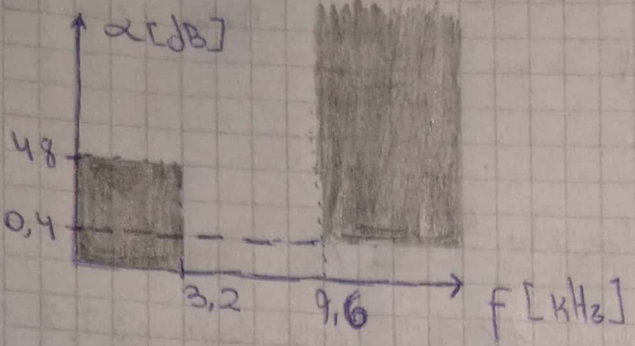
TP2

Ejercicio 5



$\alpha_{max} = 0{,}4\,dB$ $\quad \alpha_{min} = 48\,dB$

$f_s = 3{,}2\,KHz$ $\quad f_p = 9{,}6\,KHz$

~~Normalizo~~

Tomo como $\Omega_w = \omega_p \Rightarrow \omega_p' = 1 \quad \omega_s' = \frac{\omega_s}{\omega_p} = \frac{f_s \cdot \cancel{2\pi}}{F_p \cdot \cancel{2\pi}} \cong 0{,}33$

~~Por notación adopto $\omega_p' = \omega_p$, $\omega_s' = \omega_s$~~

Paso a pasabajos $\quad \Omega_p = \frac{1}{\omega_p'} = 1 \quad \Omega_s = \frac{1}{\omega_s'} = 3$

$$\xi^2 = 10^{\frac{\alpha_{max}}{10}} - 1 = 10^{0{,}4/10} - 1 \cong 0{,}0965$$

a) Vemos que butter no es porque $\xi \neq 1$

No es Bessell porque la prioridad es la atenuación

Tenemos que ver si Máx. Planicidad o Chevyshev nos da menor n

Para chevy $\alpha_{min} = 10 \log \left\{ \left(1 + \xi^2 \cosh^2 \left[n \cosh^{-1} (\Omega_S) \right) \right\} \right.$

$n=1 \quad \alpha_{min} = 2,7$

$n=2 \quad \alpha_{min} = 14,58$

$n=3 \quad \alpha_{min} = 29,74$

$n=4 \quad \alpha_{min} = 45,$

$n=5 \quad \alpha_{min} = 60,38$

Para Max. Planicidad $\alpha_{min} = 10 \log \left(1 + \xi^2 \Omega_S^{2n} \right)$

$n=1 \quad \alpha_{min} = 2,7$

$n=2 \quad \alpha_{min} = 9,45$

$n=3 \quad \alpha_{min} = 18,5$

$n=4 \quad \alpha_{min} = 28$

$n=5 \quad \alpha_{min} = 37,5$

chevy me pide menor n.

La transferencia quedaría

$$|T(j\omega)|^2 = \frac{1}{1 + \xi^2 C_5^2(\omega)}$$

$$C_5 = 2\omega C_4(\omega) - C_3(\omega) = 2\omega \left(2\omega C_3(\omega) - C_2(\omega) \right) - C_3(\omega)$$

$$C_5(\omega) = 2\omega \left[2\omega \left(4\omega^3 - 3\omega \right) - 2\omega^2 + 1 \right] - 4\omega^3 + 3\omega$$

$$C_5(\omega) = 2\omega \left[8\omega^4 - 6\omega^2 - 2\omega^2 + 1 \right] - 4\omega^3 + 3\omega$$

$$C_5(\omega) = 16\omega^5 - 16\omega^3 + 2\omega - 4\omega^3 + 3\omega = 16\omega^5 - 20\omega^3 + 5\omega$$

$$|T(j\omega)|^2 = \frac{1}{1 + \xi^2 \left(16\omega^5 - 20\omega^3 + 5\omega \right)^2}$$

$$(16\omega^5-20\omega^3+5\omega)^2=(16\omega^5)^2+(-20\omega^3)^2+(5\omega)^2+2\cdot 16\omega^5(-20\omega^3)+2\cdot 16\omega^5\cdot 5\omega+2\cdot(-20\omega^3)\cdot 5\omega$$

$$'' = 256\omega^{10}+400\omega^6+25\omega^2-640\omega^8+160\omega^6-200\omega^4$$

$$'' = 256\omega^{10}-640\omega^8+560\omega^6-200\omega^4+25\omega^2$$

$$|T(\omega)|^2=\frac{1/\xi^2}{\frac{1}{\xi^2}+256\omega^{10}-640\omega^8+560\omega^6-200\omega^4+25\omega^2}$$

$$|T(s)|^2=|T(\omega)|^2_{s=\frac{\omega}{j}}=\frac{1/\xi^2}{\frac{1}{\xi^2}-256s^{10}-640s^8-560s^6-200s^4-25s^2}$$

~~Me quedo con~~

$$\cancel{T(s)T(-s)=\frac{1/\xi^2}{\xi^2(-256)}}$$

Me quedo con polos del plano izquierdo

$$T(s)=\frac{\frac{1}{\xi\sqrt{256}}}{(s+0{,}3861)(s+0{,}1193+j1{,}0194)(s+0{,}1193-j1{,}0194)(s+0{,}3124+j0{,}6301)(s+0{,}3124-j0{,}6301)}$$

$$T(s)=\frac{1/\xi\cdot\sqrt{256}}{(s+0{,}3861)(s^2+s\,0{,}2386+1{,}0534)(s^2+0{,}6248s+0{,}5003)}$$

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Realizamos la transformación a pasaaltos

$$T_{(s)_{PA}} = T_{(s)_{PB}}\Big|_{s=\frac{1}{s}} = \frac{1/\xi\sqrt{256}}{\left(\frac{1}{s^2}+\frac{1}{s}0,2386+1,0534\right)\left(\frac{1}{s^2}+\frac{1}{s}0,6248+0,5003\right)\left(\frac{1}{s}+0,3861\right)}$$

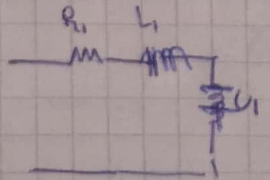
$$T_{(s)_{PA}} = \frac{\frac{1}{\xi\sqrt{256}}}{\frac{1}{s^2}\left(1,0534\,s^2+s\cdot 0,2386+1\right)\left(\frac{1}{s^2}\right)\left(0,5003\,s^2+s\cdot 0,6248+1\right)\left(\frac{1}{s}\right)\left(s\,0,3861+1\right)}$$

$$T_{(s)_{PA}} = \frac{1}{\xi\sqrt{256}}\cdot\frac{s^2}{1,053\left(s^2+s\,\frac{0,2386}{1,053}+\frac{1}{1,053}\right)}\cdot\frac{s^2}{0,5003\left(s^2+s\,\frac{0,6248}{0,5003}+\frac{1}{0,5003}\right)}\cdot\frac{s}{\left(s+\frac{1}{0,3861}\right)0,3861}$$

$\xi = \sqrt{0,0965}$

$$T_{(s)} = \frac{s^2}{s^2+s\cdot\frac{0,2386}{1,053}+\frac{1}{1,053}}\cdot\frac{s^2}{s^2+s\,\frac{0,6248}{0,5003}+\frac{1}{0,5003}}\cdot\frac{s}{s+\frac{1}{0,3861}}\cdot 0,99$$

c) Para los de segundo orden el circuito pasivo serie



y la transferencia

$$T_{1(s)} = \frac{s^2}{s^2+s\frac{R_1}{L_1}+\frac{1}{L_1C_1}}$$

Si $\Omega_z = R_1$

$$T_{1(s)} = \frac{s^2}{s^2+s\frac{1}{L_1}+\frac{1}{L_1C_1}} = \frac{s^2}{s^2+s\cdot 0,227+\frac{1}{1,053}}$$

$L_1 = 0,227^{-1} = 4,41 \quad L_1C_1 = 1,053 \Rightarrow C_1 = 0,2386$

NOTA

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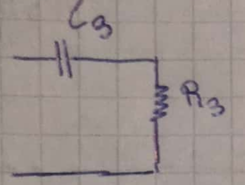
Para la segunda, $R_2 = \Omega_Z$

$$T_2 = \frac{s^2}{s^2 + s\frac{1}{L_2} + \frac{1}{L_2C_2}} = \frac{s^2}{s^2 + s1{,}25 + \frac{1}{0{,}5003}}$$

$$L_2 = 1{,}25^{-1} = 0{,}8 \qquad C_2 = \frac{0{,}5003}{L_2} = 0{,}625$$

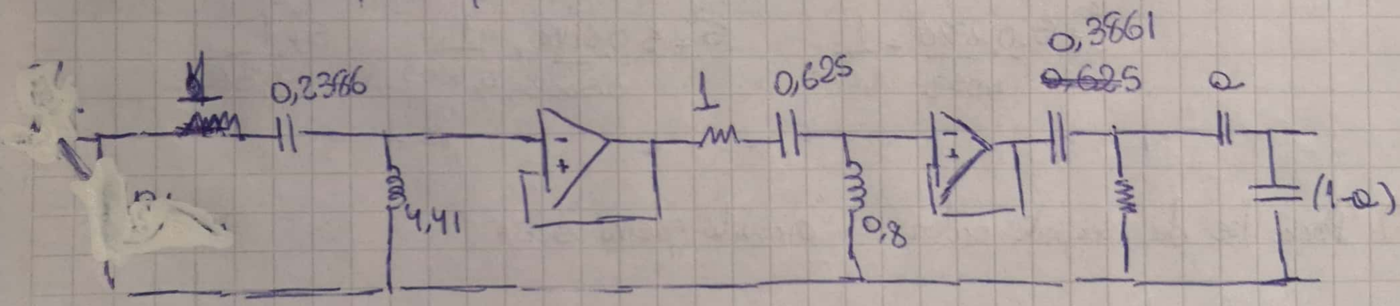
Para el de primer orden, $R_3 = \Omega_Z$



$$T_3(s) = \frac{s}{s + \frac{1}{R_3C_3}} = \frac{s}{s + \frac{1}{C_3}} = \frac{s}{s + \frac{1}{0{,}3861}}$$

$$\boxed{C_3 = 0{,}3861}$$

El circuito completo queda (normalizado en Z)



$a = 3{,}18 \rightarrow$ para la K

d) La $\Omega_Z = 2{,}2K\Omega$ $\qquad R = \Omega_Z \quad L = L\Omega_Z \quad C = \frac{C}{\Omega_Z}$

$\therefore$

$R_1 = 2{,}2K\Omega$	$R_2 = 2{,}2K\Omega$	$R_3 = 2{,}2K\Omega$
$C_1 = 108{,}45\mu F$	$C_2 = 254{,}1\mu F$	$C_3 = 175{,}5\mu F$
$L_1 = 9{,}702 KHy$	$L_2 = 1{,}76 KHy$	

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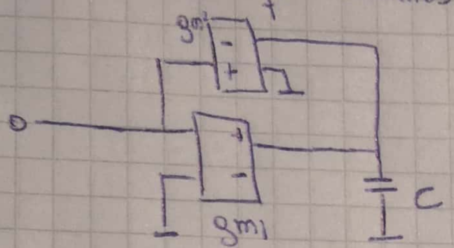
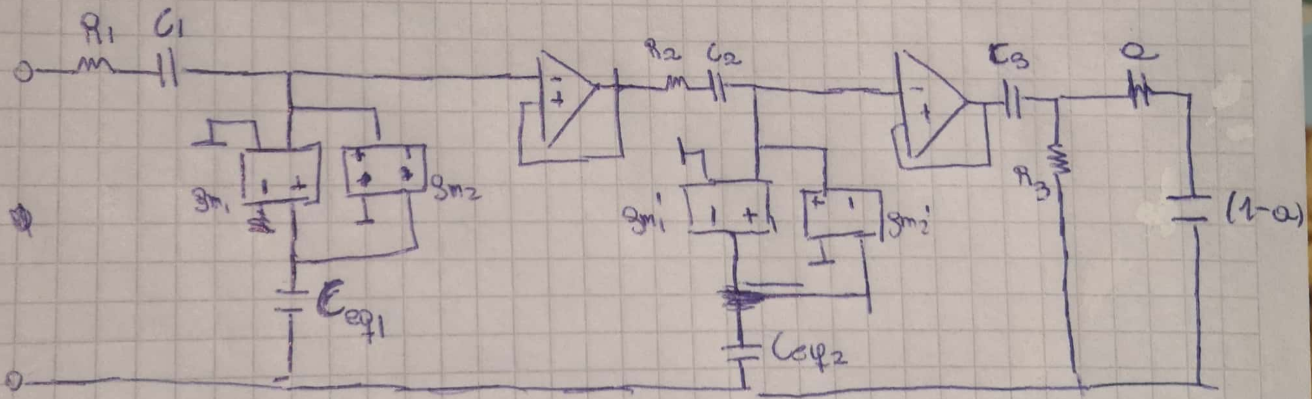
b) La gran diferencia entre los polos del ej 4 y este ejercicio es la w_o de los polos. En el 4 al ser de maxima planicidad los polos estan en la misma circunferencia w_o. Pero en cheby los polos se encuentran en una elipse por lo que sus w_o son distintos y esto queda evidenciado en este ejercicio

c) La estructura que usaremos es un girador con OTAs



Cuya $Z = \frac{sC}{g_{m1} g_{m2}}$

$\Rightarrow$ el circuito quedaría



con $\frac{C_{eq_1}}{g_{m1} \cdot g_{m2}} = L_1$

$\frac{C_{eq_2}}{g_{m1}' \cdot g_{m2}'} = L_2$

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