Seg Ter Qua Qui Sex Sáb Dom

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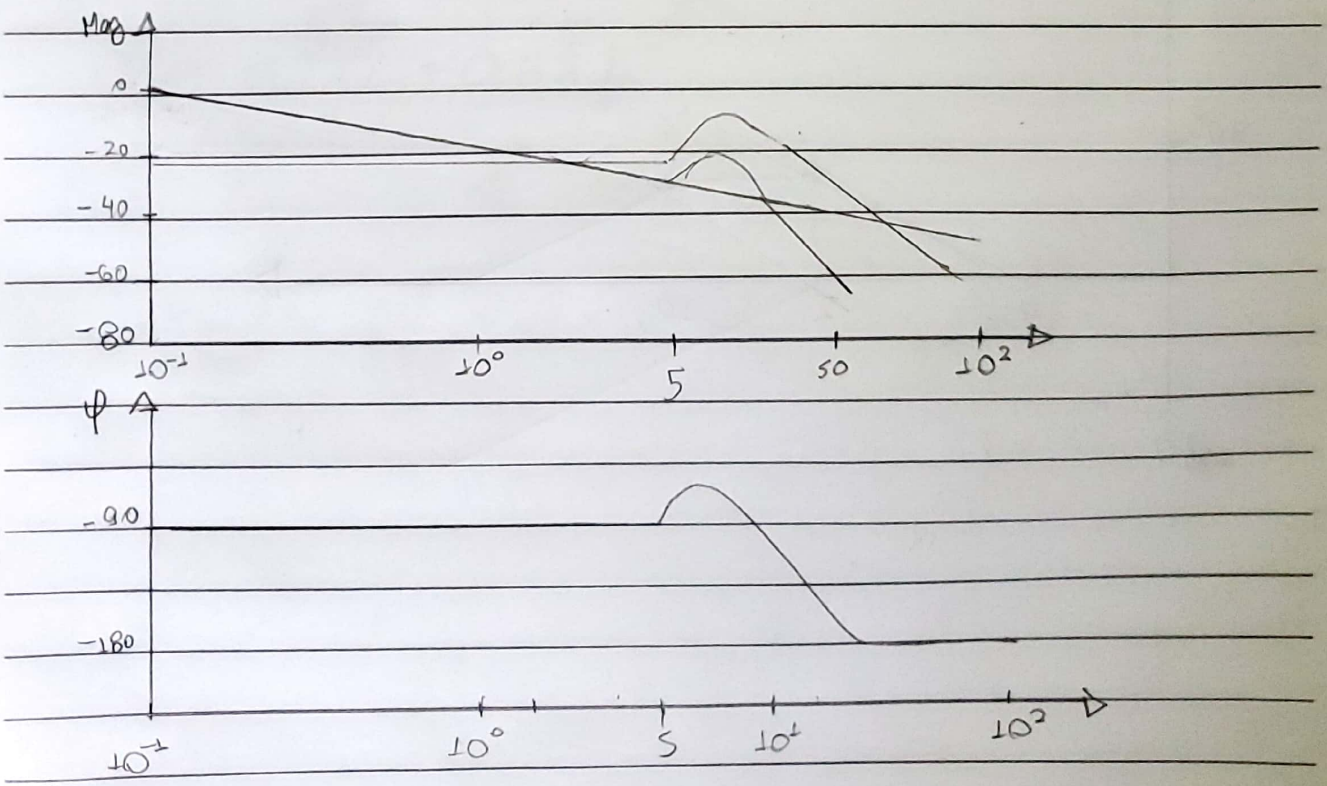
1) $G_1(s) = \frac{s^2+5s+25}{s^4+7,4s^3+76s^2+320} = \frac{s^2+5s+25}{s(s+5)(s^2+2,4s+64)}$

$G_1(\omega j) = \frac{25\left(1-\left(\frac{\omega}{5}\right)^2+\frac{\omega}{5}j\right)}{5\cdot 5\left(\frac{\omega j}{5}+1\right)64\left(1-\frac{\omega^2}{8^2}+0,09+\omega j\right)}$

$K_B = \frac{25}{320}$

- $\omega_n = 5$ rad/s (Pólos complexos) e $\zeta = 0,5$
- Pico em $\omega_r = \omega_n\sqrt{1-2\zeta^2} = 3,5$ rad/s
- $\frac{1}{s}$ → decaimento de 20dB por década
- $\omega_{rp} = \omega_n\sqrt{1-2\zeta^2} = 7,8$ rad/s



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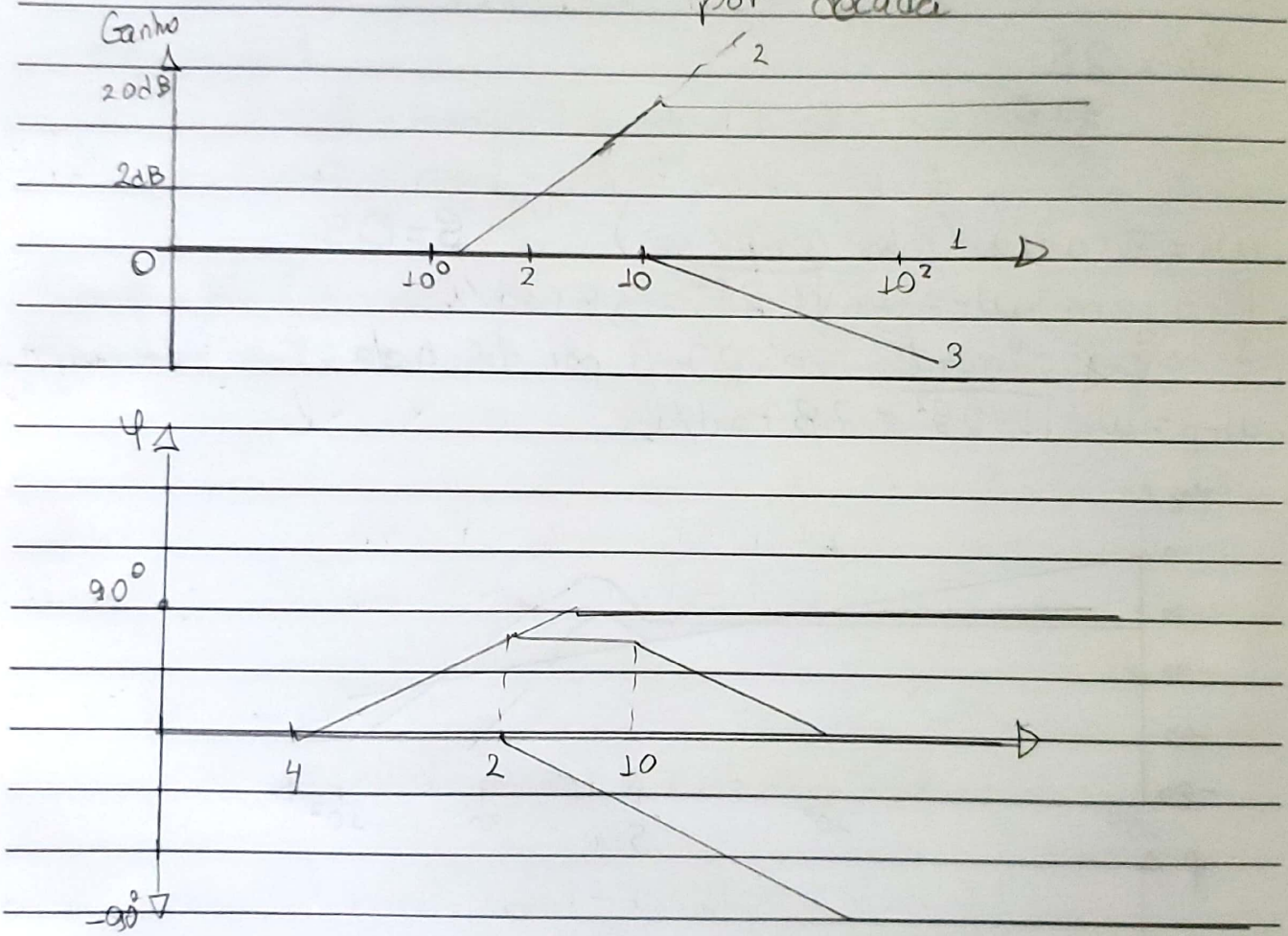
② $G_2 = 6\,\frac{s+2}{s+12} \Rightarrow G_2(jw) = \frac{1\left(\frac{w}{2}j+1\right)}{\left(\frac{w}{12}j+1\right)}$

• zero em $w_n = 2$ rad/s → acréscimo de 90° e crescimento de 20dB p/ década

• Polo em $w_{rp} = 12$ rad/s com diminuição de 12 rad/s por década



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③ Resposta no anexo

④ Pólos encontrados:

$p_1 = -5$

$p_2 = 0$

- $p_3 = -1,2 + 7,9$
- $p_4 = -1,2 - 7,9$

} dominantes, mais perto do eixo dos Imaginários

Frequências ω_n:

$\omega_n \cong 8$ rad/s (p_3 e p_4)

⑤ Overshoot

$$M_p = e^{-\frac{\xi\pi}{\sqrt{1-\xi^2}}} = 0,62$$

Erro, Teorema do valor final

$$\lim_{t\to\infty} f = \lim_{s\to 0} sF(s) = 25/320 = 0,078$$

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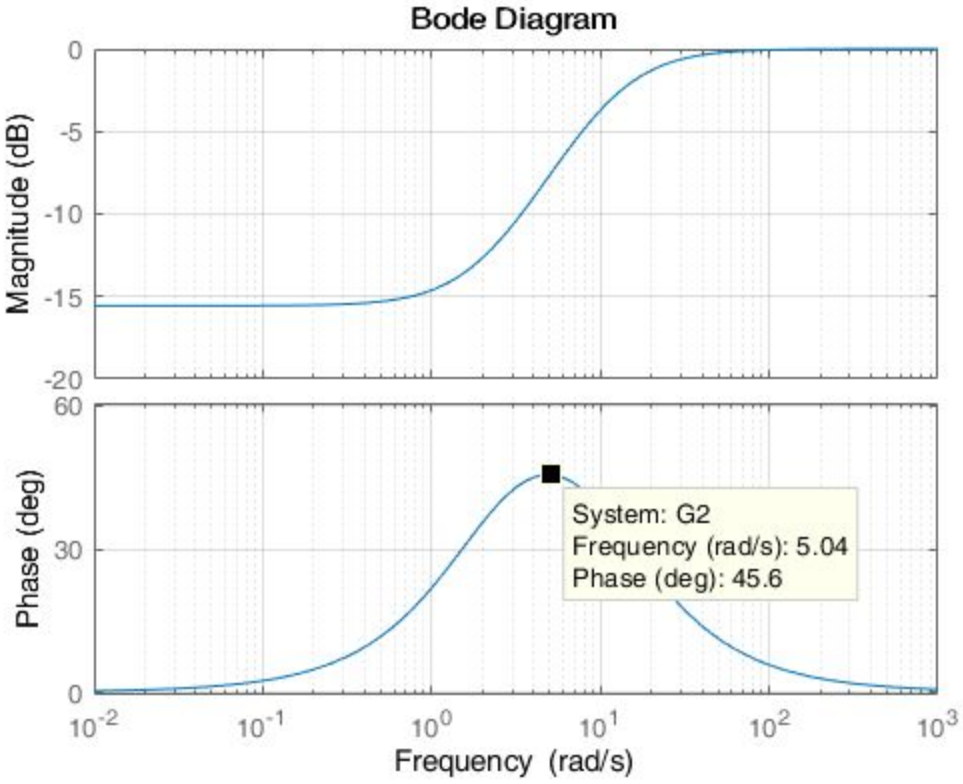
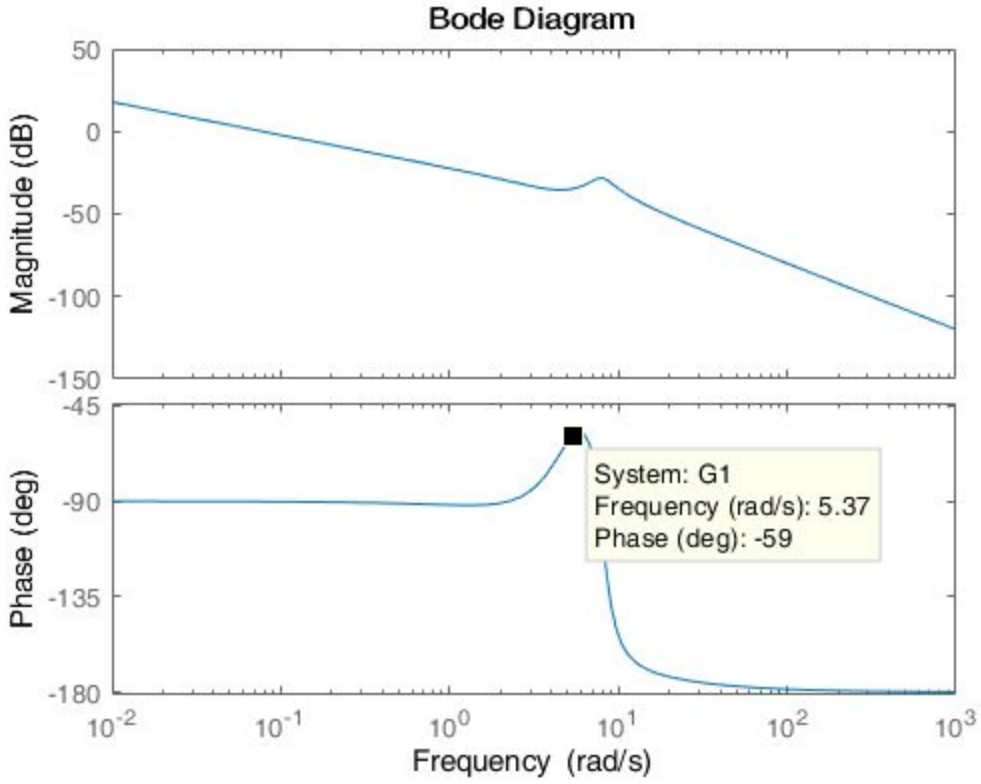
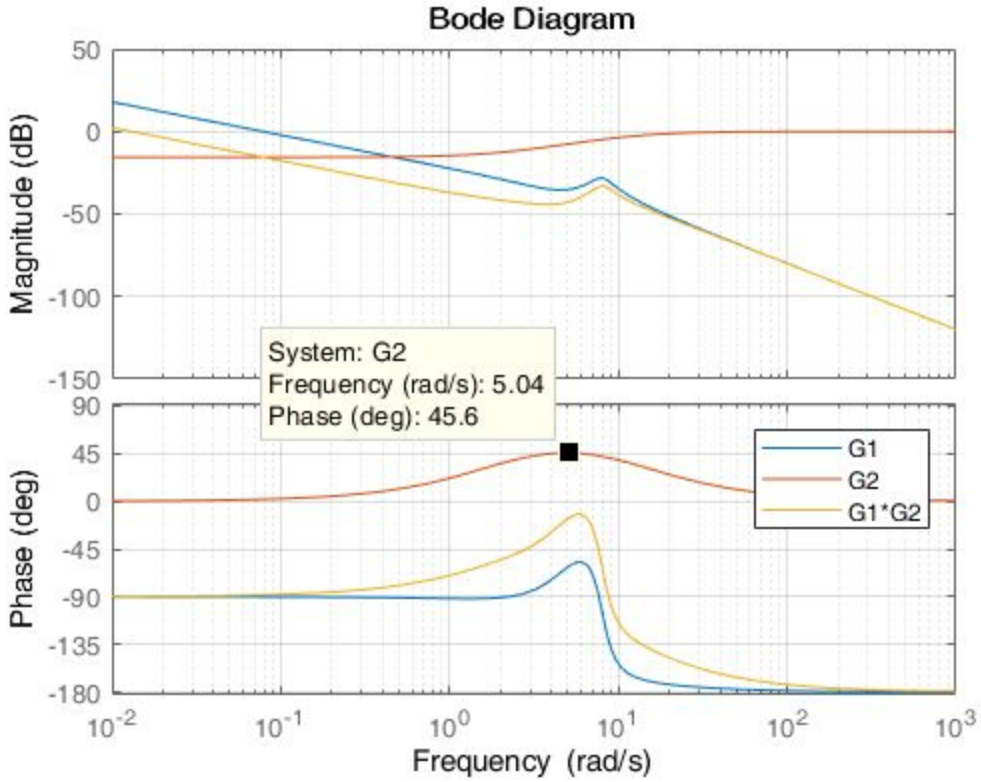
Exercício 3



Exercicio 4


Bode Diagram
Magnitude (dB)
50
0
-50
-100
-150
Phase (deg)
-45
-90
-135
-180
System: G1
Frequency (rad/s): 5.37
Phase (deg): -59
10^-2
10^-1
10^0
10^1
10^2
10^3
Frequency (rad/s)

Exercício 6


Bode Diagram
Magnitude (dB)
50
0
-50
-100
-150
System: G2
Frequency (rad/s): 5.04
Phase (deg): 45.6
Phase (deg)
90
45
0
-45
-90
-135
-180
G1
G2
G1*G2
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (rad/s)

Programa utilizado em MATLAB

```
close all

G1=tf([1 5 25],[1 7.4 76 320 0]); %reais
G2=tf([1 2],[1 12]); %imaginarios
figure(1)
bode(G1,{10^-2,10^3})
hold on
bode(G2,{10^-2,10^3})
grid on
bode(G1*G2)
legend('G1','G2','G1*G2')

%[wn,zeta] = damp(G1)

roots(G1.den(1))
```