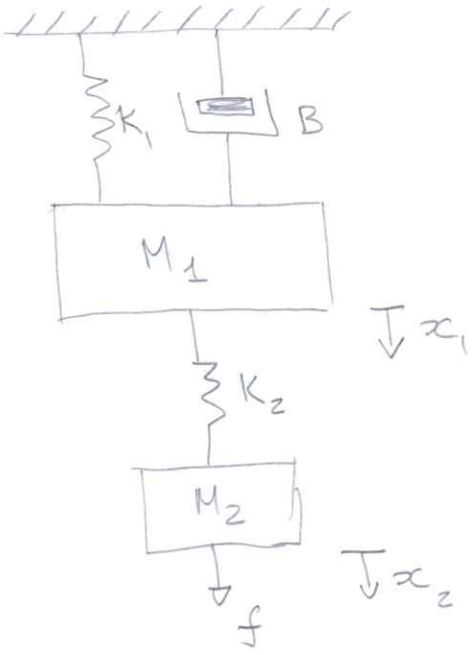
2c)




FR = mα

Funtions

$X_1 - X_{1(s)}$

$X_2 - X_{2(s)}$

$x_1 - x_{1(t)}$

$x_2 - x_{2(t)}$

$f = f(t)$

$F - F_{(s)}$

$$x_2: \quad M_2 \ddot{x}_2 = f - K_2(x_2 - x_1)$$

$$x_1: \quad M_1 \ddot{x}_1 = -K_2(x_1 - x_2) - K_1 x_1 - B\dot{x}_1$$

$$\begin{cases} s^2 M_2 X_2 = F - K_2 X_2 + K_2 X_1 \\ s^2 M_1 X_1 = -K_2 X_1 + K_2 X_2 - K_1 X_1 - sBX_1 \end{cases}$$

$$\begin{cases} F = (s^2 M_2 + K_2) X_2 - K_2 X_1 \\ 0 = (s^2 M_1 + K_2 + K_1 + sB) X_1 - K_2 X_2 \end{cases}$$

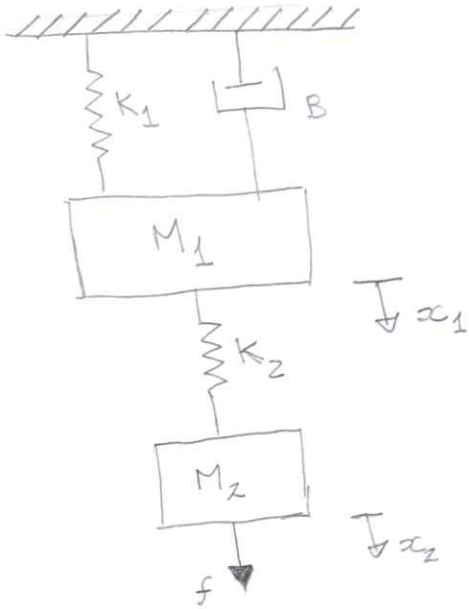
$$\begin{pmatrix} F \\ 0 \end{pmatrix} = \begin{bmatrix} -K_2 & s^2 M_2 + K_2 \\ s^2 M_1 + K_2 + K_1 + sB & -K_2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

$\frac{X_1}{F} = ?$

$$X_1 = \frac{\begin{bmatrix} F & s^2 M_2 + K_2 \\ 0 & -K_2 \end{bmatrix}}{-(s^2 M_1 + K_2 + K_1 + sB)(s^2 M_2 + K_2) - K_2^2} = \frac{+K_2 \cdot F}{\cdots\cdots}$$ ✓

olha os sinais!!

2 c)




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

$$\boxed{\Sigma F_R = M\,\ddot{x}(t)}$$

$$\begin{cases} f(t) - K_2(x_{2(t)} - x_{1(t)}) = M_2\,\ddot{x}_{2(t)} \\ -K_2(x_{1(t)} - x_{2(t)}) - K_1 x_{1(t)} - B\dot{x}_{1(t)} = M_1\,\ddot{x}_{1(t)} \end{cases}$$

valores iniciais nulos.

$$\begin{cases} F(s) - K_2 X_2(s) + K_2 X_1(s) = s^2 M_2 X_2(s) \\ -K_2 X_1(s) + K_2 X_2(s) - K_1 X_1(s) - sB X_1(s) = s^2 M_1 X_1(s) \end{cases}$$

$$\begin{cases} F(s) = (s^2 M_2 + K_2) X_2(s) - K_2 X_1(s) \\ +K_2 X_2(s) = (s^2 M_1 + K_2 + K_1 + sB) X_1(s) \end{cases}$$

$$X_{2(s)} = \frac{s^2 M_1 + K_2 + K_1 + sB}{K_2} \quad X_{1(s)}$$

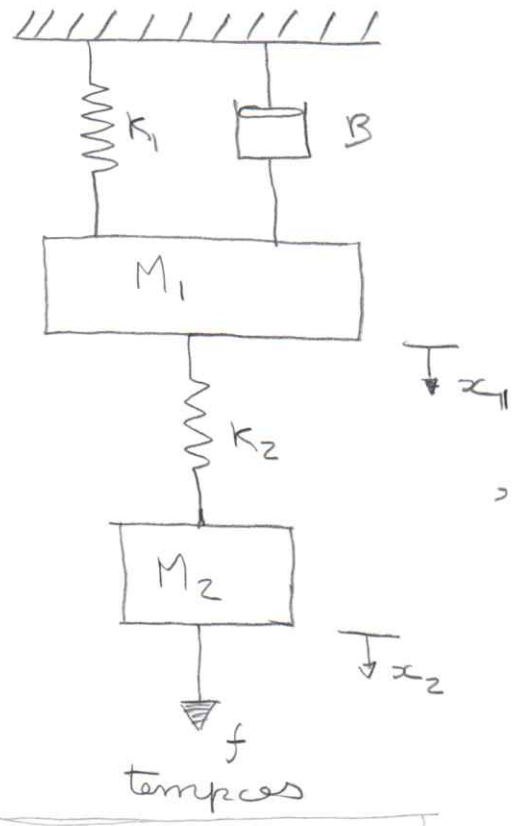
$$F(s) = \frac{(s^2 M_2 + K_2)(s^2 M_1 + K_2 + K_1 + sB)}{K_2} X_1(s) - \frac{K_2^2}{K_2} X_1(s)$$

$$= \frac{(s^2 M_2 + K_2)(s^2 M_1 + K_2 + K_1 + sB) + K_2^2}{K_2} \cdot X_1(s)$$

$$\frac{X_1(s)}{F(s)} = \frac{K_2}{(sM_2 + K_2)(s^2 M_1 + K_2 + K_1 + sB) + K_2^2}$$

Modulação de Sistema

2 C)




>> A força f é a força motora do sistema.

A força na mola 2 é a força aplicada no corpo $M_1$ e responsável pelo movimento do mesmo.

$$\sum FR = m\ddot{x}(t)$$

$$\begin{cases} f(t) - K_2(x_2(t) - x_1(t)) = m_2\ddot{x}_2(t) \\ K_2(x_2(t) - x_1(t)) - K_1 x_1(t) - B\dot{x}_1(t) = m_1\ddot{x}_1(t) \end{cases}$$

$$\begin{cases} F(s) - K_2(x_2(s) - x_1(s)) = m_2 s^2 x_2(s) \\ K_2(x_2(s) - x_1(s)) - K_1 x_1(s) - B s x_1(s) = m_1 s^2 x_1(s) \end{cases}$$

$s = \delta + j\omega$ Frequências

$$\begin{cases} F(s) - K_2 x_2(s) - K_2 x_1(s) = m_2 s^2 x_2(s) \\ K_2 x_2(s) - K_2 x_1(s) - K_1 x_1(s) - B s x_1(s) = m_1 s^2 x_1(s) \end{cases}$$