2) α_{dB}

α_{max}

α_{min}

f_p f_s f

$\alpha_{min} = 20\ dB$ $\alpha_{max} = 0,5$

$F_p = 1\ kHz$ $F_s = 2\ kHz$ $\Omega_0 = 2\pi\ 1\ kHz$

$\omega_p = 1$ $\omega_s = 2$

a) $\varepsilon^2 = 10^{\frac{\alpha_{max}}{10}} - 1 = 0,122 \rightarrow \boxed{\varepsilon = 0,35}$

$\alpha_{min} = 10 \log\left(1 + \varepsilon^2 \omega_s^{2m}\right)$ $m=1: \alpha_{min} = 1,72$ ✗ $m=2: \alpha_{min} = 4,7$ ✗

$m=3 \rightarrow \alpha_{min} = 9,44$ ✗ $m=4$ $\alpha_{min} = 15,06$ ✗ $m=5$ $\alpha_{min} = 21$ ✓ $\boxed{M=5}$

$H(j\omega) = \frac{1}{1 + \varepsilon^2\ \omega^{5.2}} \Rightarrow H(s)\ H(-s) = \frac{1}{1 - \varepsilon^2\ s^{10}}$ → Calculo raíces

$x_{1,2} = -1 \pm j0,725$ $x_{3,4} = -0,38 \pm j1,173$ $x_5 = -1,234$

$$H(s) = \frac{-1/\varepsilon}{(s+1+j0,725)(s+1-j0,725)(s+0,38+1,17)(s+0,38-1,17)(s+1,23)}$$

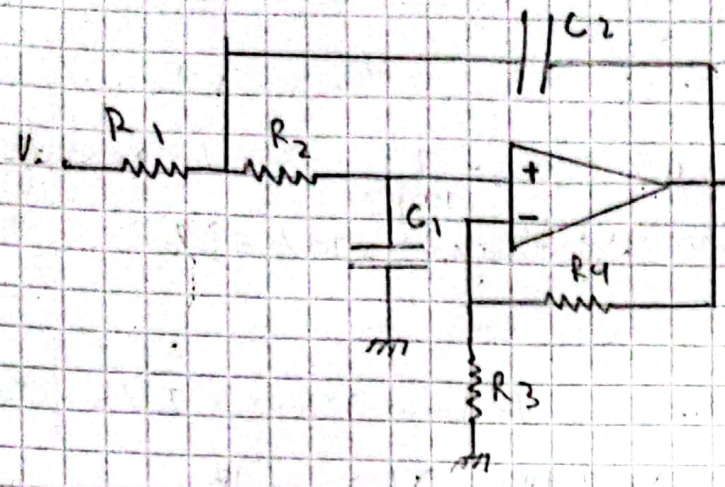
$$H(s) = \frac{-1/\varepsilon}{(s^2+2s+1,52)(s^2+0,76s+1,52)(s+1,23)}$$

Notar que $\frac{1}{\varepsilon} = 1,52^2\ 1,23 \rightarrow K = 1$

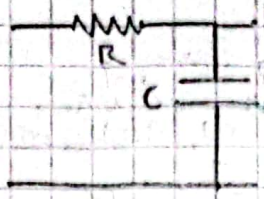
$\omega_3 = 1,23$ $Q_1 = 0,61$ $Q_2 = 1,61$

NOTA

Sallen Key:



RC Pasabajos 1er orden



$i_R = I_C$

$\frac{V_i - V_o}{R} = V_o SC$

$V_i - V_o = V_o SCR$

$V_o(SCR+1) = V_i \rightarrow T(s) = \frac{1}{SCR+1} = \frac{\frac{1}{CR}}{S + \frac{1}{RC}}$

$\omega_0 = \frac{1}{RC}$

$$H(s) = \frac{\left(\frac{R_4}{R_3}+1\right)}{s^2 + \left[\frac{1}{C_2}\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - \frac{R_4}{R_3 R_2 C_1}\right]s + \frac{1}{R_1 R_2 C_1 C_2}} \cdot \frac{1}{R_1 R_2 C_1 C_2}$$

Ganancia: $20\,dB = 20 \log |H| \rightarrow |H| = 1 \rightarrow$ unitaria

Al mínimo

Adopto $\{R_1 = R_2 = R\}$ $K = 2$

$$\begin{cases} \omega_0^2 = \frac{1}{R_1 R_2 C_1 C_2} \\ \frac{\omega_0}{Q} = \frac{1}{C_2}\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - \frac{R_4}{R_3 R_2 C_1} \end{cases}$$

$\omega_0^2 = \frac{1}{R^2 C_1 C_2}$; $\frac{\omega_0}{Q} = \frac{2}{RC_2} - \frac{R_4}{R_3}\frac{1}{RC_1}$

$K = 2 \rightarrow \frac{R_4}{R_3} = 1$; $C_1 = \frac{1}{R^2 C_2 \omega_0^2}$

$K = \frac{R_4}{R_3} + 1 \rightarrow \frac{R_4}{R_3} = K - 1$ $\quad \frac{\omega_0}{Q} = \frac{2}{RC_2} - \frac{1}{RC_1}$

Normo impedancia $\boxed{R = 1}$ $\left[C_1 = \frac{1}{\omega_0^2 C_2}\right]$

$$\frac{\omega_0}{Q} = \frac{2}{C_2} - \frac{1}{C_1} = \frac{2}{C_2} - C_2\omega_0^2 = \frac{2 - C_2^2\omega_0^2}{C_2} = \frac{\omega_0}{Q}$$

$$\rightarrow \left[C_2^2\omega_0^2 + C_2\frac{\omega_0}{Q} - 2 = 0\right]$$

Primer LP: $\omega_0 = 1{,}23 \rightarrow \omega_0^2 = 1{,}52$ $\quad Q_1 = 0{,}67$

$\boxed{C_2 = 0{,}66\,F}$ $\quad \boxed{C_1 \approx 1\,F}$

Segundo LP: $Q_2 = 1{,}67$ $\quad \omega_0 = 1{,}23$

$\boxed{C_2 = 0{,}92\,F}$ $\quad \boxed{C_1 \approx 0{,}71\,F}$

Tercer LP: $\omega_0 = 1{,}23$ con $R = 1$

$$\boxed{C = \frac{1}{\omega_0} = 0{,}81\,F}$$