

$$1. \begin{bmatrix} \dot{x} \\ \dot{y} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -100 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u \Rightarrow \begin{bmatrix} Sx(s) - x(0) \\ Sy(s) - y(0) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -100 & 0 \end{bmatrix} \begin{bmatrix} x(s) \\ y(s) \end{bmatrix} + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u(s)$$

$$Sx(s) = y(s)$$

$$Sy(s) = -100x(s) + 10u(s)$$

$$FT(y) = \frac{y(s)}{u(s)} = \frac{10s}{s^2 + 100}$$

$$FT(x) = \frac{x(s)}{u(s)} = \frac{10}{s^2 + 100}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{z} \end{bmatrix} = \begin{bmatrix} -1 & 4 & 0 \\ 5 & 2 & 0 \\ -1 & 0 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u \quad \det(A - \lambda I) = \begin{bmatrix} -1-\lambda & 4 & 0 \\ 5 & 2-\lambda & 0 \\ -1 & 0 & -3-\lambda \end{bmatrix}$$

$$\det(A - \lambda I) = (-3-\lambda)[(-1-\lambda)(2-\lambda) - 20] \quad \text{com } \lambda = s$$

$$s_1 = -3 \quad s_2 = -4,217 \quad s_3 = 5,217$$

$$FT(y) = \frac{s+1}{(s-2)(s+1)-20}$$

$$FT(x) = \frac{1}{(s-2)(s+1)-20}$$

$$2. \quad m_1 \ddot{x}_1 - k(x_1 - x_2) = u_1 \quad \dot{x}_1 = x_3 \quad \dot{x}_3 = \frac{[u_1 + k(x_1 - x_2)]}{m_1}$$

$$m_2 \ddot{x}_2 - k(x_2 - x_1) = u_2 \quad \dot{x}_2 = x_4 \quad \dot{x}_4 = \frac{[u_2 + k(x_2 - x_1)]}{m_2}$$

$$A = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ k/m_1 & -k/m_1 & 0 & 0 \\ -k/m_2 & k/m_2 & 0 & 0 \end{bmatrix}$$

$$\det(A - \lambda I) = \begin{bmatrix} -\lambda & 0 & 1 & 0 \\ 0 & -\lambda & 0 & 1 \\ k/m_1 - k/m_1 & -k/m_1 & -\lambda & 0 \\ -k/m_2 & k/m_2 & 0 & -\lambda \end{bmatrix}$$

$$\lambda_1 = \sqrt{\frac{k}{m_1}}$$

$$\lambda_2 = -\sqrt{\frac{k}{m_2}}$$

$$\lambda_3 = \sqrt{\frac{k}{m_1}}$$

$$\lambda_4 = -\sqrt{\frac{k}{m_2}}$$