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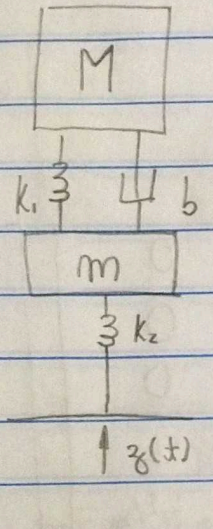
(2)

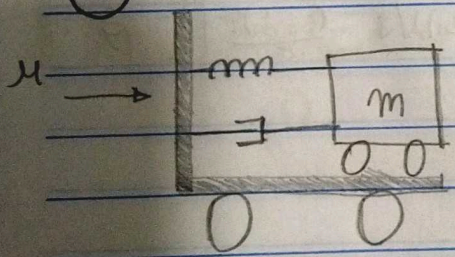


Equação movimento:

$$\begin{cases} M\ddot{x} = -k_1(x-y) - b(\dot{x}-\dot{y}) \\ m\ddot{y} = k_1(x-y) + b(\dot{x}-\dot{y}) - k_2(y-z(t)) \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \ddot{x} \\ \dot{y} \\ \ddot{y} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -k_1/M & -b/M & k_1/m & b/m \\ 0 & 0 & 0 & 1 \\ k_1/M & -b/m & \frac{-k_1-k_2}{m} & -b/m \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ k_2/m \end{bmatrix} Z(t)$$

(3) M



Eq. movimento:

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

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

(4)

$$J_G\ddot{\theta} + b_1 l(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) - b_2 l(\dot{x}_G + \dot{x}_2 - l\dot{\theta}) + K_1 l(x_G - x_1 + l\theta) - K_2 l(x_G - x_2 - l\theta) = 0$$

$$M\ddot{x}_G + b_1(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) + b_2(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) + K_1(x_G - x_1 + l\theta) + K_2(x_G - x_2 - l\theta) = 0$$

$$m_1\ddot{x}_1 + b_1(\dot{x}_G - \dot{x}_1 + l\dot{\theta}) + K_1(x_G - x_1 + l\theta) + K(x_1 - y_1) = 0$$

$$m_2\ddot{x}_2 + b_2(\dot{x}_G - \dot{x}_2 - l\dot{\theta}) + K_2(x_G - x_2 - l\theta) + K(x_2 - y) = 0$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_G \\ \dot{\theta} \\ \ddot{x}_1 \\ \ddot{x}_2 \\ \ddot{x}_G \\ \ddot{\theta} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ -\frac{(K+K_1)}{m_1} & 0 & 0 & K_1 l/m_1 & -b_1/m_1 & 0 & b_1/m_1 & b_1 l/m_1 \\ 0 & -\frac{(K+K_2)}{m_2} & K_2/m_2 & -K_2 l/m_2 & 0 & -b_2/m_2 & b_2/m_2 & -b_2 l/m_2 \\ K_1/M & K_2/M & -(K_1+K_2)/M & l(K_2-K_1)/M & b_1/M & b_2/M & -(b_1+b_2)/M & \frac{l(b_2-b_1)}{M} \\ K_1 l/J & -K_2 l/J & (K_2-K_1)l/J & -(K_2+K_1)l^2/J & b_1 l/J & -b_2 l/J & (b_2-b_1)l/J & -\frac{(b_2-b_1)l^2}{J} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_G \\ \theta \\ \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_G \\ \dot{\theta} \end{bmatrix}$$

⑤ Eq. movimento:

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

$$\begin{bmatrix} \dot{x} \\ \dot{\theta} \\ \ddot{x} \\ \ddot{\theta} \end{bmatrix} = \underbrace{\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & \frac{-m^2l^2}{J(M+m)-m^2l^2} & 0 & 0 \\ 0 & \frac{g_0 ml(M+m)}{J(M+m)-m^2l^2} & 0 & 0 \end{bmatrix}}_{A} \begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 1/(M+m-m^2l^2/J) \\ -g_0 ml/(J(M+m)-m^2l^2) \end{bmatrix}}_{B} \mu$$

⑥ Eq movimento:

$$\begin{cases} L\dot{I} + RI - V = 0 \\ m\ddot{x} = mg - KI^2/x^2 \end{cases}$$

$$\begin{bmatrix} \dot{x} \\ \ddot{x} \\ \dot{I} \end{bmatrix} = \underbrace{\begin{bmatrix} 0 & 1 & 0 \\ 2kI_0^2/mx_0^3 & 0 & -2KI_0/mx_0^2 \\ 0 & 0 & -R/L \end{bmatrix}}_{A} \begin{bmatrix} x \\ \dot{x} \\ I \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 1/L \end{bmatrix}}_{B} V$$