1) .1 $F_{total} = \sum f$ = força aplicada − atrito − força gravítica

$F_{total} = m\dot{V}$

força aplicada = $f(t)$

atrito = $-\beta V^2$

gravidade = $-mg\sin(\theta)$

Logo

$m\dot{V} = f - mg\sin(\theta) - \beta V^2$

.2 $m = 100\,kg$ $V_0 = 2\,5\,m$

$g = 10\,m\,s^{-2}$ $f(t) = m\dot{V}(t) + mg\sin(\theta) + \beta V^2(t)$

$\theta = \frac{\pi}{6}$ $f_0 = mg\sin(\theta) + \beta V_0^2 = 300N$

$\beta = 2 + \alpha = 4$

$m\dot{V} = f - mg\sin(\theta) - \beta V^2$

$m\dot{V} = 0 + \delta f - \beta 2 V_0 \cdot \delta V$

$m\dot{V}\delta V + 2V_0\beta\delta V = \delta f$

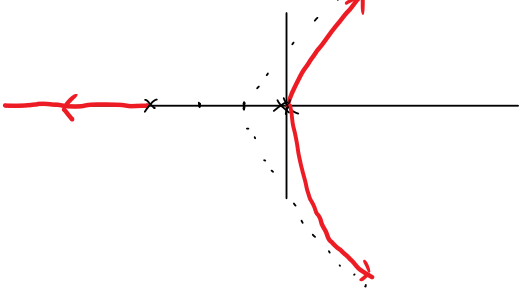
$\frac{\Delta F}{\Delta V} = \frac{1}{ms + 2V_0\beta} = \frac{0,1}{s + \frac{2V_0\beta}{100}} = \frac{0,1}{s+2}$

.3) A mudança do ângulo não altera a função P(s) do sistema linearizado.

2) .1 $P(s) = \frac{1}{s(s+1)}$

$k(s) = \frac{K}{s}$ $k>0$

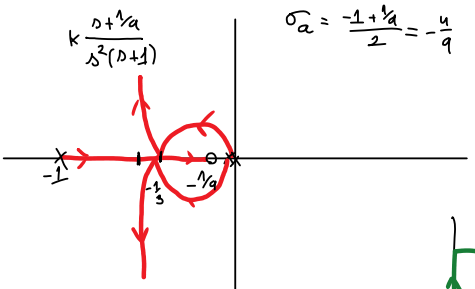
$K\frac{1}{s^2(s+1)}$ $\sigma_a = \frac{-0-0-1}{3} = -\frac{1}{3}$



.2) $k(s) = k\frac{s+1/a}{s}$

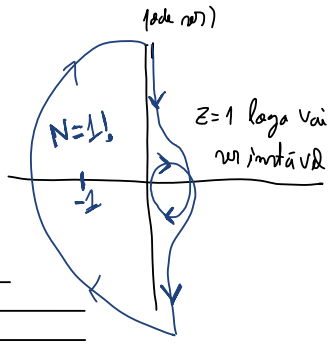
$k = -\frac{s^2(s+1)}{s+1/a}$ $\frac{dk}{ds} = 0 \Leftrightarrow 2s^3 + \frac{4s^2}{3} + \frac{2s}{a} = 0 \Leftrightarrow \begin{cases} s = -\frac{1}{3} \\ s = 0 \end{cases}$

$\sigma_a = \frac{-1+1/a}{2} = -\frac{4}{9}$



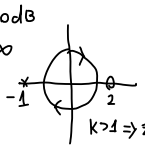
2,3) $t_s \approx \frac{\ln(\frac{3}{100})}{\xi\omega_n} \Leftrightarrow 8 = \frac{3,5}{\xi\omega_n} \Leftrightarrow \xi\omega_n = \frac{3.5}{8}$

$\Leftrightarrow \xi\omega_n = 0.4375$ (faz parte do Routh Hawis logo pode ser)



3) 1.) $P=3$ $G(s) = \frac{s-3}{s+3}$ $MG = 20dB$

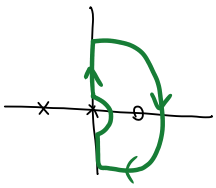
$k(s) = k$ $\phi_M = \infty$

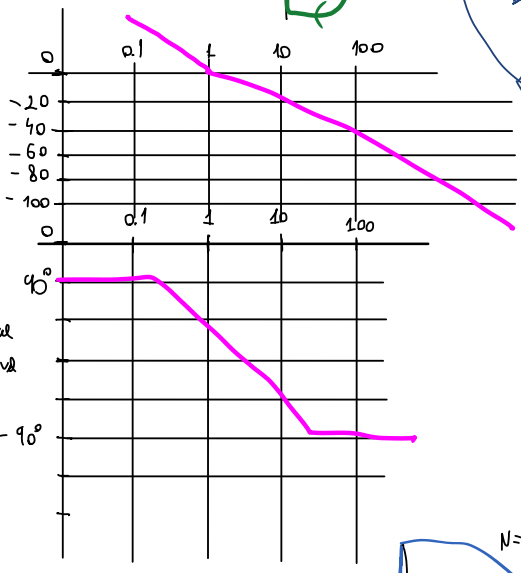


$K>1 \Rightarrow Z=1 \Rightarrow$ Instável

$K<1 \Rightarrow Z=0 \Rightarrow$ Estável

.3) $K\cdot\frac{s-3}{s(s+3)}$



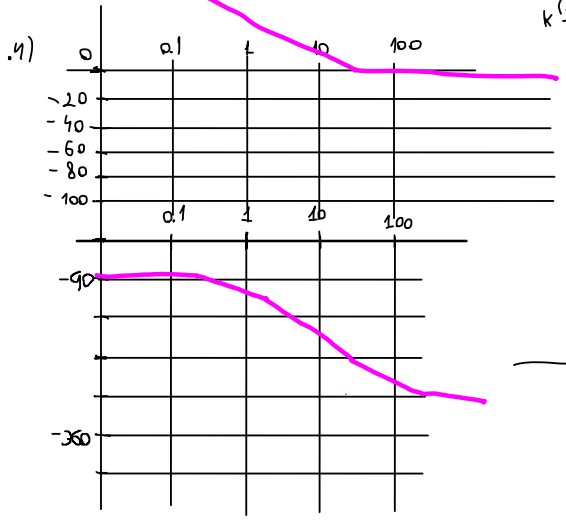


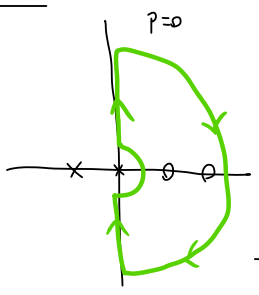
.2) $K<0$

$K>-1 \Rightarrow N=0 \Rightarrow Z=0 \Rightarrow$ Estável

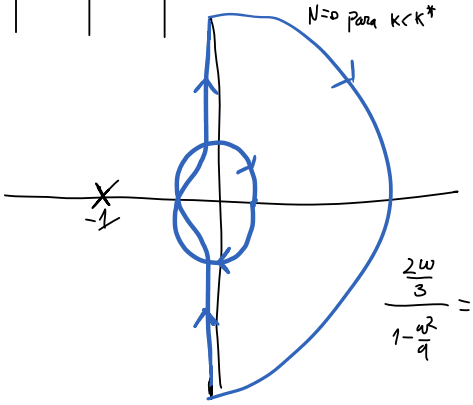
$K<-1 \Rightarrow N=1 \Rightarrow Z=1 \Rightarrow$ Instável

4) $k\frac{(s-30)(s-3)}{s(s+3)}$





N=0 para $K<K^*$



$\frac{2\omega}{3} = -\frac{30}{\omega}$

$1 - \frac{\omega^2}{9}$

$\phi_M = 0$

$\arctg(-\frac{\omega}{3}) + \arctg(-\frac{\omega}{30}) - \arctg(\frac{\omega}{3}) - \frac{\pi}{2} = -\pi \Leftrightarrow -2\arctg(\frac{\omega}{3}) - \arctg(\frac{\omega}{30}) = \frac{3\pi}{2} \Leftrightarrow$

$\frac{\frac{\omega}{9}+\frac{\omega}{3}}{1-\frac{\omega^2}{9}} = -\frac{30}{\omega} \Leftrightarrow \omega = \frac{3\sqrt{5}}{2} \Rightarrow \left|K^*\frac{(j\omega\pi - 30)(j\omega\pi - 3)}{9\omega\pi(j\omega\pi + 3)}\right| = 1 \Leftrightarrow K^* = \frac{1}{9} \Rightarrow k \in [0, \frac{1}{9}]!$

4

.1) $P(\Delta)=\frac{1}{(\Delta+1)^2}$ $\quad K(\Delta)=\frac{K}{\Delta^m}$

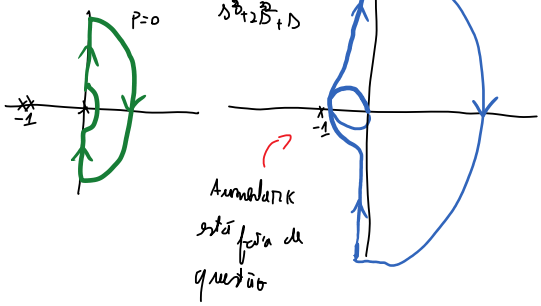
i) $\Rightarrow m=1$

ii) $\Rightarrow |K\frac{1}{\Delta(\Delta+1)^2}|\geq 20dB$ em $[0,10^{-2}]$

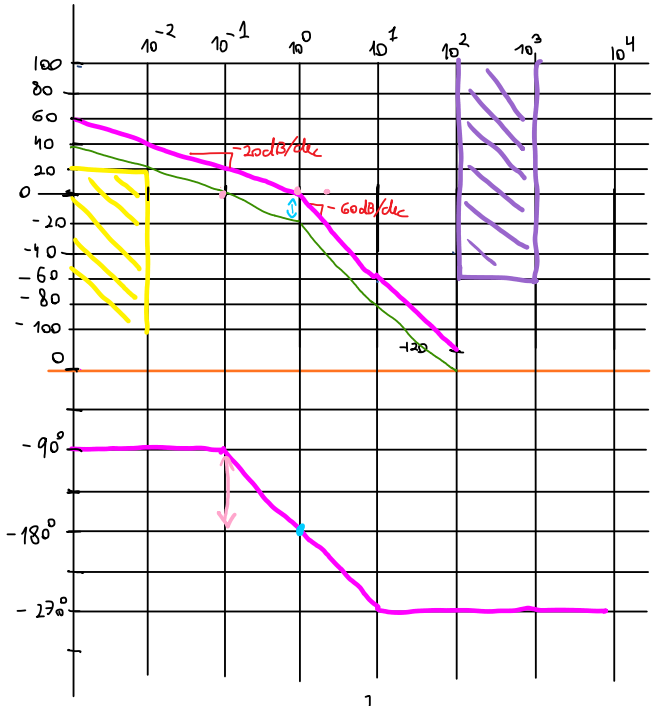
iii) $\Rightarrow |K\frac{1}{\Delta(\Delta+1)^2}|\leq -60dB$ em $[10^2,10^3]$

iv) $\Rightarrow MG\geq 20dB$

v) $\Rightarrow \phi_M \geq 30^\circ$

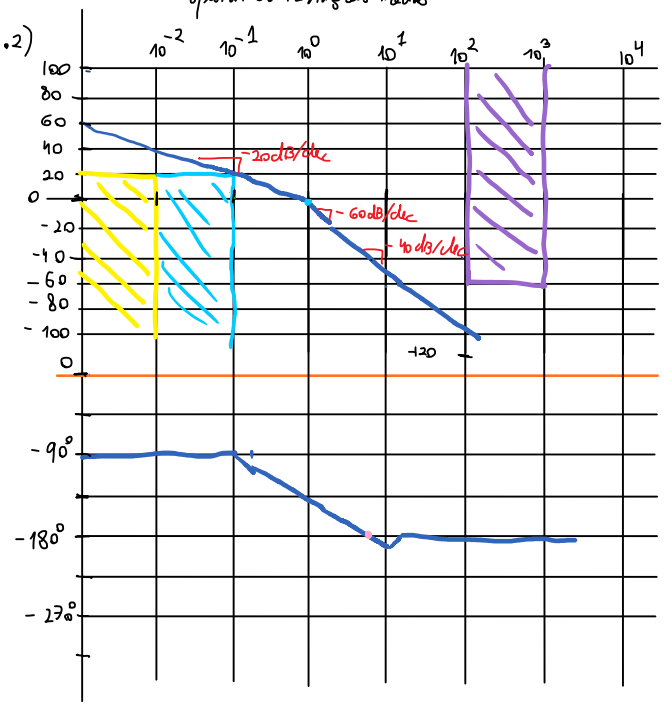


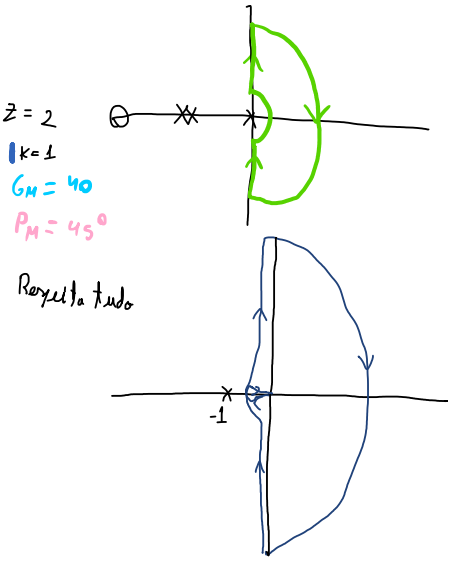
Aumentando K está fora da questão



K=0.1 e m=1 resolvem as restrições todas

.2)





4.3) $\frac{\pi}{12}<\frac{\pi}{2}-1z \Leftrightarrow$

$\Leftrightarrow \frac{\pi}{12}-\frac{\pi}{2}<-1z \Leftrightarrow$

$\frac{\pi 5}{12}\geq z$ //

$z\in[0;\frac{\pi 5}{12}]$ //