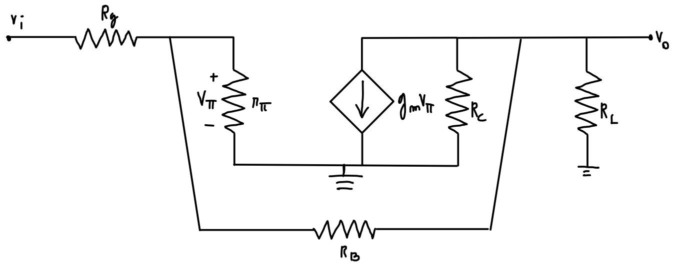
1) A   2) C   3) C   4) D   5) C

II a) Paralelo – Paralelo

Transimpedância $A_f = \frac{V}{I}$

b)



A : $y_{11} = \frac{I_1}{V_1}\Big|_{V_2=0} = \frac{1}{r_\pi}$ $y_{12} = \frac{I_1}{V_2}\Big|_{V_1=0} = 0$

$y_{21} = \frac{I_2}{V_1}\Big|_{V_2=0} = g_m$ $y_{22} = \frac{I_2}{V_2}\Big|_{V_1=0} = \frac{1}{R_C}$

β : $y_{11} = \frac{I_1}{V_1}\Big|_{V_2=0} = \frac{1}{R_B}$ $y_{12} = \frac{I_1}{V_2}\Big|_{V_1=0} = -\frac{1}{R_B}$

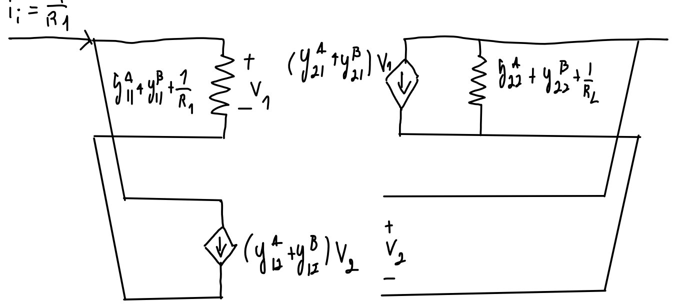
$y_{21} = \frac{I_2}{V_1}\Big|_{V_2=0} = -\frac{1}{R_B}$ $y_{22} = \frac{I_2}{V_2}\Big|_{V_1=0} = \frac{1}{R_B}$

$g_m = \frac{I_C}{V_T}$ $r_\pi = \frac{\beta}{g_m}$

$$\beta = \begin{bmatrix} 10\mu & -10\mu \\ -10\mu & 10\mu \end{bmatrix} S$$

$$A = \begin{bmatrix} 200\mu & 0 \\ 0.16 & 100\mu \end{bmatrix} S$$

c) $i_i = \frac{V_i}{R_1}$

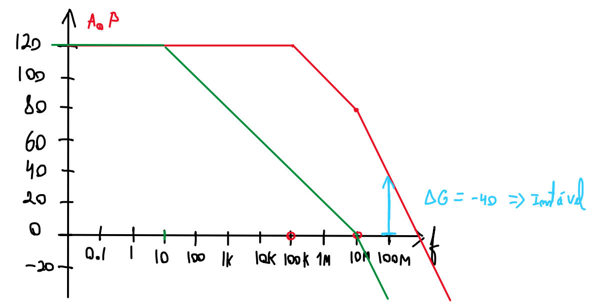


$$A' = -\frac{y_{21}^A + y_{21}^B}{\left(y_{11}^A + y_{11}^B + \frac{1}{R_s}\right)\left(y_{22}^A + y_{22}^B + \frac{1}{R_L}\right)} = -629{,}6\,K\Omega$$

$$\beta' = y_{12}^A + y_{12}^B = -10\,\mu S$$

d) $A_f = \frac{A'}{1+A'\beta'} = \frac{V_o}{I_i} = -86.29\,K\Omega$

$K_V = \frac{A_f}{R_i} = -86.29$



e)

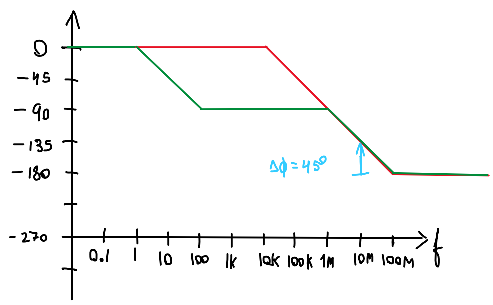
$A_o = 140\,dB$

$\omega_{p_1} = 2\pi \times 10^5$ rad/s

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

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

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



III

a) $m = 2$

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

$$A(1) = 3dB \Rightarrow \varepsilon = 1$$

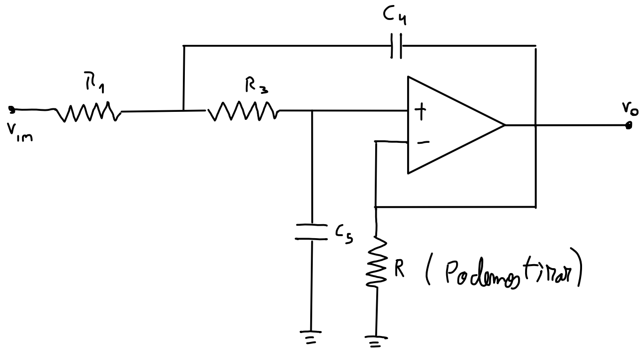
$$24.1 = 10\log(1+\Omega^4) \Rightarrow \Omega = \sqrt[4]{10^{\frac{24.1}{10}} - 1} = 4$$

$$\Omega = 4 \Rightarrow \omega = \omega_p \cdot 4 = \sqrt{3.9478\times10^7}\cdot 4 = 2{,}5132\times10^4 = 2\pi\times 4K\ rad/s$$

b)

$$Y_1 = \frac{1}{R_1}$$
$$Y_2 = 0$$
$$Y_3 = \frac{1}{R_3}$$
$$Y_4 = sC_4$$
$$Y_5 = sC_5$$

$$\frac{K\cdot\frac{1}{R_1}\cdot\frac{1}{R_3}}{\left(\frac{1}{R_1}+\frac{1}{R_3}+sC_4\right)sC_5 + \frac{1}{R_1}\cdot\frac{1}{R_3} + (1-K)\frac{1}{R_3}\cdot sC_4} \Leftrightarrow$$



$$\Leftrightarrow \frac{K\,\frac{1}{C_4C_5R_1R_3}}{s^2 + s\left(\frac{1}{C_4R_1}+\frac{1}{C_4R_3}+\frac{1-K}{C_5R_3}\right) + \frac{1}{C_4C_5R_1R_3}}$$

Vamos fazer $R_1 = R_3 = R$ e $K = 1$

$$\frac{\frac{1}{C_4C_5R^2}}{s^2 + s\left(\frac{1}{C_4R}+\frac{1}{C_4R}\right) + \frac{1}{C_4C_5R^2}}$$

$$A = \frac{1}{C_4C_5R^2} \Leftrightarrow C_5 = \frac{1}{C_4AR^2} = 112.5mF$$

$$B = \frac{1}{C_4R} + \frac{1}{C_4R} \Leftrightarrow C_4 = \frac{2}{BR} = 225mF$$

c)

$$\frac{\frac{1}{C_4C_5R^2}\cdot K}{s^2 + s\left(\frac{1}{C_4R}+\frac{1}{C_4R}+\frac{1-K}{C_5R}\right) + \frac{1}{C_4C_5R^2}}$$

$$\omega = \sqrt{\frac{1}{C_4C_5R^2}} \rightarrow \text{Manter freq} \Rightarrow \begin{array}{l} C_4 = 225mF \\ C_5 = 112.5mF \\ R = 1K \end{array}$$

Colocar os polos no eixo imaginário

$$\hookrightarrow \frac{2}{C_4R} + \frac{1-K}{C_5R} = 0 \Leftrightarrow 2C_5 + (1-K)C_4 = 0 \Rightarrow K = 2$$

Ora para ter $K=2$, sendo uma montagem não inversora, temos

$$K = 1 + \frac{R_A}{R_B}$$ e por isso podemos fazer $R_A = R_B = R = 1K\Omega$ //

IV a) FIR, é sempre estável

$$y_n = x_n + 0{,}2x_{n-1} + 0{,}4x_{n-2} + 0{,}2x_{n-3} + x_{n-4}$$

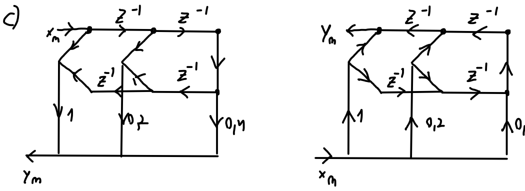
b)
$$T(e^{j\omega T}) = 1 + 0{,}2e^{-j\omega T} + 0{,}4e^{-2j\omega T} + 0{,}2e^{-3j\omega T} + e^{-4j\omega T} =$$

$$= e^{-2j\omega T}\left(0{,}4 + 2\cos(\omega T) + 0{,}4\cos(2\omega T)\right)$$

$$\omega = 0 \rightarrow 0{,}4 + 2 + 0{,}4 = 2{,}8 \rightarrow 8{,}94dB$$

$$\tau = -\frac{\partial(-2j\omega T)}{\partial\omega} = 2T \Rightarrow \text{atraso}: 20\mu s$$

c)



d) Largura da banda $\Delta = 2\pi(f_2 - f_1)T = \frac{10K}{100K}\pi = \frac{\pi}{10}$

Largura do lóbulo $\Delta = \frac{A}{N}$

$A = 4\pi$ (Retangular)

$$\frac{\pi}{10} > \frac{4\pi}{N} \Rightarrow N > 40 \ //$$

N é a ordem do filtro mais 1

Logo $n > 39$ //