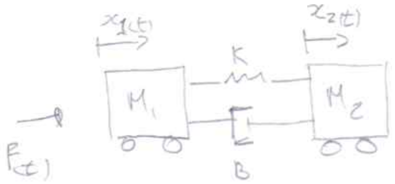
2e)



Funções

$$\begin{cases} x_1 = x_1(t) \\ x_2 = x_2(t) \\ f(t) = f \\ X_1 = X_1(s) \\ X_2 = X_2(s) \\ F = F(s) \end{cases}$$

$\boxed{FR = MCO}$

$$\frac{X_1(s)}{F(s)} = ?$$

$$\begin{cases} M_1 \ddot{x}_1 = f - K(x_1 - x_2) - B(\dot{x}_1 - \dot{x}_2) \\ M_2 \ddot{x}_2 = -K(x_2 - x_1) - B(\dot{x}_2 - \dot{x}_1) \end{cases} \quad \begin{cases} F = (s^2 M_1 + K + sB)X_1 - (K+sB)X_2 \\ 0 = (s^2 M_2 + K + sB)X_2 - (K+sB)X_1 \end{cases}$$

$$\begin{pmatrix} F \\ 0 \end{pmatrix} = \begin{bmatrix} s^2M_1 + sB + K & -(K+sB) \\ -(K+sB) & s^2M_2 + sB + K \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

$$X_1 = \frac{\begin{bmatrix} F & \cancel{-(K+sB)} \\ \cancel{0} & s^2M_2 + sB + K \end{bmatrix}}{(s^2M_1 + sB + K)(s^2M_2 + sB + K) - (K+sB)^2} \Rightarrow \frac{X_1}{F} = \frac{s^2M_2 + sB + K}{\ldots\ldots}$$

c.a) $(s^2M_1 + (sB+K))(s^2M_2 + (sB+K)) - (sB+K)^2$

$s^4 M_1M_2 + s^2M_1(sB+K) + s^2M_2(sB+K) + \cancel{(sB+K)^2} - \cancel{(sB+K)^2}$

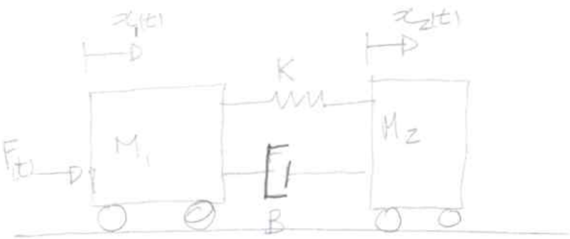
$s^4 M_1 M_2 + (s^2M_1 + s^2M_2)(sB+K)$

$s^4 M_1 M_2 + s^2(M_1 + M_2)(sB+K)$

$s^2(s^2 M_1 M_2 + (M_1 + M_2)(sB+K))$ same has result.

Practice

2e) $G(s) = \dfrac{X_{1(s)}}{F(s)}$



$$x: \quad \boxed{\sum F_R = M\,\ddot{x}_{(t)}}$$

$$\begin{cases} x_1: & F_{(t)} - K\,(x_{1(t)} - x_{2(t)}) - B(\dot{x}_{1(t)} - \dot{x}_{2(t)}) = M_1\,\ddot{x}_{1(t)} \\ x_2: & -K\,(x_{2(t)} - x_{1(t)}) - B\,(\dot{x}_{2(t)} - \dot{x}_{1(t)}) = M_2\,\ddot{x}_{2(t)} \end{cases}$$

$\mathcal{L}$; valores iniciais nulos

$$\begin{cases} F(s) - K X_{1(s)} + K X_{2(s)} - sB X_{1(s)} + sB X_{2(s)} = s^2 M_1 X_{1(s)} \\ -K X_{2(s)} + K X_{1(s)} - sB X_{2(s)} + sB X_{1(s)} = s^2 M_2 X_{2(s)} \end{cases}$$

$$\begin{cases} F(s) + K X_{2(s)} + sB X_{2(s)} = s^2 M_1 X_{1(s)} + K_1 X_{1(s)} + sB X_{1(s)} \\ sB X_{1(s)} + K X_{1(s)} = s^2 M_2 X_{2(s)} + sB X_{2(s)} + K X_{2(s)} \end{cases}$$

$$\begin{cases} F(s) + (sB + K) X_{2(s)} = (s^2 M_1 + sB + K) X_{1(s)} \\ (sB + K) X_{1(s)} = (s^2 M_2 + sB + K) X_{2(s)} \end{cases}$$

$$F(s) + \frac{(sB+K)(sB+K)}{(s^2 M_2 + sB + K)} X_{1(s)} = (s^2 M_1 + sB + K) X_{1(s)}$$

$$F(s) = \left[s^2 M_1 + sB + K - \frac{(sB+K)(sB+K)}{s^2 M_2 + sB + K} \right] X_{1(s)}$$

$$= \frac{(s^2 M_1 + sB + K)(s^2 M_2 + sB + K) - (sB+K)(sB+K)}{s^2 M_2 + sB + K} X_{1(s)}$$

$$\frac{X_{1(s)}}{F(s)} = \frac{s^2 M_2 + sB + K}{(s^2 M_1 + sB + K)(s^2 M_2 + sB + K) - (sB+K)(sB+K)}$$

$$\text{(a)}\quad s^4 M_1 M_2 + s^3 M_1 B + s^2 M_1 K + s^3 M_2 B + \cancel{s^2 B^2} + \cancel{sBK} + s^2 M_2 K + \cancel{sBK} + \cancel{K^2}$$
$$- (\cancel{s^2 B^2} + \cancel{sBK} + \cancel{sBK} + \cancel{K^2})$$

$$s^4 M_1 M_2 + s^3 M_1 B + s^2 M_1 K + s^3 M_2 B + s^2 M_2 K$$