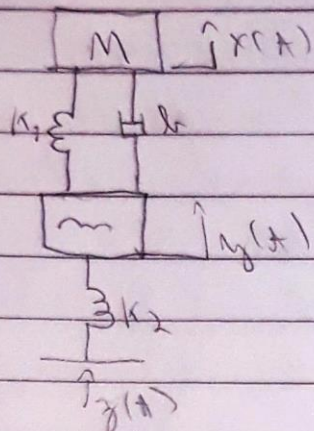


2.

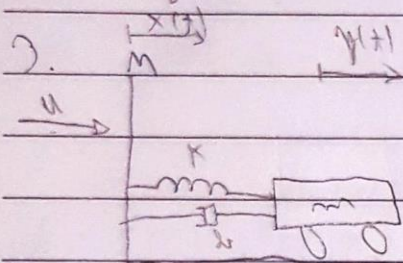


$$m\ddot{x} + k_1(y-x) + b(\dot{x}-\dot{y}) = 0$$

$$m\ddot{y} - k_1(x-y) - b(\dot{x}-\dot{y}) + k_2(y-z) = 0$$

$$\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -\frac{k_1}{m} & \frac{k_1}{m} & -\frac{b}{m} & \frac{b}{m} \\ \frac{k_1}{m} & -\frac{k_1+k_2}{m} & \frac{b}{m} & -\frac{b}{m} \end{bmatrix} \begin{bmatrix} x \\ y \\ \dot{x} \\ \dot{y} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{k_2}{m} \end{bmatrix} \begin{bmatrix} z \\ \dot{z} \\ \ddot{z} \\ \dot{\ddot{z}} \end{bmatrix}$$

2.



$$m\ddot{y} + k(y-x) + b(\dot{y}-\dot{x}) = 0$$

$$M\ddot{x} - k(y-x) - b(\dot{y}-\dot{x}) = u(t)$$

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

4. $\dot{x} = Ax + BV, U = [z(t), z(t-a)]$

$$m_1\ddot{x}_1 + k(x_1-z) - k_1(x_e - x_1 + l\theta) - b_1(\dot{x}_e - \dot{x}_1 + l\dot{\theta}) = 0$$

$$m_2\ddot{x}_2 + k(x_2-z) - k_2(x_e - x_2 + l\theta) - b_2(\dot{x}_e - \dot{x}_2 - l\dot{\theta}) = 0$$

$$M\ddot{x}_e + k_1(x_e - x_1 + l\theta) + k_2(x_e - x_2 - l\theta) + b_1(\dot{x}_e - \dot{x}_1 + l\dot{\theta}) + b_2(\dot{x}_e - \dot{x}_2 - l\dot{\theta}) = 0$$

$$J\ddot{\theta} + k_1 l(x_e - x_1 + l\theta) - k_2 l(x_e - x_2 - l\theta) + b_1 l(\dot{x}_e - \dot{x}_1 + l\dot{\theta}) + b_2 l(\dot{x}_e - \dot{x}_2 - l\dot{\theta}) = 0$$

5. $\begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & \frac{-m_1 k_1}{J(m_1+m_2)-m_1 l^2} & 0 & 0 \\ 0 & \frac{b_1 l(m_1+m_2)}{J(m_1+m_2)-m_1 l^2} & 0 & 0 \end{bmatrix} = A; \begin{bmatrix} 0 \\ 0 \\ \frac{1}{J(m_1+m_2)-m_1 l^2} \\ \frac{-k_2 l}{J(m_1+m_2)-m_1 l^2} \end{bmatrix} = B; \dot{x} = Ax + BV$

6. $\begin{bmatrix} 0 & 1 & 0 \\ \frac{2kI_0}{m_1 x_0^2} & 0 & -\frac{2kI_0}{m_1 x_0^2} \\ 0 & 0 & -\frac{k}{L} \end{bmatrix} = A; \begin{bmatrix} 0 \\ 0 \\ \frac{k}{L} \end{bmatrix} = B; x \begin{bmatrix} x \\ \dot{x} \\ I \end{bmatrix} U = V; \dot{x} = Ax + BV$