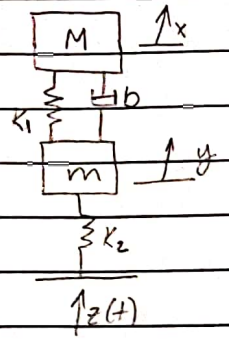
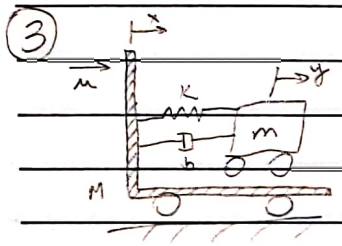
Exercício

② 

$$\begin{cases} M\ddot{x} + K_1(x-y) + b(\dot{x}-\dot{y}) = 0 \\ m\ddot{y} - K_1(x-y) - b(\dot{x}-\dot{y}) + K_2(y-z) = 0 \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \ddot{x} \\ \ddot{y} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -K_1/M & K_1/M & -b/M & b/M \\ K_1/m & (-K_1-K_2)/m & b/m & -b/m \end{bmatrix} \begin{bmatrix} x \\ y \\ \dot{x} \\ \dot{y} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ K_2/m \end{bmatrix} z(t)$$

$\dot{u} = Au + Bz$

③ 

$$\begin{cases} m\ddot{y} + K(y-x) + b(\dot{y}-\dot{x}) = 0 \\ M\ddot{x} - K(y-x) - b(\dot{y}-\dot{x}) = u \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \ddot{x} \\ \ddot{y} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -K/M & K/M & -b/M & b/M \\ K/m & -K/m & b/m & -b/m \end{bmatrix} \begin{bmatrix} x \\ y \\ \dot{x} \\ \dot{y} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1/M \\ 0 \end{bmatrix} u(t)$$

$\dot{z} = Az + Bu$

④
$$\begin{cases} m_1\ddot{x}_1 + K(x_1 - z) - K_1(x_G - x_1 + l\theta) - b_1(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) \\ m_2\ddot{x}_2 + K(x_2 - z') - K_2(x_G - x_2 - l\theta) - b_2(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) \\ M\ddot{x}_G + K_1(x_G - x_1 + l\theta) + K_2(x_G - x_2 - l\theta) + b_1(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) + b_2(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) \\ J_G\ddot{\theta} + K_1 l(x_G - x_1 + l\theta) - K_2 l(x_G - x_2 - l\theta) + b_1 l(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) + b_2 l(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) \end{cases}$$

⑤ $\begin{cases} (M+m)\ddot{x} + m\ell\ddot{\theta} = u \\ J\ddot{\theta} + m\ell\ddot{x} - mlg\theta = 0 \end{cases}$

$\dot{X} = AX + Bu$

$$A = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -\frac{m^2\ell^2}{J(m+M) - m^2\ell^2} & 0 & 0 \\ 0 & \frac{g m \ell (M+m)}{J(M+m) - m^2\ell^2} & 0 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ \frac{1}{M+m - m^2\ell^2/J} \\ \frac{-g m \ell}{J(m+M) - m^2\ell^2} \end{bmatrix}$$

⑥ $\begin{cases} m\ddot{x} = mg - KI^2/x^2 \\ L\dot{I} + RI = V \end{cases}$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 2KI_0^2/mx_0^3 & 0 & -\frac{2KI_0}{mx_0^2} \\ 0 & 0 & -R/L \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1/L \end{bmatrix}$$