Ex:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -100 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u$$

$$\rightarrow \begin{bmatrix} sX(s) \\ sY(s) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -100 & 0 \end{bmatrix} \begin{bmatrix} X(s) \\ Y(s) \end{bmatrix} + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u \Rightarrow \begin{matrix} sX(s) = Y(s) \\ sY(s) = -100X(s) \\ \quad + 10u(s) \end{matrix}$$

$$\Downarrow$$

$$Y(s) = \frac{10s \cdot U(s)}{s^2 + 100}$$

$$F_1(s) = \frac{10s}{s^2+100} \; ; \; F_2 = \frac{10}{s^2+100} \qquad X(s) = \frac{10U(s)}{s^2+100}$$

Ex: 2)

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{z} \end{bmatrix} = \begin{bmatrix} -1 & 4 & 0 \\ 5 & 2 & 0 \\ -1 & 0 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u$$

$$\det(A - sI) = \begin{bmatrix} -1-s & 4 & 0 \\ 5 & 2-s & 0 \\ -1 & 0 & -3-s \end{bmatrix}$$

$$\det(A - sI) = (-3-s)\left[(-1-s)(2-s) - 20\right]$$

$$s_1 = -3 \; ; \; s_2 = \frac{1+\sqrt{89}}{2} \; ; \; s_3 = \frac{1-\sqrt{89}}{2}$$

2.1) $m_1\ddot{x}_1 - K(x_1 - x_2) = u_1$; $m_2\ddot{x}_2 - K(x_2 - x_1) = u_2$

$$\begin{bmatrix} \dot{x}_1 \\ \ddot{x}_1 \\ \dot{x}_2 \\ \ddot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{-K}{m} & 0 & \frac{K}{m_1} & 0 \\ 0 & 0 & 0 & 1 \\ \frac{K}{m_2} & 0 & -\frac{K}{m_2} & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ \dot{x}_1 \\ x_2 \\ \dot{x}_2 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ \frac{1}{m_1} & 0 \\ 0 & 0 \\ 0 & \frac{1}{m_2} \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$\dot{x}_1 = x_3$ $\dot{x}_2 = x_4$ $\dot{x}_3 = \frac{u_1 + K(x_2 - x_1)}{m_1}$

$\dot{x}_4 = \frac{[u_2 + K(x_2 - x_1)]}{m_2}$

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

$s_1 = \sqrt{\frac{K}{m_2}}$; $s_2 = -\sqrt{\frac{K}{m_2}}$; $s_3 = \sqrt{\frac{K}{m_1}}$;

$s_4 = \sqrt{\frac{K}{m_1}}$

2.2) Os resultados não iguais a 2.1