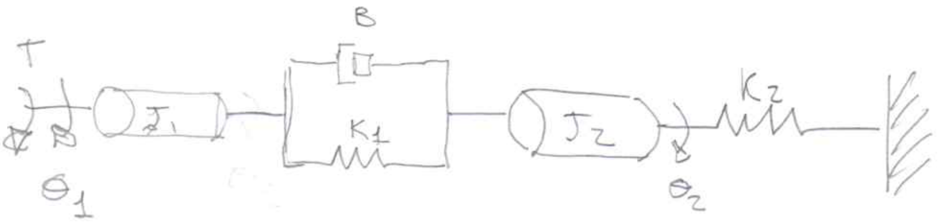
7a)



$$G(s) = \frac{\theta_{2(s)}}{T_{(s)}} = ?$$

$$\sum T = J\,\ddot{\theta}_{(t)}$$

$$\begin{cases} \theta_1: & T - B(\dot{\theta}_1 - \dot{\theta}_2) - K_1(\theta_1 - \theta_2) = J_1\,\ddot{\theta}_1 \\ \theta_2: & -B(\dot{\theta}_2 - \dot{\theta}_1) - K_1(\theta_2 - \theta_1) - K_2\,\theta_2 = J_2\,\ddot{\theta}_2 \end{cases}$$

$\mathcal{L}$; condições iniciais nulas.

$$\begin{cases} T_{(s)} - BS\,\theta_{1(s)} + BS\,\theta_{2(s)} - K_1\,\theta_{1(s)} + K_1\,\theta_{2(s)} = S^2 J_1 \theta_{1(s)} \\ -BS\,\theta_{2(s)} + BS\,\theta_{1(s)} - K_1\,\theta_{2(s)} + K_1\,\theta_{1(s)} - K_2\,\theta_{2(s)} = S^2 J_2\,\theta_{2(s)} \end{cases}$$

substituir $\theta_{1(s)}$ primeira equação

$$-(BS + K_2 + K_1 + S^2 J_2)\,\theta_{2(s)} + (BS + K_1)\,\theta_{1(s)} = 0$$

$$(SB + K_1)\,\theta_{1(s)} = (S^2 J_2 + SB + K_1 + K_2)\,\theta_{2(s)}$$

$$\theta_{1(s)} = \frac{(S^2 J_2 + SB + K_1 + K_2)}{SB + K_1}\,\theta_{2(s)}$$

$$T_{(s)} + (SB + K_1)\,\theta_{2(s)} = (S^2 J_1 + SB + K_1)\,\theta_{1(s)}$$

$$= \left(\frac{(S^2 J_1 + SB + K_1)\cdot(S^2 J_2 + SB + K_1 + K_2)}{SB + K_1}\right)\theta_{2(s)}$$

$$T_{(s)} = \left(\frac{(S^2 J_1 + SB + K_1)(S^2 J_2 + SB + K_1 + K_2)}{(SB + K_1)} - \frac{(SB + K_1)^2}{(SB + K_1)}\right)\theta_{2(s)}$$

tesis

PL

11/3/2020

7a) continuación

$$\Theta_{1(s)} = \frac{s^2 J_2 + sB + K_1 K_2}{(sB + K_1)} \Theta_{2(s)}$$

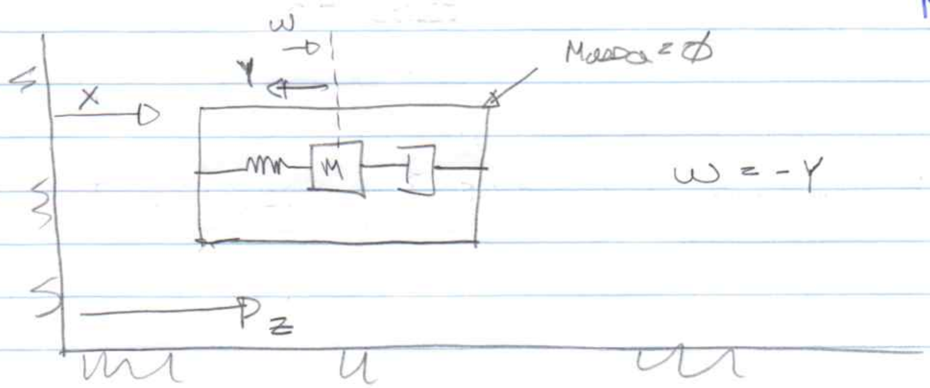
simplificar anterior después sustituir

$$T_{(s)} - K_1 \Theta_{1(s)} + K_1 \Theta_{2(s)} - sB\Theta_{1(s)} + sB\Theta_{2(s)} = s^2 J_1 \Theta_{1(s)}$$

$$T_{(s)} + \Theta_{1(s)}(-K - sB - s^2 J_1) + K_1 \Theta_{2(s)} + sB\Theta_{2(s)} = 0$$

acelerómetro mecanico.

NOTA.



$\omega = -Y$

$$X - Y = Z \Rightarrow \ddot{X} - \ddot{Y} = \ddot{Z}$$

masa

$$f_M = M\ddot{Z}$$

mola

$$f_K = K\omega$$

$$f_B = B\dot{\omega}$$

$$f_K + f_B + f_M = 0$$

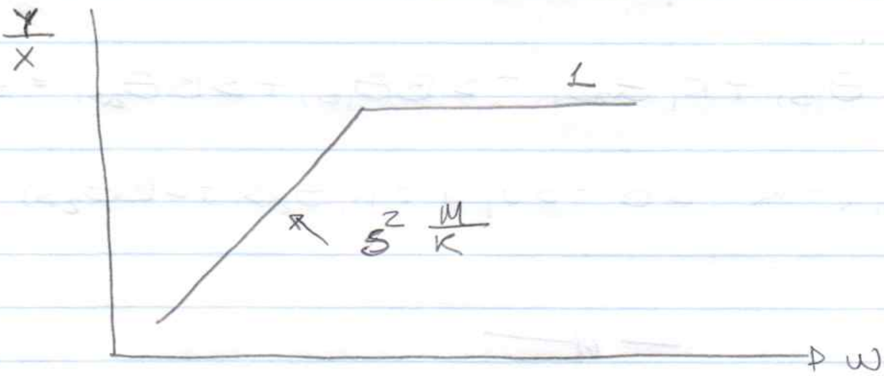
$$K\omega + B\dot{\omega} + M\ddot{Z} = 0$$

$$-KY - B\dot{Y} + M(\ddot{x} - \ddot{Y}) = 0 \Rightarrow M\ddot{x} = M\ddot{Y} + B\dot{Y} + KY$$

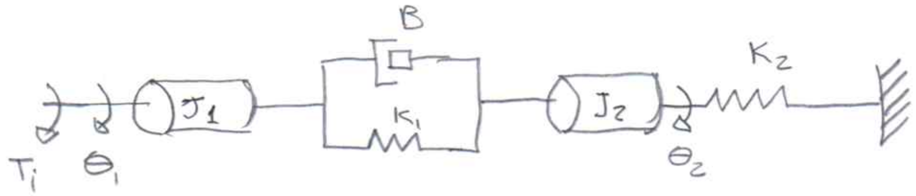
$$\boxed{\frac{Y(s)}{X(s)} = \frac{s^2 M}{s^2 M + sB + K}}$$

$s \to 0$ $\quad \frac{Y(s)}{X(s)} = \frac{s^2 M}{K}$

$s \to \infty$ $\quad \frac{Y(s)}{X(s)} = 1$



7a)



$$\frac{\theta_2}{T}$$

θ_1: $\Sigma FR = J_1\ddot{\theta}_1$ $\qquad$ θ_2: $\Sigma FR = J_2\ddot{\theta}_2$

$$\begin{array}{l} \theta_1 \\ \theta_2 \end{array}\begin{cases} T_1 - B(\dot{\theta}_1 - \dot{\theta}_2) - K_1(\theta_1 - \theta_2) = J_1\ddot{\theta}_1 \\ -K_1(\theta_2 - \theta_1) - B(\dot{\theta}_2 - \dot{\theta}_1) - K_2(\theta_2) = J_2\ddot{\theta}_2 \end{cases}$$

$$\begin{cases} T_1 = \underline{s^2 J_1\theta_1} + \underline{sB\theta_1} - sB\theta_2 + \underline{K_1\theta_1} - K_1\theta_2 \\ 0 = s^2 J_2\theta_2 + K_1\theta_2 - \underline{K_1\theta_1} + sB\theta_2 - \underline{sB\theta_1} + K_2\theta_2 \end{cases}$$

$$\begin{cases} T_1 = (s^2J_1 + sB + K_1)\theta_1 - (sB + K_1)\theta_2 \\ 0 = -(sB + K_1)\theta_1 + (s^2J_2 + sB + K_1)\theta_2 \end{cases}$$

$$\begin{pmatrix} T \\ \phi \end{pmatrix} = \begin{vmatrix} s^2J_1 + sB + K_1 & -(sB + K_1) \\ -(sB + K_1) & +s^2J_2 + sB + K_1 \end{vmatrix} \begin{vmatrix} \theta_1 \\ \theta_2 \end{vmatrix}$$

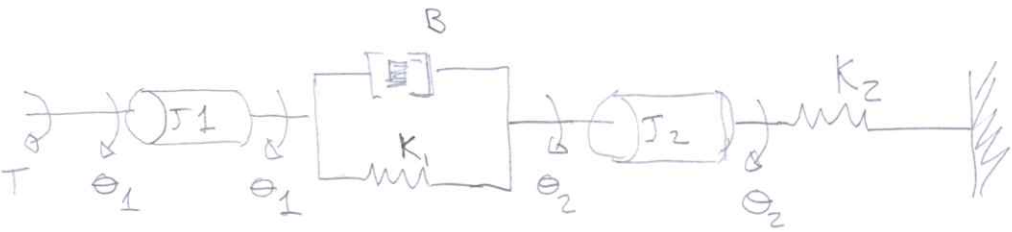
$$\theta_2 = \frac{\begin{vmatrix} s^2J_1 + sB + K & T \\ -(sB + K_1) & \phi \end{vmatrix}}{\begin{vmatrix} s^2J_1 + sB + K_1 & -(sB + K_1) \\ -(sB + K_1) & +s^2J_2 + sB + K_1 \end{vmatrix}}$$

$$= \frac{T(sB + K)}{(s^2J_1 + \underbrace{sB + K_1}_{})(s^2J_2 + \underbrace{sB + K_1}_{}) - (sB + K_1)^2}$$

$$\frac{\theta_2}{T} = \frac{sB + K}{s^4J_1J_2 + s^2J_1(sB + K_1) + s^2J_2(sB + K_1) + \cancel{(sB + K_1)^2} - \cancel{(sB + K_1)^2}}$$

=

7a)



$\frac{\theta_2}{T} = ?$

$$\boxed{\Sigma T = J\ddot{\theta}}$$

Funções

$\theta_1 - \theta_{1(t)}$
$\theta_2 - \theta_{2t}$
$T - T_{(t)}$
$\theta_1 - \theta_{1(s)}$
$\theta_2 - \theta_{2(s)}$
$T - T_{(s)}$

$$\begin{cases} \theta_1: & J_1\ddot{\theta}_1 = T - K_1(\theta_1 - \theta_2) - B(\dot{\theta}_1 - \dot{\theta}_2) \\ \theta_2: & J_2\ddot{\theta}_2 = -K_1(\theta_2 - \theta_1) - B(\dot{\theta}_2 - \dot{\theta}_1) - K_2\theta_2 \end{cases}$$

$$\begin{cases} T = (s^2 J_1 + K_1 + sB)\theta_1 - (K_1 + sB)\theta_2 \\ 0 = (s^2 J_2 + K_1 + sB + K_2)\theta_2 - (K_1 + sB)\theta_1 \end{cases}$$

$$\begin{pmatrix} T \\ 0 \end{pmatrix} = \begin{bmatrix} s^2 J_1 + sB + K_1 & -(K_1 + sB) \\ -(sB + K_1) & s^2 J_2 + sB + K_1 + K_2 \end{bmatrix} \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix}$$

$$\frac{\theta_2}{T} = \frac{sB + K_1}{(s^2 J_2 + sB + K_1 + K_2)(s^2 J_1 + sB + K_1) - (sB + K_1)^2}$$

$$= \frac{sB + K_1}{s^4 J_2 J_1 + s^2 J_2 (sB + K_1) + s^2 J_1 (sB + K_1) + \cancel{(sB + K_1)^2} + s^2 J_1 K_2 + K_2 (sB + K_1) - \cancel{(sB + K_1)^2}}$$

$$\boxed{\frac{\theta_2}{T} = \frac{sB + K_1}{s^4 J_1 J_2 + (s^2 J_2 + s^2 J_1 + K_2)(sB + K_1) + s^2 J_1 K_2}}$$ ✓