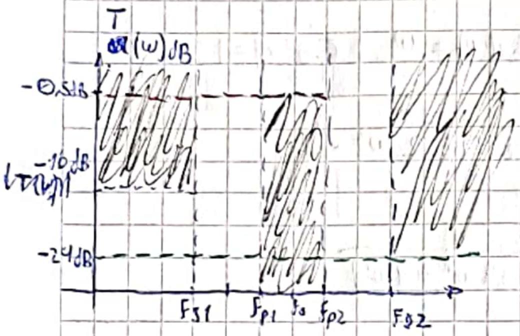
Tarea Semanal 4 bis²

Filtro pasabanda

$w_0 = 2\pi\, 22KHz$; $Q = 5$

$F_{S1} = 17KHz$; $F_{S2} = 30KHz$



$\Omega_w = w_0$

$w_0' = 1$ $\quad w_{s1}' = 0,772$ $\quad w_{s2}' = 1,636$

$$BW = \frac{w_0}{Q} = 4,4$$

$F_{p2} - F_{p1} = BW \quad \wedge \quad F_{p2} \cdot F_{p1} = F_0^2$

$F_{p2} - \frac{F_0^2}{F_{p2}} = BW \qquad F_{p1} = \frac{F_0^2}{F_{p2}}$

$F_{p2}^2 - F_{p2} \cdot BW - F_0^2 = 0 \Rightarrow F_{p2} = 24,31 KHz$; $F_{p1} = 19,31$

$w_{p1}' = 1,1$; $w_{p2}' = 0,9$; $BW' = 0,2$

Núcleo de transformación: $\Omega = Q \cdot \frac{w^2 - w_0^2}{w}$

para cumplir con las restricciones inferiores:

$\Omega_{p1} = 5 \cdot \frac{-0,9^2 + 1}{0,9} = 1$ $\qquad \alpha_{max} = 0,5\,dB$

$\alpha_{min} = 16\,dB$

$\Omega_{s1} = 5 \cdot \frac{1 - 0,772^2}{0,772} = 2,617$

$\varepsilon^2 = 10^{\alpha_{min}/10} - 1 = 0,122$

$\alpha_{min} = 10\log\left(1 + \varepsilon^2 \cosh^2\left[n \cdot \cosh^{-1}(w_{s1})\right]\right) \Rightarrow n = 3$

para cumplir con las restricciones superiores

$\Omega_{p2} = 5 \cdot \frac{1,1^2 - 1}{1,1} = 1$ $\qquad \alpha_{min} = 24\,dB$

$\alpha_{max} = 0,5\,dB \Rightarrow \varepsilon^2 = 0,122$

$\Omega_{s2} = 5 \cdot \frac{1,636^2 - 1}{1,636} = 5,13$ $\qquad \alpha_{min} = 10\log\left(1 + \varepsilon^2 \cosh^2\left[n \cosh^{-1}(w_{s2})\right]\right) \Rightarrow n = 2$

tendremos que realizar un cheby de orden 3

$C_3(w) = 2w \cdot C_2(w) - C_1(w)$ $\qquad$ $C_2(w) = 2w\,C_1(w) - C_0(w)$

$C_3(w) = 4w^3 - 2w - w = 4w^3 - 3w$ $\qquad$ $C_1(w) = w \; ; \; C_0(w) = 1$

$C_2(w) = 2w^2 - 1$

$$|T(w)|^2 = \frac{1}{1+\varepsilon^2(4w^3-3w)^2} = \frac{1}{1+\varepsilon^2\cdot(16w^6 - 24w^4 + 9w^2)}$$

$$|T(w)|^2 = \frac{1}{16\varepsilon^2 w^6 - 24\varepsilon^2 w^4 + 9\varepsilon^2 w^2 + 1}$$

$$|T(w)|^2 = \frac{1/16\,\varepsilon^{-2}}{w^6 - \frac{3}{2}w^4 + \frac{9}{16}w^2 + \frac{1}{16}\varepsilon^{-2}}$$

$$|T(w)|^2 = |T(s)|^2\Big]_{w=s/j} = \frac{1/16\,\varepsilon^{-2}}{-s^6 + \frac{3}{2}s^4 - \frac{9}{16}s^2 + \frac{1}{16}\varepsilon^{-2}} = T(s)\cdot T(-s)$$

$T(s) = \dfrac{c}{s^3 + as^2 + bs + c}$; $T(-s) = \dfrac{c}{-s^3 + as^2 - bs + c}$

$c^2 = \dfrac{1}{16}\varepsilon^{-2} \Rightarrow \left[c = \dfrac{\varepsilon^{-1}}{4}\right]$ $\qquad$ $a^2 - 2b = -\dfrac{3}{2}$ $\qquad$ $-b^2 + 2ac = -\dfrac{9}{16}$

$\dfrac{a^2}{2} + \dfrac{3}{4} = b$ $\qquad$ $-\left(\dfrac{a^2}{2} + \dfrac{3}{4}\right)^2 + \dfrac{a\varepsilon^{-1}}{2} = -\dfrac{9}{16}$

$$\Rightarrow -\left(\frac{a^4}{4} + \cancel{2}\cdot\frac{3a^2}{\cancel{2}\cdot 4} + \frac{9}{16}\right) + \frac{a\varepsilon^{-1}}{2} = -\frac{9}{16}$$

$$\frac{a^4}{4} + \frac{3a^2}{4} - \frac{a\varepsilon^{-1}}{2} = 0$$

$$a^4 + 3a^2 - 2a\varepsilon^{-1} = 0$$

Queda polo a la dcha

$a_0 = 0 \;\vee\; a^3 + 3a - 2\varepsilon^{-1} = 0$

$\boxed{a_1 = 1{,}2529}$ $\quad a_{2-3} = -0{,}[illegible] \pm j1{,}88$

a tiene que ser real

$\boxed{b = \dfrac{a^2}{2} + \dfrac{3}{4} = 1{,}5348}$

$$T_{LP}(s) = \frac{\varepsilon^{-1}\cdot 1/4}{s^3 + 1{,}2529\,s^2 + 1{,}5348\,s + \varepsilon^{-1}\cdot 1/4}$$

Los polos de esta Función estarán en:

$$s = -0{,}626 \quad ; \quad s = -0{,}313 \pm j\,1{,}022 \longrightarrow \omega_0 = 1{,}0688 \quad ; \quad Q = \frac{1}{2\cos\left(tg^{-1}\left(\frac{1{,}022}{0{,}313}\right)\right)} = 1{,}707$$

$$T_{LP}(\$) = \frac{0{,}7150}{(\$+0{,}626)(\$^2+\$\,0{,}625+1{,}0688)} = \frac{0{,}626}{\$+0{,}626} \cdot \frac{1{,}068^2}{\$^2+\$\,0{,}625+1{,}0688^2}$$

Para llegar a la transferencia pasa banda

$$T_{BP}(s) = T_{LP}(\$)\Big|_{\$=Q\cdot\frac{\omega_0^2+s^2}{s}}$$

$$T_{BP}(s) = \frac{0{,}626}{5\,\frac{1+s^2}{s}+0{,}626} \cdot \frac{1{,}142}{\left[5\cdot\frac{1+s^2}{s}\right]^2+\left[5\cdot\frac{1+s^2}{s}\right]\cdot 0{,}626+1{,}142}$$

$$T_{BP}(s) = \frac{0{,}626}{\frac{5(1+s^2+s\cdot 0{,}626/5)}{s}} \cdot \frac{1{,}142}{\frac{25}{s^2}\cdot(1+s^2)^2+\frac{5\cdot 0{,}626}{s}(1+s^2)+1{,}142}$$

$$T_{BP}(s) = \frac{s\,\frac{0{,}626}{Q}}{s^2+s\,\frac{0{,}626}{Q}+1} \cdot \frac{1{,}142\,s^2}{\underbrace{25(s^4+2s^2+1)+0{,}626\cdot Q\cdot s\,(1+s^2)+s^2\,1{,}142}_{\text{Busco los polos de este denominador}}}$$

$$25\cdot(s^4+2s^2+1)+3{,}135(1+s^2)+s^2\,1{,}142=0$$

$$25\,s^4+3{,}13\,s^3+(50+1{,}142)s^2+3{,}13\,s+25=0$$

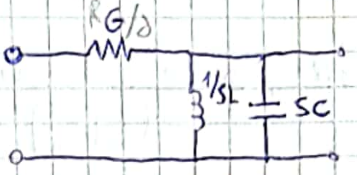
$$s_{12} = -0{,}028 \pm j\,0{,}902 \longrightarrow \omega_{012} = 0{,}902 \quad ; \quad Q = 16{,}12$$

$$s_{34} = -0{,}034 \pm j\,1{,}106 \longrightarrow \omega_{034} = 1{,}107 \quad ; \quad Q = 16{,}28$$

$$T_{BP}(s) = \frac{s\cdot\frac{1}{7{,}98}}{s^2+s\cdot\frac{1}{7{,}98}+1} \cdot \frac{s\,\frac{0{,}902}{16{,}12}}{s^2+s\,\frac{0{,}902}{16{,}12}+0{,}902^2} \cdot \frac{s\,\frac{1{,}107}{16{,}28}}{s^2+s\,\frac{1{,}107}{16{,}28}+1{,}107^2}\cdot K$$

Implementación pasiva:

Para cada sección de orden 2 se utiliza



$$T(s) = \frac{G}{sC + \frac{1}{sL} + G} = \frac{sLG}{s^2LC + sLG + 1}$$

$$\left[\, T(s) = \frac{s \cdot \frac{1}{RC}}{s^2 + s \cdot \frac{1}{RC} + \frac{1}{LC}} \,\right]$$

$$\omega_0^2 = \frac{1}{LC} \quad ; \quad \frac{\omega_0}{Q} = \frac{1}{RC} \Rightarrow Q = RC \cdot \omega_0$$

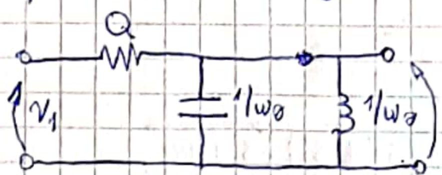
$$C = \frac{1}{L\omega_0^2} \quad ; \quad R = \frac{Q}{\omega_0 C} \quad ; \quad \text{si } L = \frac{1}{\omega_0}$$

$R -$

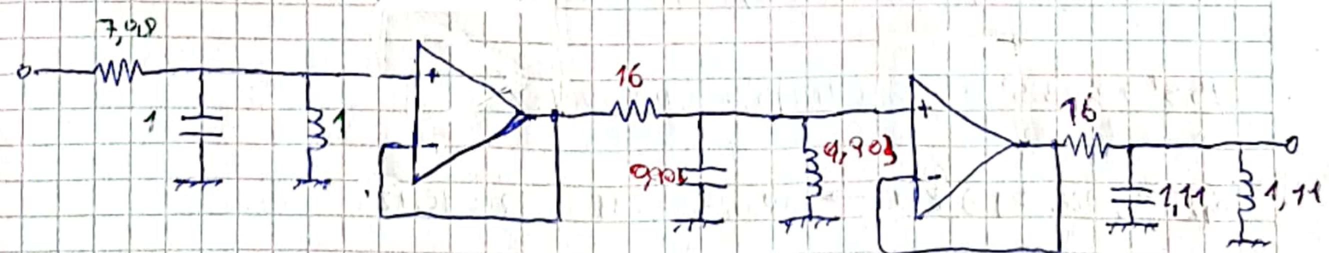
$R = \omega_0 \cdot Q$

$$C = \frac{1}{\omega_0} \quad ; \quad R = Q \quad ; \quad L = \frac{1}{\omega_0}$$

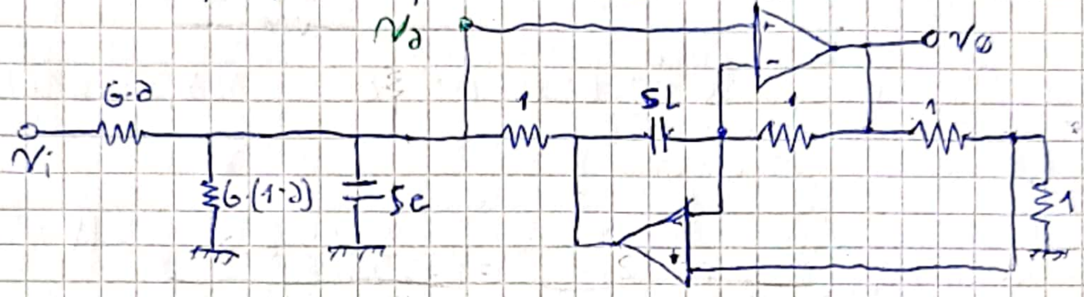
para cada segmento



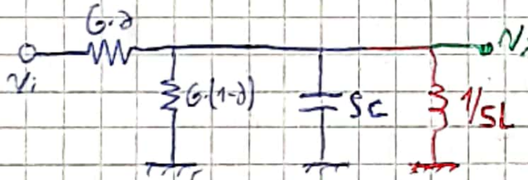
$$\text{Entonces: } T_{BP}(s) = \underbrace{\frac{s \cdot \frac{1}{7{,}98}}{s^2 + s\,\frac{1}{7{,}98} + 1^2}}_{\text{sección a}} \cdot \underbrace{\frac{s\,\frac{0{,}902}{16{,}12}}{s^2 + s\,\frac{0{,}902}{16{,}12} + 0{,}901^2}}_{\text{sección b}} \cdot \underbrace{\frac{s\,\frac{1{,}107}{16{,}28}}{s^2 + s\,\frac{1{,}107}{16{,}28} + 1{,}107^2}}_{\text{sección c}}$$



Circuito propuesto para la activación:



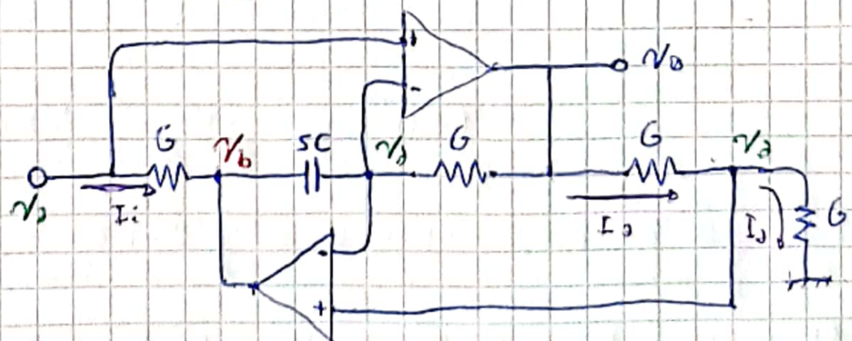
Si yo tomara como salida v_a, el Gic estaría simulando un inductor, por lo que



$$\frac{v_a}{v_i} = \frac{G\cdot a}{SC + \frac{1}{SL} + G\cdot(1-a) + G\cdot a} = \frac{SLG\cdot a}{S^2LC + SLG + 1} = \frac{aS\frac{1}{RC}}{S^2 + S\cdot\frac{1}{RC} + \frac{1}{LC}}$$

a será una atenuación debido al Voltage Forwarding

ahora $T(s) = \frac{v_0}{v_i} = \frac{v_a}{v_i}\cdot\frac{v_0}{v_a}$



$$\overbrace{(v_0 - v_a)\,G}^{I_a} = \overbrace{(v_a - 0v)\,G}^{I_a}$$

$$v_0G - v_aG = v_a\cdot G$$

$$v_0\cdot G = 2v_a\cdot G$$

$$\boxed{\frac{v_0}{v_a} = 2}$$

$$\boxed{T(s) = \frac{v_a}{v_i}\cdot\frac{v_0}{v_a} = 2\cdot a\cdot\frac{S\cdot\frac{1}{RC}}{S^2 + S\cdot\frac{1}{RC} + \frac{1}{LC}}}$$