A)}{R}$$

$$\ddot{x} = \frac{F - B_2\dot{x}}{M}$$

$$\theta_A = \frac{x}{R}$$

Representacion en VE:

$$\dot{x} = f(x,u) = Ax + Bu$$

$$y = g(x,u) = Cx + Du$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} \theta \\ \dot{\theta} \\ x \\ \dot{x} \end{bmatrix}$$

$$u = \tau_a$$

$$y = x_3$$

$$\boldsymbol{\dot{x}_1 = x_2}$$

$$\dot{x}_2 = \ddot{\theta} = \frac{\tau_a - B_1\dot{\theta} - K(\theta - \theta_A)}{J}$$

$$\dot{x}_2 = \frac{u - B_1 x_2 - K\left(x_1 - \frac{x_3}{R}\right)}{J}$$

$$\boldsymbol{\dot{x}_2 = \frac{u - B_1 x_2 - K x_1 + K\frac{x_3}{R}}{J}}$$

$$\boldsymbol{\dot{x}_3 = x_4}$$

$$\dot{x}_4 = \ddot{x} = \frac{F - B_2\dot{x}}{M}$$

$$\dot{x}_4 = \frac{\frac{K\left(x_1 - \frac{x_3}{R}\right)}{R} - B_2 x_4}{M}$$

$$\boldsymbol{\dot{x}_4 = \frac{\frac{K x_1}{R} - \frac{K x_3}{R^2} - B_2 x_4}{M}}$$

$$\boxed{\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \end{bmatrix} = \begin{pmatrix} 0 & 1 & 0 & 0 \\ -\frac{K}{J} & -\frac{B_1}{J} & \frac{K}{RJ} & 0 \\ 0 & 0 & 0 & 1 \\ \frac{K}{RM} & 0 & -\frac{K}{R^2 M} & -\frac{B_2}{M} \end{pmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{pmatrix} 0 \\ \frac{1}{J} \\ 0 \\ 0 \end{pmatrix} u}$$

$$\boxed{y = \begin{pmatrix} 0 & 0 & 1 & 0 \end{pmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}}$$