

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

$$f_p = 1 \text{ kHz}$$

$$f_s = 2 \text{ kHz}$$

$$\omega = 2\pi \cdot 1 \text{ kHz}$$

$$\omega_p = 1$$

$$\omega_s = 2$$

$$a) \gamma^2 = 10^{\frac{\alpha_{max}}{20}} - 1 = 0,122 \rightarrow \boxed{\gamma = 0,35}$$

$$\alpha_{min} = 10 \log(1 + \gamma^2 \omega_s^{2m}) \quad m=1: \alpha_{min} = 1,72 \text{ X} \quad m=2: \alpha_{min} = 4,7 \text{ X}$$

$$m=3: \alpha_{min} = 9,44 \text{ X}$$

$$m=4: \alpha_{min} = 15,08 \text{ X}$$

$$m=5: \alpha_{min} = 21,7 \checkmark$$

$$\boxed{m=5}$$

$$H(j\omega) = \frac{1}{1 + \gamma^2 \omega_s^{5,2}} \Rightarrow H(s) \cdot H(-s) = \frac{1}{1 - \gamma^2 s^{10}} \rightarrow \text{Cálculo raíces}$$

$$x_{1,2} = -1 \pm j0,725$$

$$x_{3,4} = -0,38 \pm j1,173$$

$$x_5 = -1,234$$

$$H(s) = \frac{-1/\gamma}{(s+1+j0,725)(s+1-j0,725)(s+0,38+j1,173)(s+0,38-j1,173)(s+1,23)}$$

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

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

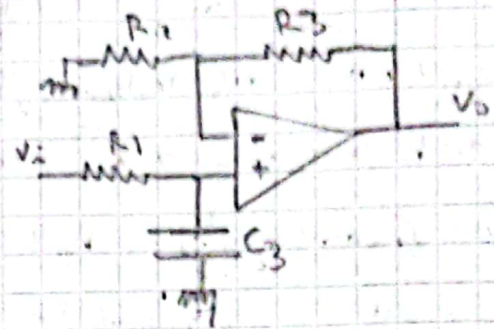
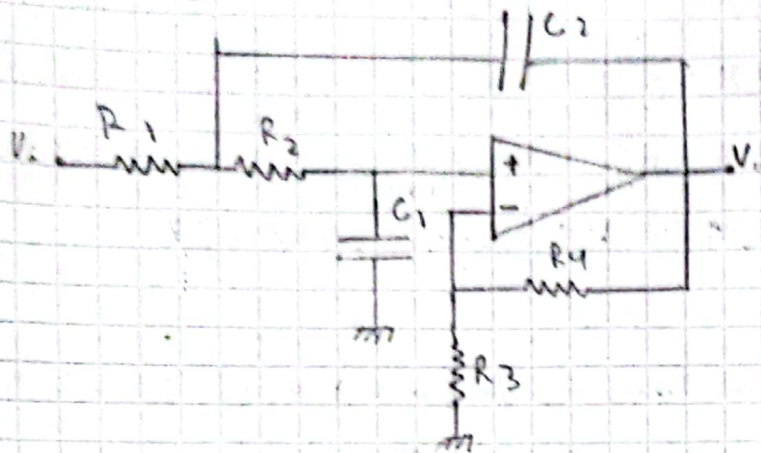
$$\omega_0 = 1,23$$

$$Q_1 = 0,61$$

$$Q_2 = 1,61$$

Sallen key:

LP. 1^{er} orden activo (No inactivo)



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

Ganancia: 20 dB = 20 log |H| ~ |H| = 1 ~ unitario

Para ganancia unitaria: $R_1 = m R_2$ $C_2 = m C_1$ $\frac{R_4}{R_3} + 1 = 1 \Rightarrow \frac{R_4}{R_3} \rightarrow 0$

$$\omega_0 = \frac{1}{R_2 C_1 \sqrt{m+1}} \quad Q = \frac{\sqrt{m+1}}{m+1}$$

Como $m=5$, necesitamos un primer orden activo

Ganancia = 1

$$H(s) = \left(1 + \frac{R_3}{R_2} \right) \frac{1}{s + \frac{1}{RC}} \quad \omega_0 = \frac{1}{\sqrt{RC}} \quad \frac{R_3}{R_2} \rightarrow 0$$

Reemplazo: Con $R_2 = 7$ $\omega_0 = 1,23$ $Q_1 = 0,61$ $Q_2 = 1,69$

$$H_1(s) = \frac{7,52}{(s^2 + 2,5s + 1,52)} \quad R_1 = 7, m = 7 \Rightarrow m = \left(\frac{Q(m+1)}{m} \right)^2 = 1,4664$$

$$C_1 = \frac{1}{R \omega_0 \sqrt{m+1}} = 0,66 \text{ F} \quad C_{2,1} = 7 \text{ F}$$

$$H_2(s) = \frac{7,52}{(s^2 + 0,765s + 1,52)} \quad m = 10,3684 \quad C_{1,2} = 0,25 \text{ F} \quad C_{2,2} = 2,6 \text{ F}$$

$$H_3(s) = \frac{7,23}{(s + 1,23)} \quad C_3 = \frac{1}{\omega_0^2 R_1} = 0,66 \text{ F} \quad R_1 = 7$$

Ganancia unitaria: $\frac{R_{4,1}}{R_{3,1}} = \frac{R_{4,2}}{R_{3,2}} \rightarrow 0 = \left(\frac{7}{100} \right) = \frac{R_{3,1}}{R_{2,1}}$