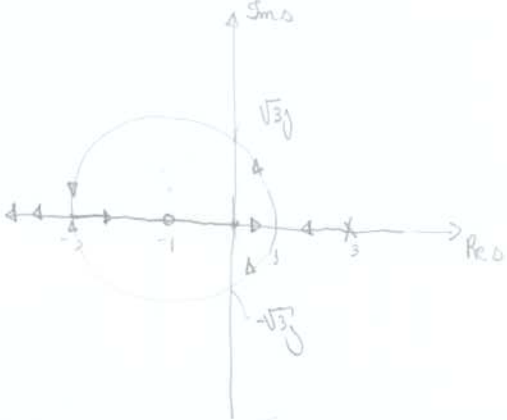
1- $C(s) = K \quad P(s) = \dfrac{(s+1)}{s(s-3)}$, $n = 2$, $m = 1$

assint : 180



$N(s) = s+1$

$N'(s) = 1$

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

$D'(s) = 2s - 3$

$D'N - DN' = (2s-3)(s+1) - (s^2-3s).1 = s^2 + 2s - 3$

$s_1 = -3$

$s_2 = 1$

$D(jw) + KN(jw) = 0 \Rightarrow$

$jw(jw-3) + Kjw + K = 0$

$-w^2 - 3jw + Kjw + K = 0$

$K = w^2 \Rightarrow w = \pm\sqrt{3}$

$Kw - 3w = 0 \Rightarrow K = 3$

$\boxed{K > 3}$

2- $C(s) = K_c \quad P(s) = \dfrac{2}{s(s+1)}$

$|P(s)| = \dfrac{1}{K_c} \Rightarrow \dfrac{2}{|jw||jw+1|} = \dfrac{1}{K_c} \Rightarrow \dfrac{2}{w\sqrt{w^2+1}} = \dfrac{1}{K_c} \Rightarrow 2K_c = w\sqrt{w^2+1} \Rightarrow 4K_c^2 = w^2(w^2+1) \Rightarrow K_c^2 = \dfrac{1(2)}{4} = \dfrac{1}{2} \Rightarrow K_c = \dfrac{\sqrt{2}}{2}$

$\angle C(s)P(s) = -\pi/2 - \text{atan}\,w \Rightarrow \angle C(s)P(s) = \pi/4 \Rightarrow -\text{atan}\,w = \pi/4 + \pi/2 \Rightarrow \text{atan}\,w = -3\pi/4 \Rightarrow w = 1$

b) Não é possível mudar o diagrama de magnitude por faixa.

3)-

(4)

$$\mathbb{C} = [B \;\; AB \;\; A^2B] = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & \gamma \\ 0 & \gamma & \beta+\gamma^2 \end{bmatrix} \Rightarrow \det(\mathbb{C}) = -1 \Rightarrow \text{É controlável } \forall\, \alpha, \beta, \gamma$$

$$\mathbb{O} = \begin{bmatrix} C \\ CA \\ CA^2 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ \alpha & \beta & \gamma \\ \alpha\gamma & \gamma+\beta\gamma & \beta+\gamma^2 \end{bmatrix} \Rightarrow \det(\mathbb{O}) = \alpha^2 \Rightarrow \text{É observável para } \alpha \neq 0$$

5)

$$p_c(s) = s^2 + 6s + 9$$

$$\mathbb{C} = [B \;\; AB] = \begin{bmatrix} 1 & 0 \\ 1 & 4 \end{bmatrix} \Rightarrow \text{rank}(\mathbb{C}) = 2 \Rightarrow \text{É controlável}$$

$$\det(sI - A + BK) = s^2 + (K_1 + K_2 - 3)s + K_2 - 3K_1$$

$$K_2 - 3K_1 = 9 \qquad K_1 = 0$$

$$K_1 + K_2 - 3 = 6 \Rightarrow K_2 = 9 \qquad K = [0 \;\; 9]$$

$$y = [0 \;\; 1]X \Rightarrow \boxed{y = X_2}$$

$$A - BK = \begin{bmatrix} 0 & -9 \\ 1 & -6 \end{bmatrix} \Rightarrow (A - BK)^{-1} = \begin{bmatrix} -2/3 & 1 \\ -1/9 & 0 \end{bmatrix}$$

$$X(\infty) = -(A - BK)^{-1} B . K_2 r_0 = \begin{bmatrix} -3r_0 \\ r_0 \end{bmatrix} \Rightarrow y(\infty) = r_0 \Rightarrow \text{erro em regime nulo}$$