1. Paralelo $\rightarrow Z \searrow$

C

2. Realimentação inclui o andar de saída $\Rightarrow$ C

3. B

4. D

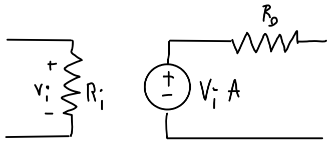
5. B

II a) Série - Série

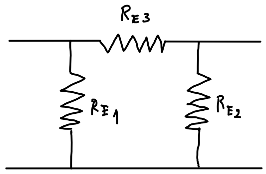
Tensão (V_i) - Corrente (I_o)

Transcondutância //

b) A



β



$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0} = R_i \qquad Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0} = 0$$

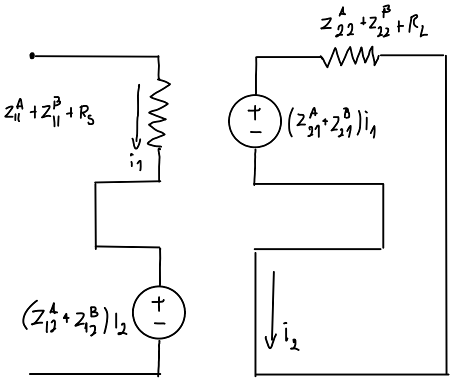
$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0} = A R_i \qquad Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0} = R_o$$

$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0} = R_{E1} // (R_{E2}+R_{E3}) \qquad Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0} = \frac{R_{E1}\cdot R_{E2}}{(R_{E1}+R_{E2}+R_{E3})}$$

$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0} = \frac{R_{E1}\cdot R_{E2}}{(R_{E1}+R_{E2}+R_{E3})} \qquad Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0} = R_{E2} // (R_{E1}+R_{E3})$$

$$A = \begin{bmatrix} 1K & 0 \\ -1M & 209 \end{bmatrix} \qquad \beta = \begin{bmatrix} 1714 & 286 \\ 286 & 1714 \end{bmatrix}$$

c)



$$A' = -\frac{z_{21}^A + z_{21}^B}{(z_{11}^A + z_{11}^B + R_S)(z_{22}^A + z_{22}^B + R_L)} = 22{,}6\ mS$$

$$\beta' = z_{12}^A + z_{12}^B = 286\,\Omega$$

$A_0 = 140\,dB$

$\omega_{p_1} = 2\pi \times 10^6\ rad/s$

$\omega_{p_2} = 2\pi \times 10^7\ rad/s$

$A_f = 20\,dB = \frac{1}{\beta} \Leftrightarrow \beta = -20\,dB$

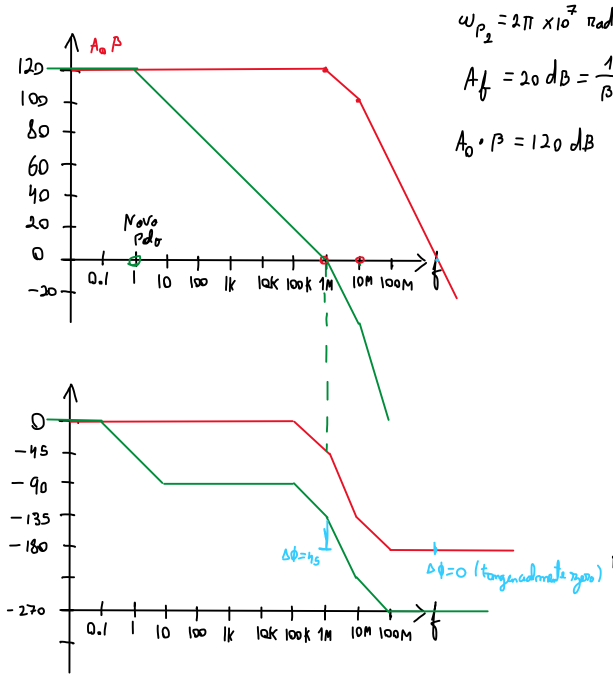
$A_0 \cdot \beta = 120\,dB$

d) $$A_f = \frac{I_o}{V_i} = \frac{A'}{1 + A'\beta'} = 3\ mS$$

$$K_V = \frac{V_o}{V_i} = -R_L \frac{I_o}{V_i} = -30$$

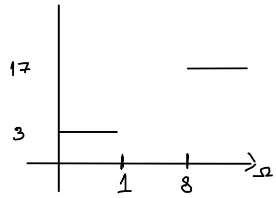
Série - $R \nearrow$ $\rightarrow$ A impedância de saída aumenta

e)



É marginalmente estável

III a)



$A_p = 3dB$

$\omega_p = 50K \, rad/s$

$A_s = 17dB$

$\omega_s = 6,25K rad$

$A(\Omega) = 10\log(1+\varepsilon^2\Omega^{2n})$

$A(1) = 10\log(1+\varepsilon^2) \Rightarrow \varepsilon = 1$

$17 = 10\log(1+8^{2n}) \Rightarrow n=1$

$H(S) = S+1$

$T(s) = \frac{1}{S+1}\Big|_{S=\frac{\omega_p}{s}} = \frac{s}{s+\omega_p} = \frac{s}{s+50K}$

b) Para $n=1$ Chebyshev e Butterworth são iguais//

c) $s = \frac{2}{T}\frac{1-z^{-1}}{1+z^{-1}}$

$$T(z^{-1}) = \frac{s}{s+\omega_p}\Big|_{s=\frac{2}{T}\frac{1-z^{-1}}{1+z^{-1}}} = \frac{\frac{2}{T}\frac{1-z^{-1}}{1+z^{-1}}}{\frac{2}{T}\frac{1-z^{-1}}{1+z^{-1}}+\omega_p} = \frac{2(1-z^{-1})}{2(1-z^{-1})+\omega_p\cdot T\cdot(1+z^{-1})} = \frac{4-4z^{-1}}{4-4z^{-1}+1+z^{-1}} = \frac{4-4z^{-1}}{5-3z^{-1}} = 0,8\frac{1-z^{-1}}{1-0,6z^{-1}}$$

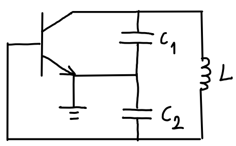
d) Filtro IIR → Polos? → 0,6 está dentro do circulo unitário, logo é estável

(A transformação bilinear não altera a estabilidade, logo é estável)

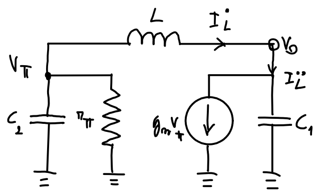
$50 KHz = \frac{f_s}{2} \Rightarrow$ Atenuação do analógico em ∞ → $A(\infty) = 1 = 0dB$

Equação de recorrência: $y_n = 0,8x_n - 0,8x_{n-1} + 0,6y_{n-1}$

IV a)



=>



$I_L' = -\frac{V_\pi}{\frac{1}{sC_2}//r_\pi}$ $\qquad I_L'' = g_m V_\pi + V_o(sC_1)$

$\frac{V_\pi - V_o}{sL} = I_L' \Leftrightarrow V_o = V_\pi - I_L'(sL) \Leftrightarrow V_o = V_\pi\left(1+\frac{sL}{\frac{1}{sC_2}//r_\pi}\right)$

$$I_L' = I_L'' \Leftrightarrow -\frac{V_\pi}{\frac{1}{sC_2}//r_\pi} = g_m V_\pi + V_o(sC_1) \Leftrightarrow -\frac{V_\pi}{\frac{1}{sC_2}//r_\pi} = g_m V_\pi + V_\pi\left(1+\frac{sL}{\frac{1}{sC_2}//r_\pi}\right)(sC_1) \Leftrightarrow -sC_2 - \frac{1}{r_\pi} = g_m + sC_1 + s^2C_1L\left(sC_2+\frac{1}{r_\pi}\right) \Leftrightarrow$$

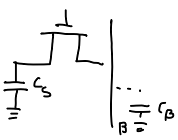
$$\Leftrightarrow sC_2 + \frac{1}{r_\pi} + g_m + sC_1 + s^3C_1C_2L + \frac{s^2C_1L}{r_\pi} = 0$$

Parte real: $\frac{1}{r_\pi} + g_m - \frac{\omega^2C_1L}{r_\pi} = 0 \Leftrightarrow 1+g_m r_\pi - \frac{1}{L}\frac{C_1+C_2}{C_1C_2}\cdot C_1L = 0 \Leftrightarrow 1+g_m r_\pi - \frac{C_1+C_2}{C_2} = 0 \Leftrightarrow g_m r_\pi = \frac{C_1}{C_2}$ Condição oscilação

Parte imaginária: $\omega C_2 + \omega C_1 - \omega^3C_1C_2L = 0 \Leftrightarrow C_2+C_1 = \omega^2C_1C_2L \Leftrightarrow \omega = \sqrt{\frac{1}{L}\frac{C_1+C_2}{C_1C_2}}$ Freq.

b) Pierce ⇒ elevada precisão!

V −



Na leitura temos $C_S + C_B$ logo as cargas vão se redistribuir ficando $V = \frac{V_{DD}}{2} \pm \Delta V$