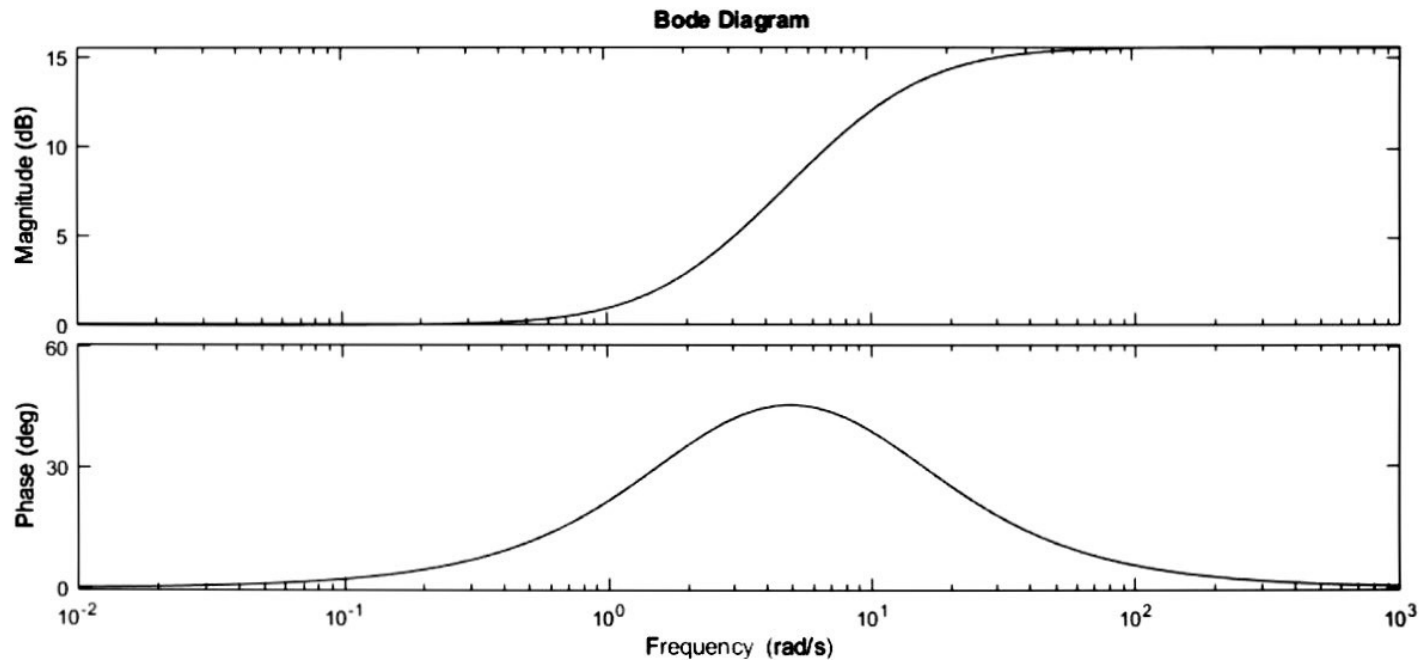
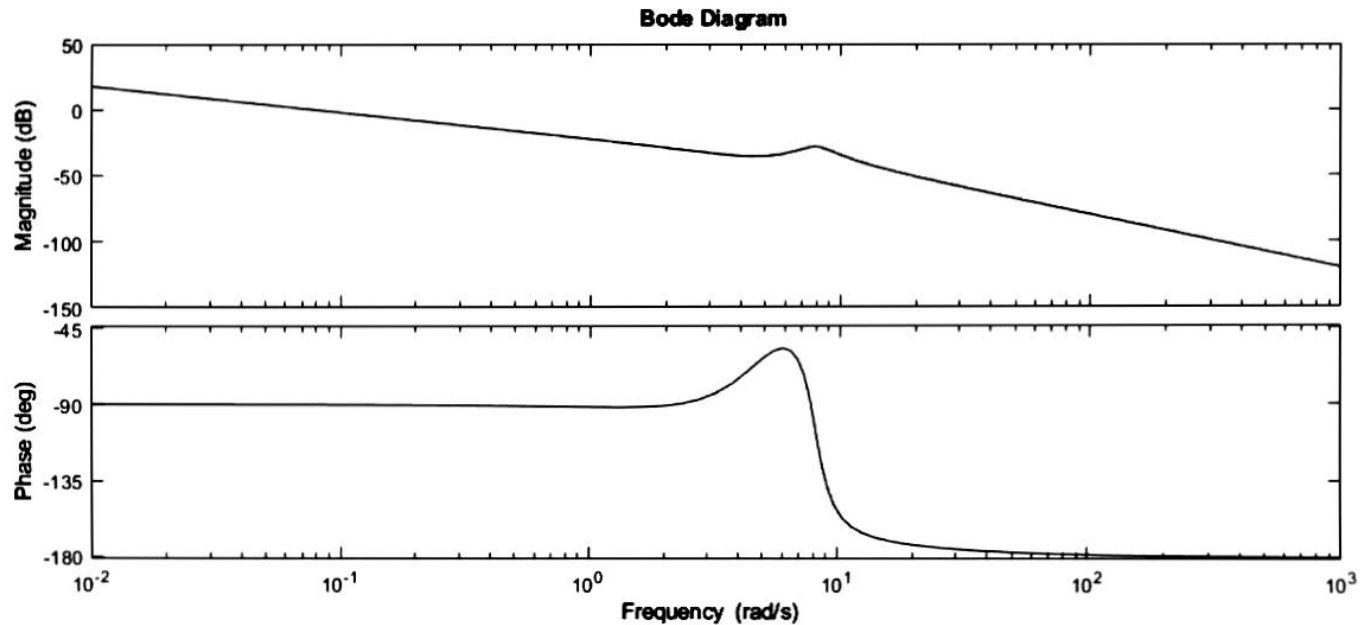


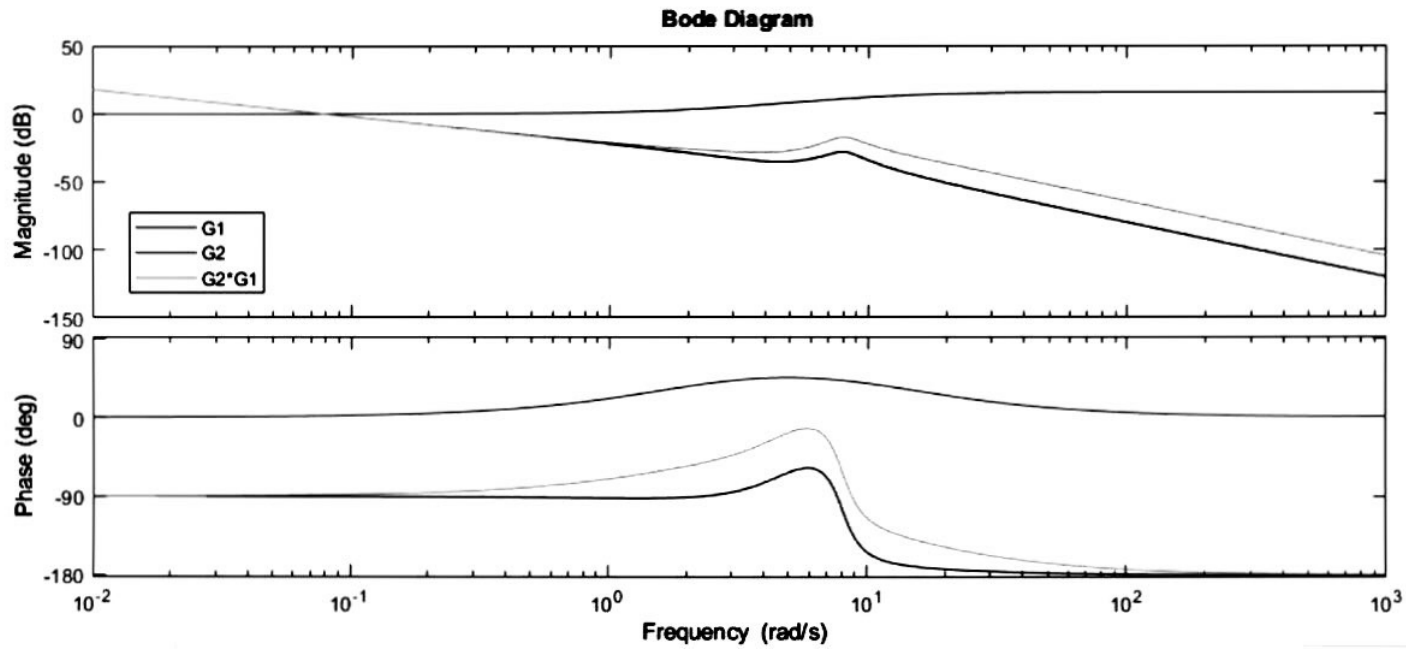
3)



4)



6)



Gabriel R. Camargo - 10772460 3, 4, 5 → diagrama inicial

$$1) G_1(s) = \frac{s^2 + 5s + 25}{s(s^3 + 7,4s^2 + 76,3s + 320)} \Rightarrow G_1(j\omega) = \frac{25(1 - (\frac{\omega}{5})^2 + \frac{\omega}{5}j)}{5s(\frac{\omega}{5} + 1)64(\frac{\omega}{8})^2}$$

Cte de Pade = $\frac{25}{5 \cdot 64} = \frac{5}{64}$; $20 \log(\text{cte}) = -22,14 \text{ dB} \rightarrow \text{fase } 0^\circ$

- Par de zero complexos com apuracao em $\omega_{n2} = 5 \text{ rad/s}$; $\zeta_2 = \frac{\omega_n}{2 \cdot 5} = 0,5$

Pico $\rightarrow \omega_{n2} = \omega_n \sqrt{1 - \zeta^2} = 3,5 \text{ rad/s}$

$\hookrightarrow M_{n2} = \frac{1}{2\zeta\sqrt{1-\zeta^2}} = 1,15 \rightarrow M_{n2} \text{ dB} = 1,25 \text{ dB}$

Em $\omega \gg \omega_{n2} \rightarrow$ aumenta 90 dB/década e $+180^\circ$ na fase

- integrador $\frac{1}{s}$, decain 20 dB/década e inicia fase em -90°

- Polo em $-s \rightarrow$ decain 20 dB/década , queda de 90° na fase p/ $\omega_{p1} > 5 \frac{\text{rad}}{\text{s}}$

- Poles complexos conjugadas

$\omega_{np} = 8 \text{ rad/s}$

$\zeta = 0,15$

$\omega_{np} = \omega_n \sqrt{1 - \zeta^2} = 7,8 \text{ rad/s}$

$M \text{ dB} = 20 \log \left(\frac{1}{2\zeta\sqrt{1-\zeta^2}} \right) = 10,55 \text{ dB}$

Com $\omega \gg \omega_{np} \rightarrow$ cai 40 dB/década \rightarrow diminui de -180°

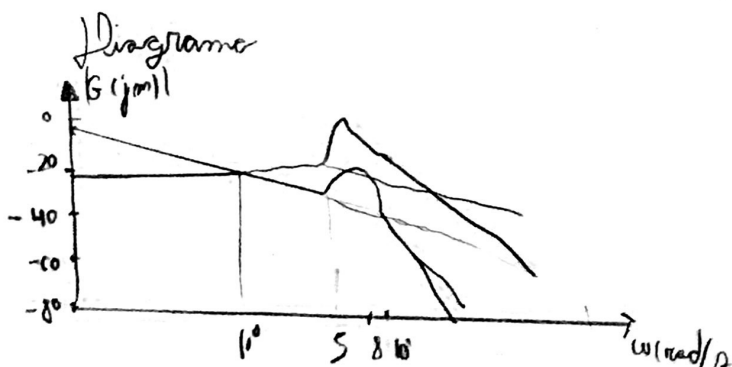
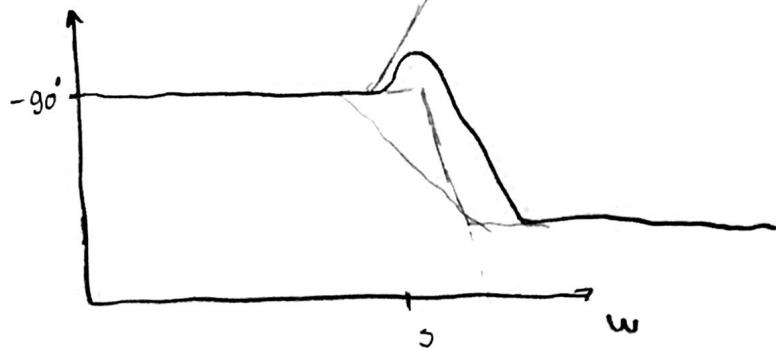


Diagrama fase

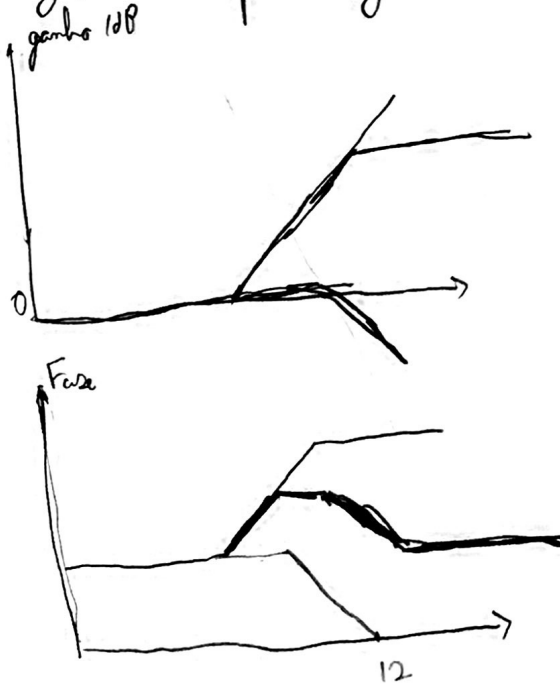


$$\textcircled{2} \quad G_2(s) = 6 \frac{s+2}{s+12} \Rightarrow G_2(j\omega) = \frac{1 \left(\frac{\omega}{2}j + 1 \right)}{\left(\frac{\omega}{12}j + 1 \right)}$$

→ 0 em $\omega_{n2} = 2 \text{ rad/s}$. Acréscimo de fase $+90^\circ$ dps de $\omega = 2 \text{ rad/s}$ e cresce 20 dB/década

→ Polo em $\omega_{np} = 12 \text{ rad/s}$ → Diminui fase -90° dps $\omega = 12 \text{ rad/s}$ e decai de 20 dB/década

Diagrama de fase e ganho



$\textcircled{3}$ Fase em 5 rad/s de $45,5^\circ$

4) Polos \rightarrow $p_1 = -5$
 $p_2 = 0$
 $p_3 = -1,2 + 7,9i$
 $p_4 = -1,2 - 7,9i$ } Dominantes

$$\omega_m = \sqrt{1,2^2 + 7,9^2} = 7,99 \text{ rad/s}$$

$$\xi = \frac{+1,2}{7,99} = 0,15$$

Resonância: $\omega_n = \omega_m \sqrt{1 - \xi^2} = 7,8 \text{ rad/s}$

Fase em ω_n rad/s $\rightarrow -62,3^\circ$

5) $M_p = \frac{e^{\frac{-\xi \pi}{\sqrt{1-\xi^2}}}}{2\sqrt{1-\xi^2}} = 62\%$

Erro = $\lim_{t \rightarrow \infty} |e(t)| = \lim_{s \rightarrow 0} sF(s) = \frac{25}{320} = 0,078$

\downarrow entrada impulso

6) G_2 em série com $G_1 \rightarrow$ multiplicação de função transf.
 \hookrightarrow valores são os mesmos das assíntotas

Fase ω_n rad/s é 180°

G_2 em série com G_1 aumenta fase entre 1 rad/s e 100 rad/s
 e a magnitude vale 15 dB em 5 rad/s