

## Tarefa 01)

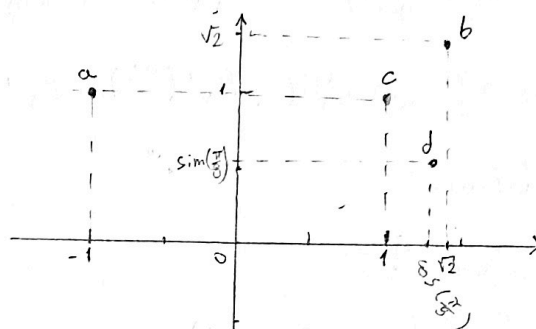
01)

a)  $s = -1 + j = \sqrt{2} e^{\frac{3\pi}{4}j}$

b)  $s = 2 e^{\frac{\pi}{4}j} = \sqrt{2} + \sqrt{2}j$

c)  $s = 1 + j = \sqrt{2} e^{\frac{\pi}{4}j}$

d)  $s = \sqrt{2} e^{\frac{\pi}{8}j} = \sqrt{1 + \frac{\sqrt{2}}{2}} + \sqrt{1 - \frac{\sqrt{2}}{2}}j$



02)  $y''' + a_2 y'' + a_1 y' + a_0 y = u$

a)  $Ys^3 + a_2 Ys^2 + a_1 Ys + a_0 Y = U \rightarrow \frac{Y}{U} = \frac{1}{s^3 + a_2 s^2 + a_1 s + a_0}$

$\hookrightarrow \text{e.q.} \rightarrow s^3 + a_2 s^2 + a_1 s + a_0 = 0$

a.1)  $a_0 = a_1 = a_2 = 2$

$$\hookrightarrow \text{raízes} = \left\{ \begin{array}{l} -1,5437 \\ -0,2282 + 1,1151j \\ -0,2282 - 1,1151j \end{array} \right\} \text{Re negativos} \rightarrow \text{estável}$$

a.2)  $a_0 = a_1 = a_2 = -2$

$$\hookrightarrow \text{raízes} = \left\{ \begin{array}{l} 1,8393 \\ -0,4196 + 0,6063j \\ -0,4196 - 0,6063j \end{array} \right\} \rightarrow \text{Re positiva} \rightarrow \text{instável}$$

b)  $y = x_1 \rightarrow \dot{x}_1 = x_2$

$y' = x_2 \rightarrow \dot{x}_2 = x_3$

$y'' = x_3 \rightarrow \dot{x}_3 = -a_2 x_3 - a_1 x_2 - a_0 x_1 + u$

$$\rightarrow \dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -a_0 & -a_1 & -a_2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$y = [1 \ 0 \ 0] x$

$$03) G(s) = \frac{Y(s)}{U(s)} = \frac{10}{s(s+2)(s+20)} = \frac{1}{4} \cdot \frac{1}{s \left( \frac{s}{2} + 1 \right) \left( \frac{s}{20} + 1 \right)}$$

$$\begin{aligned} \text{a) Magnitude } & |G(j\omega)|_{dB} = 20 \log |G(j\omega)| = \\ & = -20 \log(4) - 20 \log(\omega) - 20 \log\left(\sqrt{\left(\frac{\omega}{2}\right)^2 + 1}\right) - 20 \log\left(\sqrt{\left(\frac{\omega}{20}\right)^2 + 1}\right) \end{aligned}$$

$$\text{fase } \angle G(j\omega) \Big|_{\text{graus}} = -90^\circ - \tan^{-1}\left(\frac{\omega}{2}\right) - \tan^{-1}\left(\frac{\omega}{20}\right)$$

decompondo fraturas

1) Ganho constante

$$\text{2) Magnitude } \rightarrow -20 \log(4), \quad 0 < \omega < \infty$$

$$\text{3) fase } \rightarrow 0^\circ, \quad 0 < \omega < \infty$$

1) Pólo em  $s = 0$

$$\text{2) Magnitude } \rightarrow -20 \log(\omega), \quad 0 < \omega < \infty$$

$$\text{3) fase } \rightarrow -90^\circ, \quad 0 < \omega < \infty$$

1) Pólo em  $s = -2$

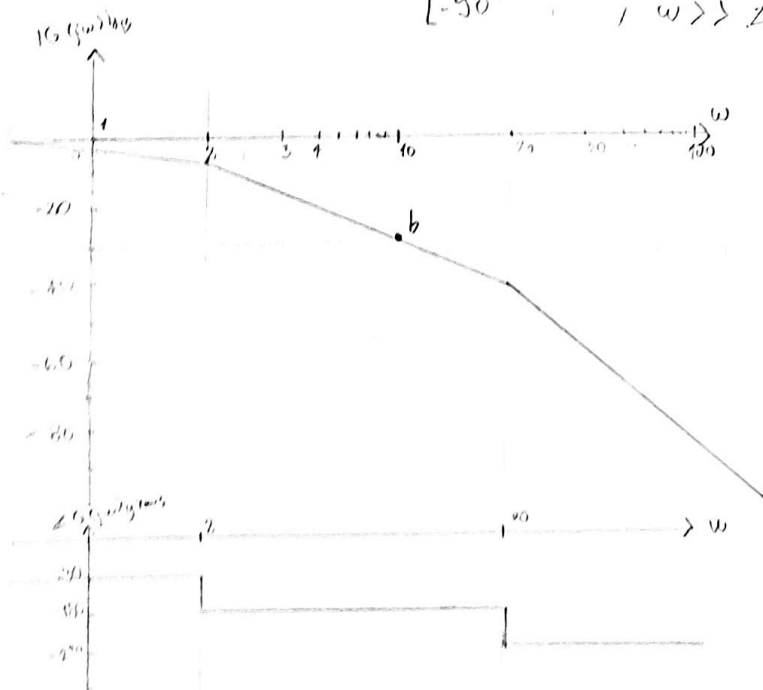
$$\text{2) Magnitude } \rightarrow \begin{cases} 0 \text{ dB} & , \omega \ll 2 \\ -20 \text{ dB/dec} & , \omega \gg 2 \end{cases}$$

$$\text{3) fase } \rightarrow \begin{cases} 0^\circ & , \omega \ll 2 \\ -90^\circ & , \omega \gg 2 \end{cases}$$

1) Pólo em  $s = -20$

$$\text{2) Magnitude } \rightarrow \begin{cases} 0 \text{ dB} & , \omega \ll 20 \\ -20 \text{ dB/dec} & , \omega \gg 20 \end{cases}$$

$$\text{3) fase } \rightarrow \begin{cases} 0^\circ & , \omega \ll 20 \\ -90^\circ & , \omega \gg 20 \end{cases}$$



$$b) u(t) = \sin(10t) \rightarrow \omega_b = 10$$

$$\hookrightarrow \gamma(\omega) \approx -30 \text{ dB}$$