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PME 3380 - AULA 12/11/2020

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1. $G_1(s) = \dfrac{s^2 + 5s + 25}{s(s^3 + 7{,}45s^2 + 76s + 320)}$

$G_1(j\omega) = \dfrac{25\,(1 - (\omega/5)^2 + j\omega/5)}{5\cdot 5\left(\frac{j\omega}{5} + 1\right) 64 \left(1 - \frac{\omega^2}{64} + 0{,}0375 j\omega\right)}$

$20 \log k_b = 20 \log\left(\frac{5}{64}\right) = 20 \log(0{,}078125) = -22{,}14\ dB$

→ decaimento de 20 dB por decada
→ início de fase $-90°$ } $\frac{1}{s}$

$\omega_n = 5\ rad/s$ → $\omega_r = \omega_n\sqrt{1 - 2\xi^2} = 5\sqrt{1 - 2\cdot 0{,}5^2} = 3{,}5\ rad/s$

zero //

$M_r = 20 \log\left(2\xi\sqrt{1-\xi^2}\right)^{-1} = 1{,}25\ dB$

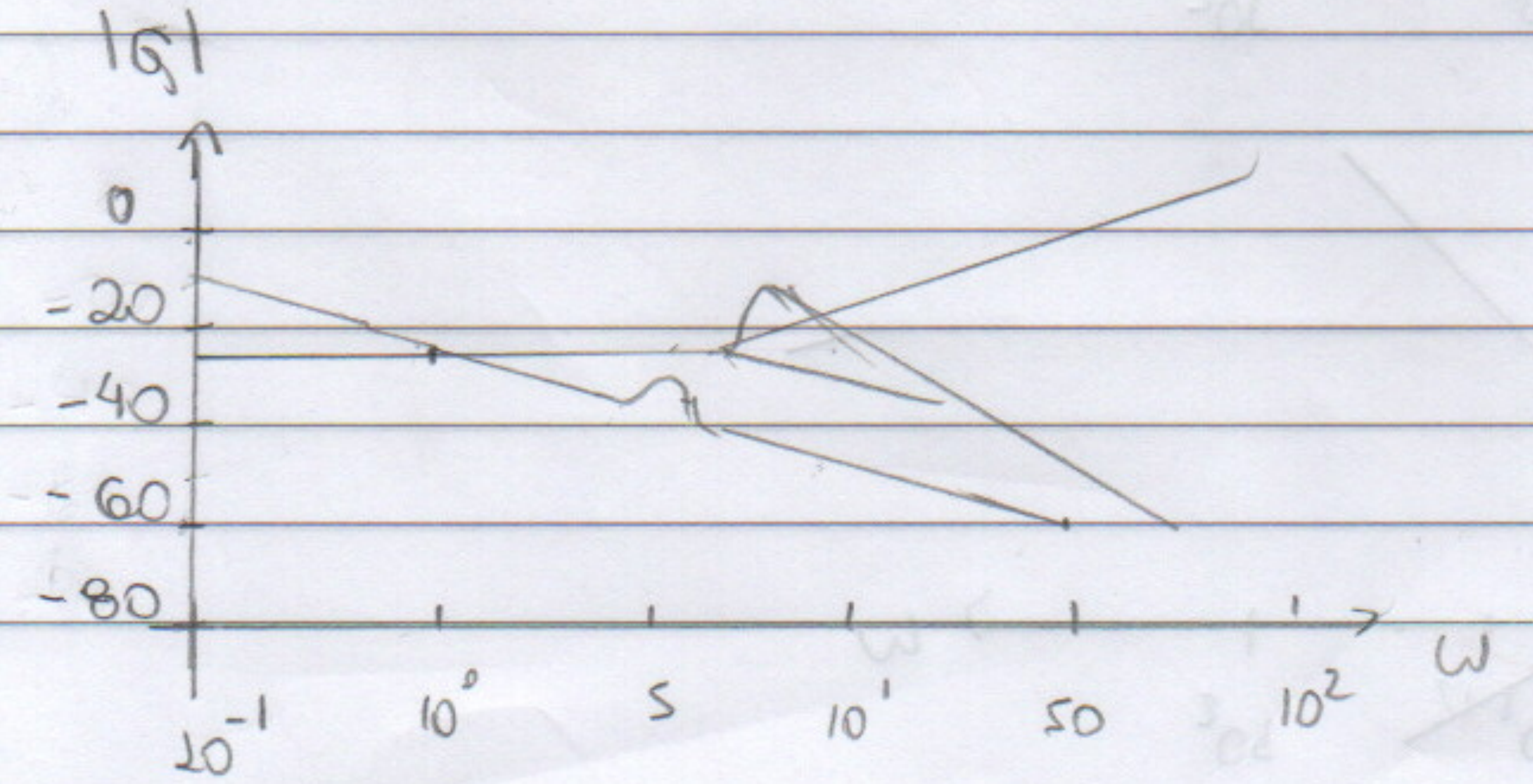
→ decaimento 20 dB / decada
→ queda de 90° na fase ($\omega p > 5\ rad/s$) } -5

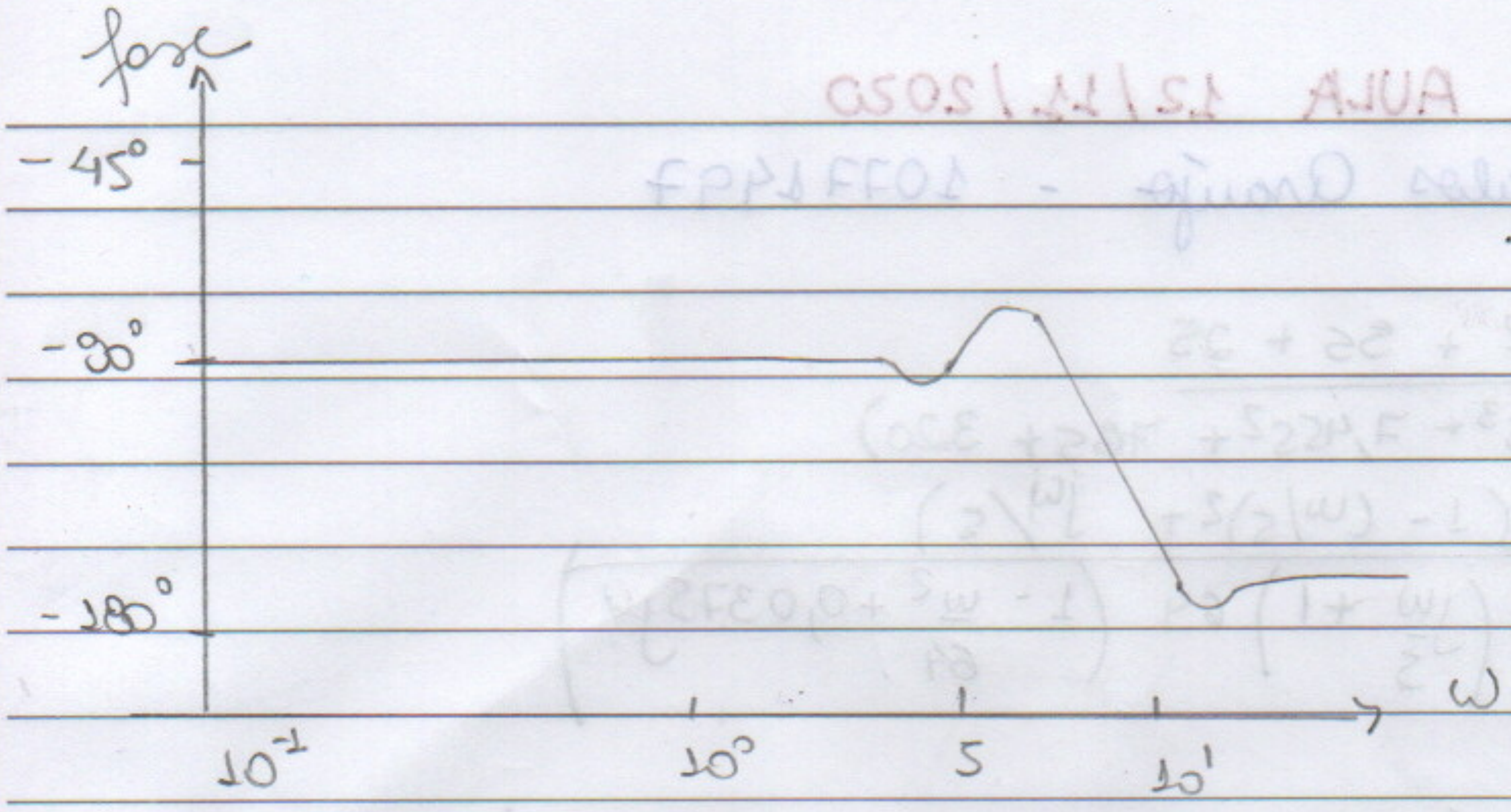
para os polos conjugados: $\omega_n = 8\ rad/s$; $\xi = 0{,}15$

$\omega_{rp} = \omega_n\sqrt{1 - 2\xi^2} = 8\sqrt{1 - 2\cdot 0{,}15^2}$

$\omega_{rp} \approx 7{,}8\ rad/s$

$M_r = 20 \log\left(2\xi\sqrt{1-\xi^2}\right)^{-1} \approx 10{,}55\ dB$





2. $G_2(s) = \frac{G(s+2)}{s+12}$ ∴ $G_2(j\omega) = \left(\frac{\omega j/2 + 1}{\omega j/12 + 1}\right)$

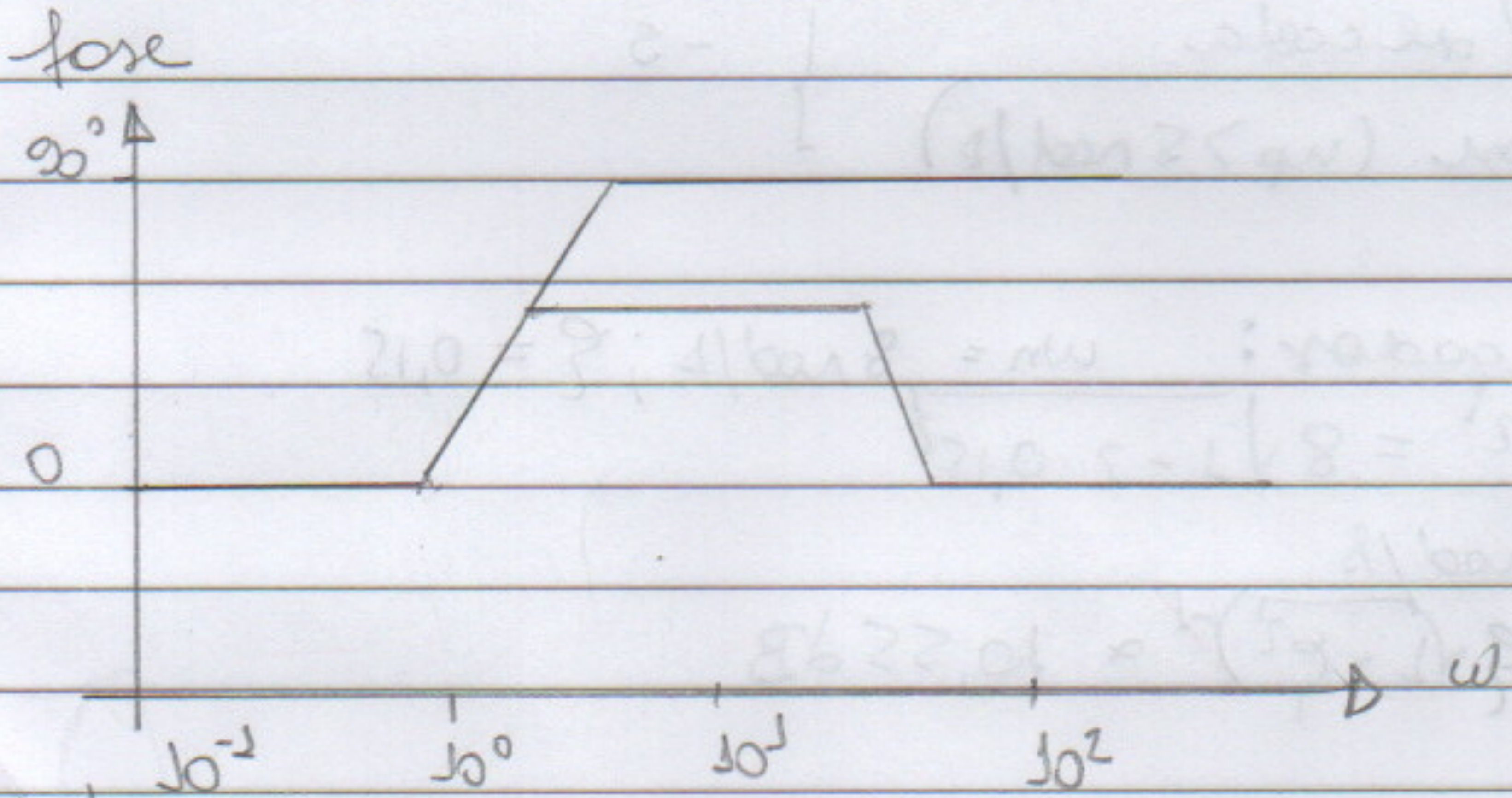
ω_{n2} = 2 rad/s ⇒ zero

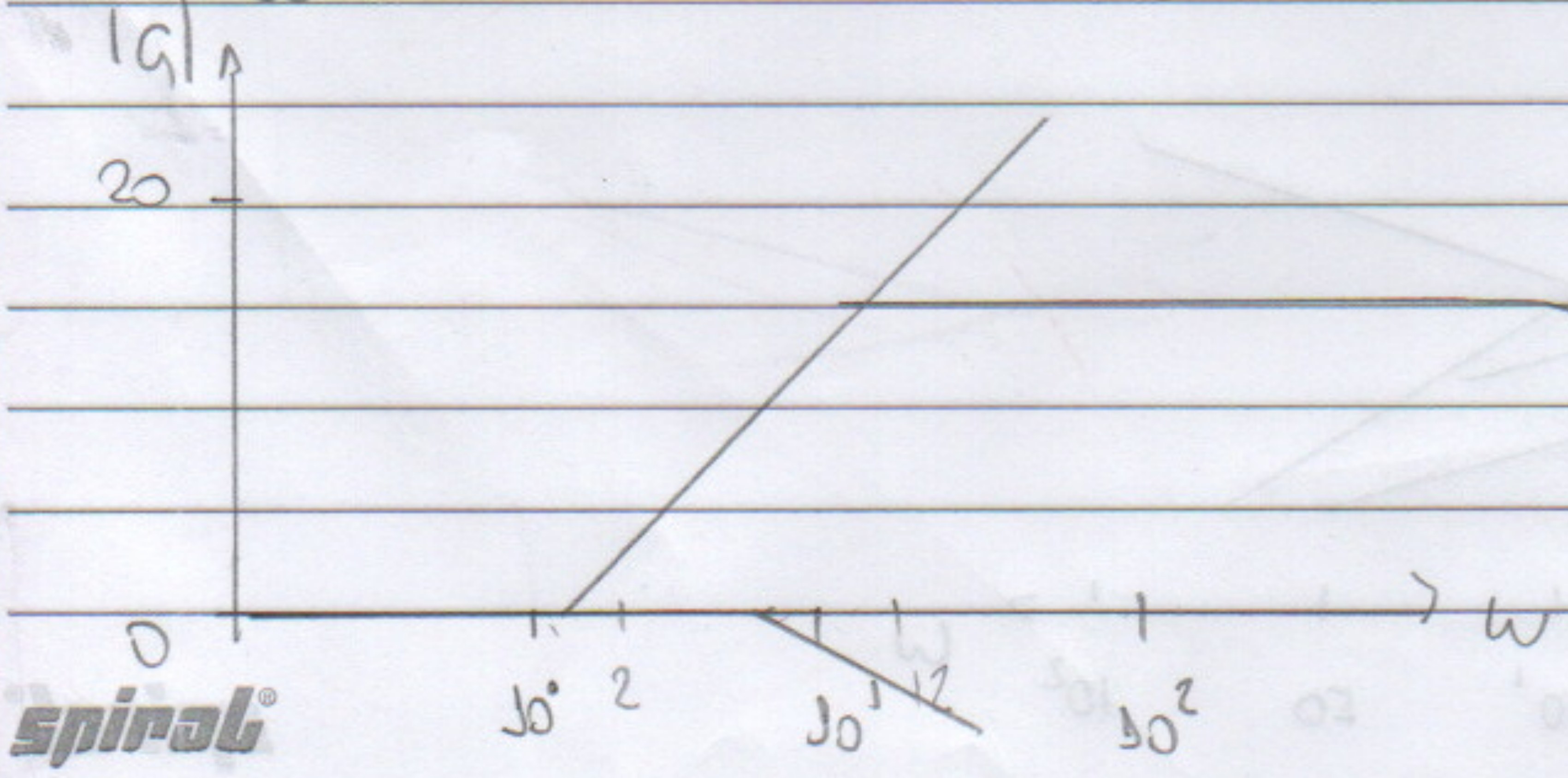
↳ acréscimo de fase de 90° depois de ω_{n2}

↳ crescimento de 20dB/década

ω_{np} = 12 rad/s ⇒ polo

↳ diminuição de fase após 12 rad/s





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4\. definição dos polos $\begin{cases} p_1 = -5 \\ p_2 = 0 \\ p_{3,4} = -1,2 \pm 7,9i \end{cases}$

$p_{3,4} = -\xi \omega_n \pm \omega_n \sqrt{\xi^2 - 1}$

Considerando o polo dominante:

$\omega_n = \sqrt{1,2^2 + 7,9^2} = 7,9906$ rad/s

$\therefore -\xi = \dfrac{-1,2}{7,9906} \Rightarrow \xi = 0,1502$

$\omega_r = \omega_n \sqrt{1 - 2\xi^2} = 7,9906 \sqrt{1 - 2(0,1502)^2}$

$\omega_r = 7,808$ rad/s

spiral