Ejercicio ①

- Filtro Pasa-banda.

$$\left.\begin{array}{l} f_{ci} = 1{,}6\,kHz \\ f_{cs} = 2{,}5\,kHz \end{array}\right\} \left.\begin{array}{l} f_0 = 2\,kHz \\ B = 0{,}9\,kHz \end{array}\right\} Q = 2{,}22.$$

$$\left.\begin{array}{l} f_{si} = 1250 \\ f_{ss} = 3200 \end{array}\right\} \text{Simétricas.}$$

$$\hookrightarrow f_{sp_B} = 2{,}166.$$

→ 3dB de Ripple:

$$|H(j\Omega)|^2 = \frac{1}{1+\Omega^{2N}}$$

$$dl_{dB} = 10 \log_{10}(1+\Omega_s^{2N}) \rightarrow \boxed{N=3}$$

→ Prototipo Pasa-Baja:

$$H(s) = \frac{1}{(s+1)\left(s^2 + 2\cos\left(\frac{\pi}{3}\right)s+1\right)}$$

→ Trasformo a passa banda:

$$P = K(s) = 2,22\ \frac{(s^2+\omega_0^2)}{s} = \frac{Q\,(s^2+\omega_0^2)}{s}$$

$$H(P) = \frac{1}{(P+1)\left(P^2+2\cos\left(\frac{\pi}{3}\right)P+1\right)}$$

$$\rightarrow H(s) = \frac{1}{\left(\frac{Q(s^2+\omega_0^2)}{\omega_0 s}+1\right)\left(\frac{Q^2(s^2+\omega_0^2)^2}{\omega_0^2 s^2}+\frac{Q(s^2+\omega_0^2)}{\omega_0 s}\,2\cos\left(\frac{\pi}{3}\right)+1\right)}$$

$$H(s) = \frac{s^3}{\left(\frac{Q}{\omega_0}(s^2+\omega_0^2)+s\right)\left(\frac{Q^2}{\omega_0^2}(s^2+\omega_0^2)^2+s\frac{Q}{\omega_0}(s^2+\omega_0^2).2\cos\left(\frac{\pi}{3}\right)+s^2\right)}$$

$$H(s) = \frac{s^3}{P(s)}$$

$$H(s) = \frac{s^3}{\frac{Q}{\omega_0}\left(s^2+\frac{\omega_0}{Q}s+\omega_0^2\right)\frac{Q^2}{\omega_0^2}\left(\left(s^2+\omega_0^2\right)^2+s\frac{\omega_0}{Q}\left(s^2+\omega_0^2\right)+\frac{\omega_0^2}{Q^2}s^2\right)}$$

$$H(s) = \frac{s^3\,\frac{\omega_0^3}{Q^3}}{\left(s^2+\frac{\omega_0}{Q}s+\omega_0^2\right)\left(s^4+s^3\frac{\omega_0}{Q}+s^2\left(2\omega_0^2+\frac{\omega_0^2}{Q}\right)+s\frac{\omega_0^3}{Q}+\omega_0^4\right)}$$

$$SOS_1 = \frac{s\,\frac{\omega_0}{Q}\,K}{s^2+\frac{\omega_0}{Q}s+\omega_0^2} = \frac{s\cdot 0{,}4504\,\omega_0}{s^2+s0{,}4504\,\omega_0+\omega_0^2}$$

$$SOS_2 = \frac{s\cdot 0{,}268\,\omega_0}{s^2+s\,0{,}268\,\omega_0+1{,}17\omega_0^2}$$

$$SOS_3 = \frac{s\cdot 0{,}182\cdot\omega_0}{s^2+s\cdot 0{,}182\,\omega_0+0{,}6768\,\omega_0^2}$$

K = ganancia total para $\left(|H(j\omega)|_{\omega=0}\right) = 4{,}153$

Filtro Ackenberg-Mosberg BP banda

$$H(s) = -\frac{R_2}{R_1} \cdot \frac{s \frac{1}{R_2 C}}{s^2 + s\frac{1}{R_2 C} + \frac{1}{(C R_3)^2}}$$

$$\omega_0^2 = \frac{1}{(C R_3)^2} \qquad K = -\frac{R_2}{R_1} \qquad Q = \frac{R_2}{R_3}$$

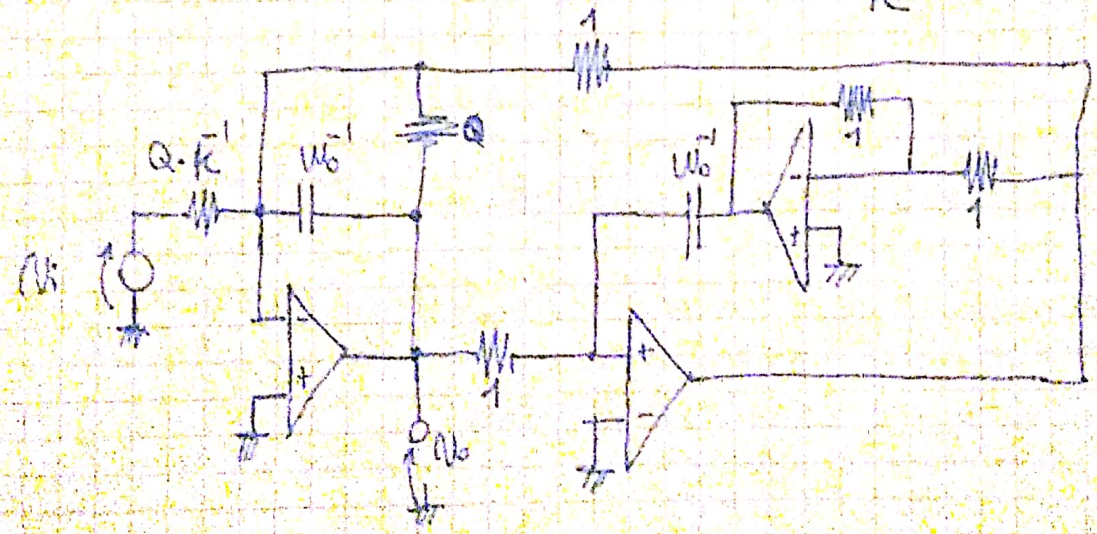
Normalizo:

$1 = R_4 = R_3$

$C = \omega_0^{-1}$

$R_2 = Q$

$R_1 = \frac{Q}{K}$



$SOS_1 \Rightarrow$ $\omega_0 = 2\pi\ 2000\,kHz \rightarrow C = 79{,}579\,nF$

$Q^{-1} = 0{,}4504 \rightarrow R_2 = 2{,}22.$

$$R_1 = \frac{Q}{R} = \frac{2{,}22}{4{,}153} = 0{,}5346.$$

$SOS_2 \Rightarrow$ $\omega_0 = 2\pi(2000kHz) \cdot 1{,}215 \rightarrow C = 65{,}495\,nF$

$Q^{-1} = 0{,}2205 \rightarrow R_2 = 4{,}5351.$

$$R_1 = \frac{Q}{R} = 4{,}5351.$$

$SOS_3 \Rightarrow$ $\omega_0 = 2\pi(2000kHz)\ 0{,}822 \rightarrow C = 96{,}009\,nf.$

$Q^{-1} = 0{,}2212 \rightarrow R_2 = 4{,}5207$

$R_1 = 4{,}5207.$