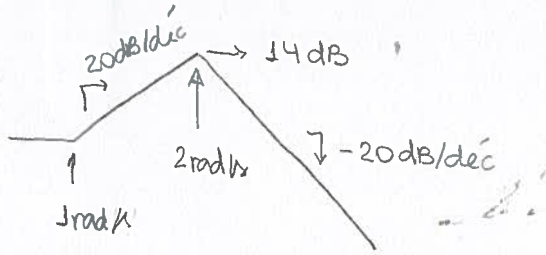
CORREÇÃO P3

21)



$$G(s) = k(s+1)\cdot\frac{4}{s^2+2s+4}$$

$$20\log|G(j2)| = 14dB = 20dB - 6dB$$

$$= 20\log 10 - 20\log 2$$

$$= 20\log 5$$

$$|G(j2)| \approx k \cdot 2 \rightarrow \boxed{k = \frac{5}{2}}$$

$$\boxed{G(s) = \frac{10(s+1)}{s^2+2s+4}}$$

) $C(s) = k\cdot\frac{s+2}{s+5}$

$$1 + 10k\cdot\frac{(s+1)(s+2)}{(s+5)\cdot(s^2+2s+4)}$$

$$10k = \frac{0,6\cdot 3,1\ 3,7}{(1,5)^2}$$

$$\boxed{k \approx 0,3}$$

:) $MG = \infty$

$MF = 40°$

$w \approx 1,9\ rad/s$

22) $G(s) = \frac{s+5}{(s+1)(s^2+2s+5)}$ $\quad C(s) = k_p\cdot\left(1+\frac{1}{\pi s}\right)$

a) $1 + kG(s) = 0$

$$s^3 + 3s^2 + (4+k)s + 2 + 5k = 0$$

s^3	1	$4+k$
s^2	3	$2+5k$
s	$12+3k-2-5k$	
1	$2+5k$	

$$3s^2 + 27 = 0$$

$$\boxed{w_{osc} = 3\ rad/s}$$

$$\boxed{k_{osc} = 5}$$

$k_p = 0{,}45 \cdot 5 = 2{,}25$

$T_i = \frac{T_{osc}}{1{,}2} = 1{,}7s$

b) $K_p = \infty \rightarrow \varepsilon_d = 0$

$K_r = \frac{5}{2} \cdot \frac{K_p}{T_i} \cong 3 \rightarrow \varepsilon_r = \frac{1}{3}$

$K_a = 0 \rightarrow \varepsilon_p = \infty$

c) $\ddot{y} + 5\dot{y} + 6y = \dot{u}$

$y(0) = 1 \quad \dot{y}(0) = 0$

$A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad C = \begin{bmatrix} 0 & 1 \end{bmatrix} \quad D = [0]$

d) $A - LC = \begin{bmatrix} 0 & 1-l_1 \\ -6 & -5-l_2 \end{bmatrix}$

$\det(sI - (A-LC)) = s^2 + (5+l_2)s + 6(1-l_1)$

$P(s) = (s+4)(s+6) = s^2 + 10s + 24$

$\begin{cases} 5 + l_2 = 10 \\ 6 - 6l_1 = 24 \end{cases} \Rightarrow L = \begin{bmatrix} -3 \\ 5 \end{bmatrix}$

e) $\dot{e} = (A-LC)e(t), \quad e(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$z(t) = [1 \quad 0]\, e(t)$

$e(t) = e^{(A-LC)t} e(0)$

$z(t) = [1 \quad 0] \cdot \mathcal{L}^{-1}\left\{ \begin{bmatrix} s & -4 \\ 6 & s+10 \end{bmatrix}^{-1} \right\} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$= [1 \quad 0] \cdot \mathcal{L}^{-1}\left\{ \frac{1}{s^2+10s+24} \cdot \begin{bmatrix} s+10 & 4 \\ -6 & s \end{bmatrix} \right\} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \mathcal{L}^{-1}\left\{ \frac{s+10}{s^2+10s+24} \right\} = 3e^{-4t} - 2e^{-6t}, \quad \forall t \geq 0$

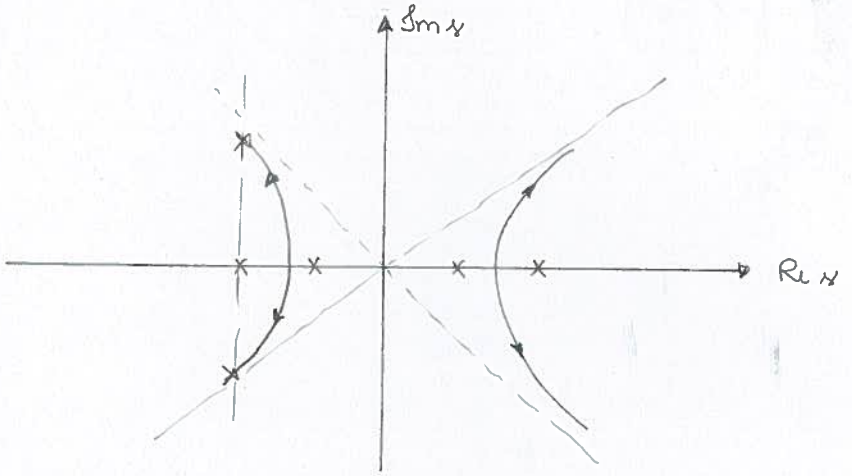
4) $\dot{x} = \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$

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

$$\min \int_0^\infty 4x_1^2 + \rho u^2 \, dt$$

$Q = \begin{bmatrix} 4 & 0 \\ 0 & 0 \end{bmatrix} \Rightarrow V = [2 \quad 0]$ $\qquad$ $\varphi(s) = V(sI - A)^{-1} \cdot B = \dfrac{2}{s^2 - s + 2}$

$$1 + \rho^{-1} \cdot \frac{4}{(s^2 - s - 2)(s^2 + s - 2)} = 0$$



$t_E = 2s$

$\downarrow$

$\xi\omega_n = 2$

$4\rho^{-1} \simeq 1{,}4 \,.\, 1{,}6 \,.\, 3{,}2 \,.\, 4$

$\boxed{\rho \simeq 1/6}$

) $K = [6 \quad 5]$

$$A_f = A - BK = \begin{bmatrix} 0 & 1 \\ -4 & -4 \end{bmatrix} \Rightarrow P(s) = (s+2)^2$$

$$S(s) = (C - DK) \cdot \left(sI - \underbrace{(A - BK)}_{A_f} \right)^{-1} B + D$$

$$S(s) = \frac{1}{(s+2)^2} \Rightarrow S(0) = \frac{1}{4}$$

$F(s) = S(s)\, KM$

$F(0) = 1 \rightarrow \boxed{KM = 4}$

$$\begin{bmatrix} 6 & 5 \end{bmatrix} \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} = 4$$

$$6m_1 + 5m_2 = 4$$

$$M = \begin{bmatrix} 0 \\ 5/4 \end{bmatrix}.$$

c) $\rho \to \infty$

Pólos : $-1, -2$

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

$$A - BK = \begin{bmatrix} 0 & 1 \\ 2-K_1 & 1-K_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} = Af$$

$$K = \begin{bmatrix} 4 & 4 \end{bmatrix}$$