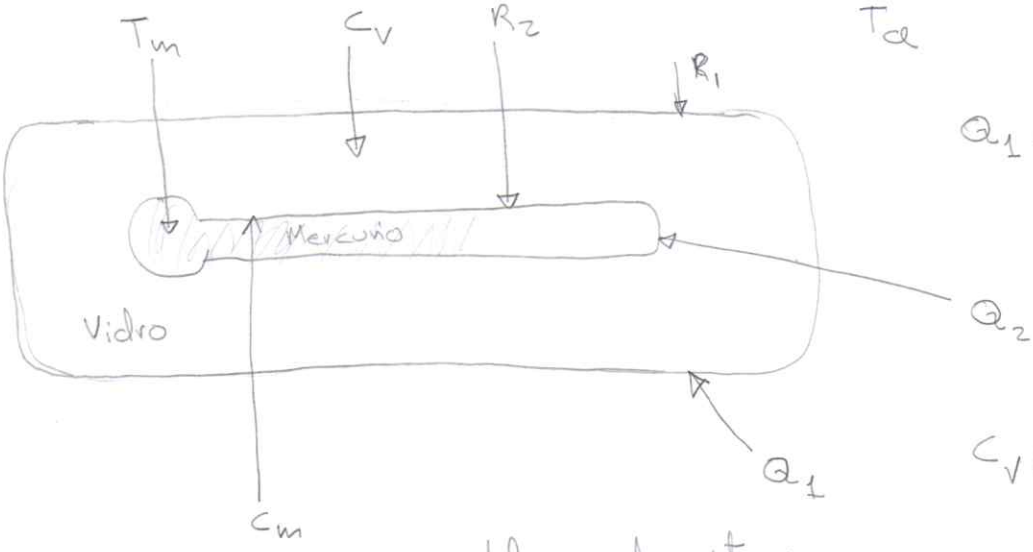
theory



Q_1 1 Q_2 - heat energy flow.

C_v 1 C_m - capacidade calorífica.

thermal system

$$\frac{T_m(s)}{T_a(s)} = ?$$

Note: $\boxed{Q = \frac{\theta_{1(t)} - \theta_{2(t)}}{R}}$

- Heat energy flow

Q - heat energy flow

$\theta_{1(t)}$ 1 $\theta_{2(t)}$ - temperature

R - resistência térmica.

- Heat spread - A variation in the material lead to an increase in amount of heat stored.

$$\boxed{H.S = C\left[\theta_{m(t)} - \theta_{m(0)}\right]}$$

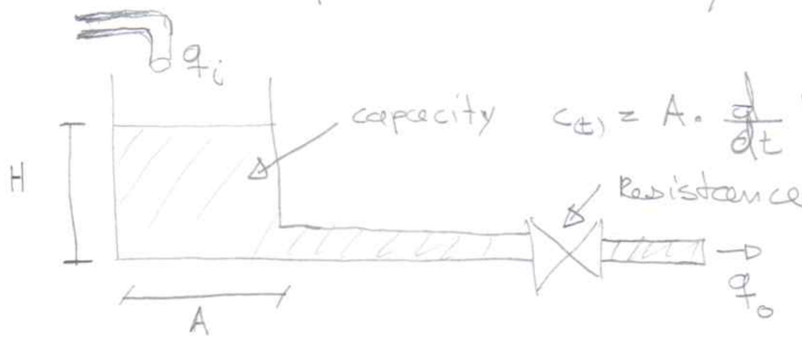
- Heat Balance equation

$$\frac{\theta_{m(0)} - \theta_{m(t)}}{R} = C\,\frac{d}{dt}\left(\theta_{m(t)} - \theta_{m(0)}\right)$$

$$\Leftrightarrow \quad R.C\,\frac{d}{dt}\theta_{m(t)} + \theta_{m(t)} = \theta_{(0)}$$

theory

Liquid-level system



$$C_{(t)} = A \cdot \frac{d}{dt} H_{(t)} = \frac{d}{dt} V_{(t)}$$

$$q_o = \frac{H}{R}$$

law of mass conservation:

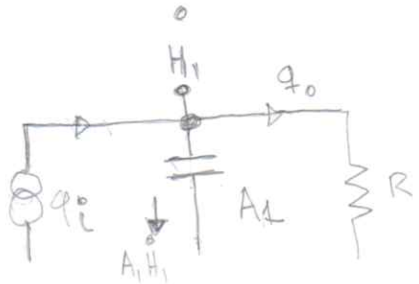
$$\boxed{\frac{d}{dt} V_{(t)} = q_i - q_o} \Rightarrow \boxed{q_i = q_o + \frac{d}{dt} V_{(t)}}$$

$$q_i = A \cdot \frac{d}{dt} h_{(t)} + q_o$$

$$q_o = \frac{h}{R}$$

$$\Theta_{i(s)} = sA\, H_{(s)} + \Theta_{o(s)}$$

$$\Theta_{o(s)} = \frac{H_{(s)}}{R}$$



theory.

$$\begin{cases} \boxed{t_s = \dfrac{4}{\varepsilon \omega_n}} \\ \boxed{t_p = \dfrac{\pi}{\omega_n \sqrt{1-\varepsilon^2}}} \end{cases} \qquad \begin{cases} 4 = t_s \varepsilon \omega_n \\ t_p \cdot \omega_n \cdot \sqrt{1-\varepsilon^2} = \pi \end{cases}$$

$$t_p \cdot \frac{4}{t_s \cdot \varepsilon} \cdot \sqrt{1-\varepsilon^2} = \pi \qquad \omega_n = \frac{4}{t_s \varepsilon}$$

$$t_p^2 \cdot \frac{4^2}{t_s^2 \varepsilon^2} \cdot (1-\varepsilon^2) = \pi^2$$

$$t_p^2 \cdot \frac{4^2}{t_s^2 \varepsilon^2} - \frac{t_p^2 \cdot 4^2}{t_s^2} = \pi^2$$

$$t_p^2 \frac{4^2}{t_s^2 \varepsilon^2} = \pi^2 + \frac{t_p^2 \cdot 4^2}{t_s^2}$$

$(ab)^2 = a^2 \cdot b^2$

$(2.3)^2 = 2^2 \cdot 3^2$

$$t_s^2 \varepsilon^2 = \frac{t_p^2 4^2}{\pi^2 + \frac{t_p^2 \cdot 4^2}{t_s^2}}$$

$\left(\frac{a}{b}\right)^2 = \frac{a^2}{b^2}$

$$= \frac{t_p^2 4^2}{\frac{t_p^2 \cdot 4^2 + \pi^2 t_s^2}{t_s^2}}$$

$$t_s^2 \varepsilon^2 = \frac{t_p^2 4^2 t_s^2}{t_p^2 \cdot 4^2 + \pi^2 t_s^2}$$

NOTA!

$$\boxed{\varepsilon = \sqrt{\frac{1}{1+\left(\frac{\pi t_s}{4 t_p}\right)^2}}}$$

$$\varepsilon^2 = \frac{t_p^2 \cancel{t_s^2} 4^2}{\cancel{t_s^2}(t_p^2 \cdot 4^2 + \pi^2 t_s^2)}$$

$$= \frac{t_p^2 4^2}{t_p^2 \cdot 4^2 + \pi^2 t_s^2}$$

$$\boxed{\omega_n = \frac{4}{\varepsilon t_s}}$$

$$= \frac{\cancel{t_p^2 4^2}}{\left(1 + \frac{\pi^2 t_s^2}{t_p^2 4^2}\right) \cancel{t_p^2 4^2}}$$

$$\varepsilon = \sqrt{\frac{1}{\left(1 + \frac{\pi^2 t_s^2}{t_p^2 4^2}\right)}}$$

theory tesis T 15/4/2020

Método do Lugar Geométrico de Raízes.

$$\frac{2\angle 15^\circ \times 3\angle 40^\circ}{7\angle 10^\circ} = \frac{2\times 3}{7} \Big| \begin{array}{l} 5+40 \\ -10 \end{array}$$

theory

teorema do valor inicial

$$x(0) = \lim_{t \to 0} x(t) = \lim_{s \to \infty} s \times X(s)$$

teorema do valor final

$$x(\infty) = x_{ss} = \lim_{t \to \infty} x(t) = \lim_{s \to 0} s \times X(s)$$

$$R(s) \longrightarrow \boxed{G(s)} \longrightarrow C(s) \qquad G(s) = F.T$$

$$C(s) = G(s) \cdot R(s)$$

$$C(\infty) = \lim_{s \to 0} s \times G(s) \times R(s) \quad \begin{cases} \frac{1}{s} & \text{unit step} \\ \frac{1}{s^2} & \\ \frac{1}{s^3} & \end{cases}$$

$\Downarrow$

- $\lim_{s \to 0} G(s)$ unit step
- $K_{\square} \Leftarrow$ $\lim_{s \to 0} \frac{G(s)}{s}$ Ramp
- $\lim_{s \to 0} \frac{G(s)}{s^2}$ parabola

they explain this in a confusing manner!

F.T = função de transferência
F.T.M.A = " " " malha aberta
FTMF = " " " " fechada.

Lugar Geometrico!

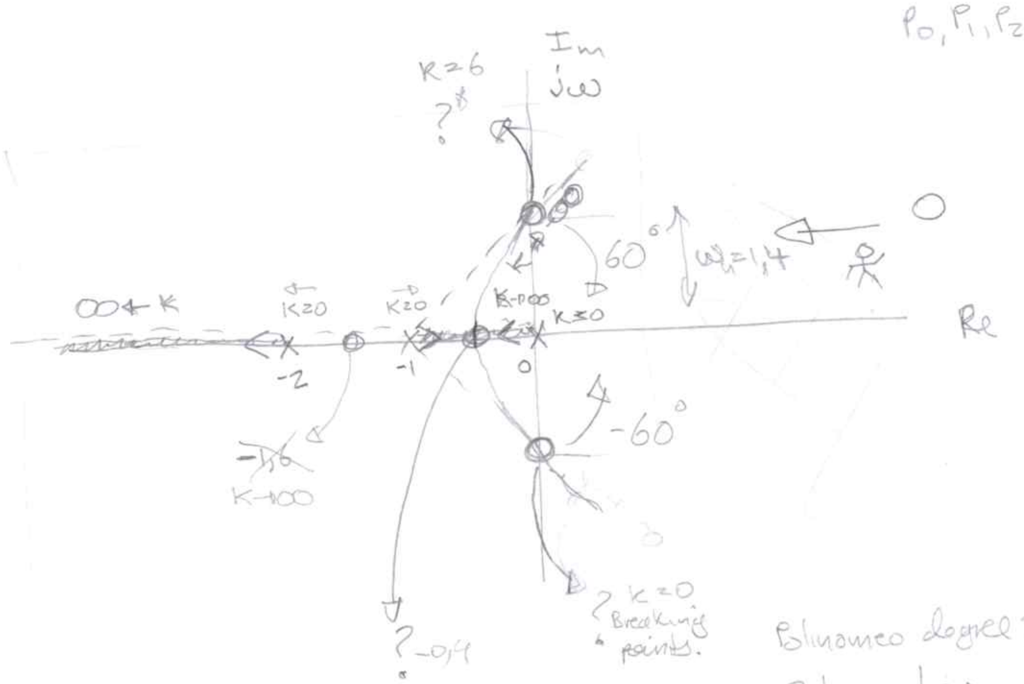
$$K \frac{1}{s(s+1)(s+2)}$$

$d=3$ $\quad d-n=3-0$
$n=\emptyset$ $\quad =3$

$N=1$; $\varepsilon > 1$

$p_0, p_1, p_2 = (-1, -2, \emptyset)$

$\Rightarrow K = \emptyset$



Polinomeo degree 3 ⇒ 3 branches

3

$$\theta = \frac{2b+1}{3-0}$$

$\frac{1}{3}$; 1 ; $\frac{5}{3}$

odd number of poles and zeros

$= -60, 60, 180°$

$b = -1, 0, +1$

$$\delta = \frac{(0-2-2)-(0)}{3-0} = -1$$, Lugar angulo

numerator

Breaking Point

$$K \frac{1}{s(s+1)(s+2)} + 1 = 0 \Leftrightarrow K = -\frac{(s(s+1)(s+2))}{1}$$

$$= -(s^3 + 3s^2 + 2s)$$

$$\frac{d}{dt} K = -(3s^2 + 6s + 2) = 0$$

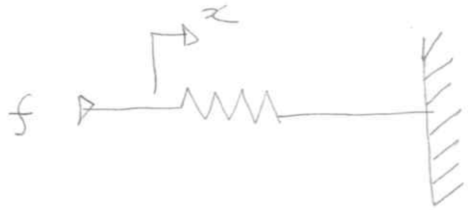
$$s = \frac{-6 \pm \sqrt{6^2 - 4 \cdot 3 \cdot 2}}{2 \cdot 3} = \frac{-6 \pm \sqrt{12}}{6} = -1 \pm 0{,}6$$

$-1{,}6$ $\quad -0{,}4$

$$K = -s(s+1)(s+2) \; ; \; s = -0{,}4$$
$$= -s^3 + 3s^2 + 2s$$
$$= (-0{,}4)^3 + 3(0{,}4)^2 + 2(-0{,}4)) \approx$$

Modelação de Sistemas 11/3/2020

theory

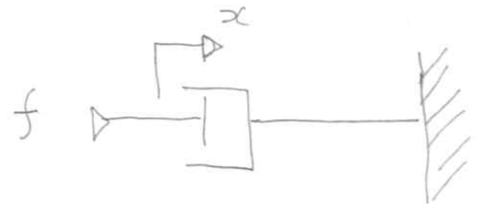


$$\boxed{\sum F_{(t)} = M\, a_{(t)}}$$

$$f(t) = -K x$$

$\mathcal{L}$ ask ??

$$F(s) = -K X(s)$$



$$f(t) = -B \frac{d}{dt} x$$

$\mathcal{L}$

$$F(s) = -s B X(s)$$

x-spot
⇓
mass spot = ΣFr

$$\boxed{\sum F_R = m_i\, x_{(t)}}$$

Definition
1 point

$$\begin{cases} f_{(t)} - K x_{(t)} = 0 \\ f_{(t)} - B \dot{x}_{(t)} = 0 \end{cases}$$

$x \rightarrow$ [m]
$\theta \rightarrow$ [rad]

$$\boxed{\sum T_{(t)} = J \ddot{\theta}_{(t)}}$$

$$\boxed{\sum T_t = F x}$$

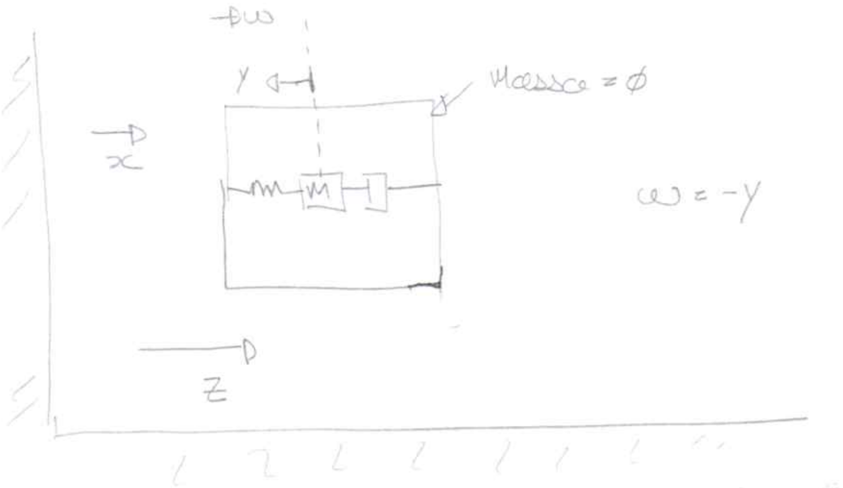
$$J\theta = F x$$
$$J\dot{\theta} = F\dot{x}$$
$$J\ddot{\theta} = F\ddot{x}$$

$$\begin{cases} \dfrac{x}{\theta} = \dfrac{h}{2\pi} \\ \dfrac{\dot{x}}{\dot{\theta}} = \dfrac{h}{2\pi} \\ \dfrac{\ddot{x}}{\ddot{\theta}} = \dfrac{h}{2\pi} \end{cases}$$

$$V = \omega r \quad [m/s]$$

theory.

A celerometro



$$x - y = z \Rightarrow \ddot{x} - \ddot{y} = \ddot{z}$$

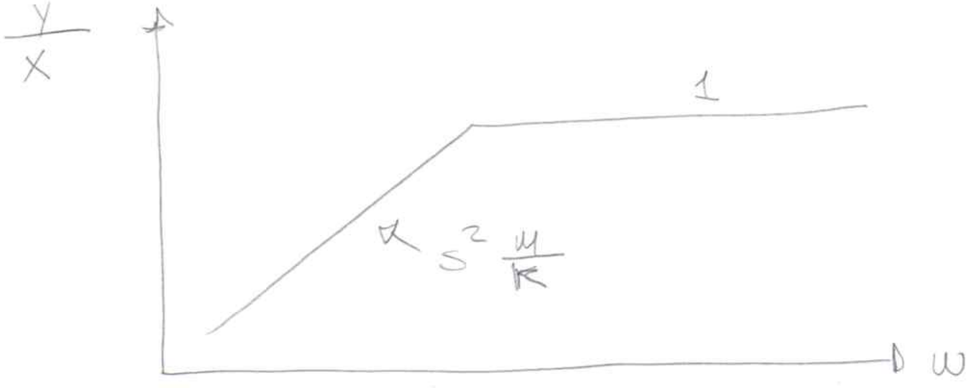
$$-Ky - B\dot{y} + M(\ddot{x} - \ddot{y}) = 0$$

$$M\ddot{x} = M\ddot{y} + B\dot{y} + Ky$$

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

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

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



theory tesis

27/4/2020 2

JTM

$\boxed{\text{Lugar Geométrico}}$

$$K \cdot \frac{1}{s(s+1)(s+2)} + 1$$

$$K + s(s+1)(s+2)$$

$$s^3 + 3s^2 + 2s + K$$

$$1 \quad 1 \quad 1 \quad 1$$

explained in slides mcalkc algorithm!

$$\begin{array}{lll} s^3 & 1 & 2 \\ s^2 & 3 & K \\ s^1 & \frac{6-K}{3} & 0 \\ s^0 & K & \end{array}$$

$$\begin{cases} 6-K > 0 \\ K > 0 \end{cases} \qquad 0 < K < 6$$

$$3s^2 + 6s^0 = 0$$

$$s^2 = -2 \Leftrightarrow s = \pm \sqrt{-2}$$

$$= \pm j\sqrt{2} \simeq 1{,}4$$

$\omega \simeq \quad \frac{\omega}{1} = tg\, 60°$