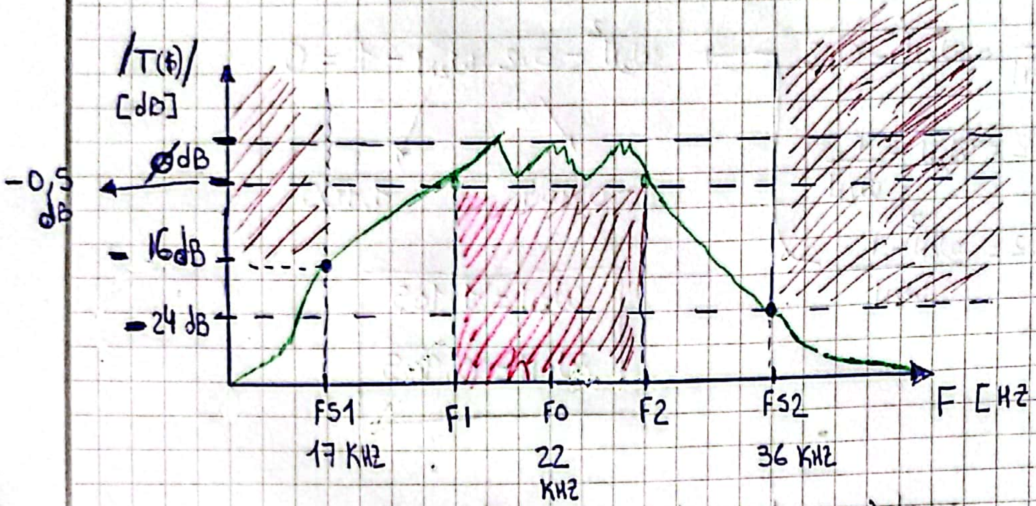
TS5 Ⓐ

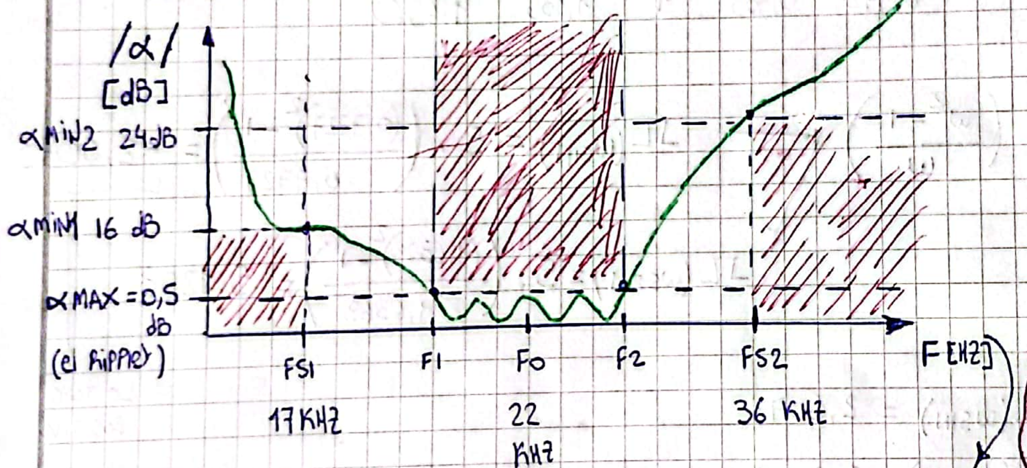
TAREA SEMANAL 5 PASABANDA



Se sabe que:

- $Q = 5$
- Aproximación Chebyshev con ripple de 0,5 dB

→ Hago la plantilla de atenuación:



NORMALIZO RESPECTO A W_o

$\boxed{W_{ON} = 1}$

- $Q = \frac{W_{ON}}{B} \therefore \Rightarrow Q = \frac{1}{B} \Rightarrow B = \frac{1}{Q} \Rightarrow \left[B = \frac{1}{5} = 0,2\right]$

- $B = W_{2N} - W_{1N} \Rightarrow 0,2 = W_{2N} - W_{1N} \Rightarrow \left[W_{1N} = W_{2N} - 0,2\right]$

- $W_o^2 = W_1 \cdot W_2 \Rightarrow W_{ON}^2 = W_{1N} \cdot W_{2N} \Rightarrow \left[1 = W_{1N} \cdot W_{2N}\right]$

$\llcorner 1^2 = 1$

$$\begin{cases} \omega_{1N} = \omega_{2N} - 0{,}2 \\ 1 = \omega_{1N} \cdot \omega_{2N} \end{cases} \longrightarrow \omega_{1N} = \frac{1}{\omega_{2N}}$$

$$\omega_{1N} = \omega_{2N} - 0{,}2$$

$$\frac{1}{\omega_{2N}} = \omega_{2N} - 0{,}2$$

$$0{,}2 = \omega_{2N} - \frac{1}{\omega_{2N}}$$

$$0{,}2 = \frac{\omega_{2N}^2 - 1}{\omega_{2N}} \longrightarrow \omega_{2N}^2 - 0{,}2 \cdot \omega_{2N} - 1 = 0$$

$$\cancel{-0{,}904} \qquad 1{,}105$$

$$\boxed{\begin{array}{l} \omega_{2N} = 1{,}105 \\ \omega_{1N} = 0{,}905 \end{array}}$$

F_{S1N}	F_{1N}	F_{0N}	F_{2N}	F_{S2N}	F_N
0,7727	0,905	1	1,105	1,6363	

ω_{S1N}	ω_{1N}	ω_{0N}	ω_{2N}	ω_{S2N}	ω_N
0,7727	0,905	1	1,105	1,6363	

- $\Omega = Q \cdot \left(\frac{\omega^2 - 1}{\omega}\right)$

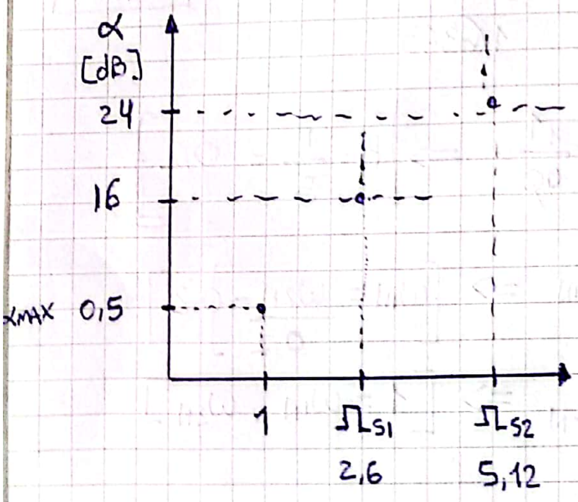
$$\Omega(\omega_{S1N}) = 5 \cdot \left(\frac{(0{,}7727)^2 - 1}{0{,}7727}\right) = -2{,}6073$$

LO TOMO POSITIVO

$$\Omega(\omega_{S2N}) = 5 \cdot \left(\frac{(1{,}6363)^2 - 1}{1{,}6363}\right) = 5{,}1258$$

$$\Omega(\omega_{S1N}) = 2{,}6073$$

$$\Omega(\omega_{S2N}) = 5{,}1258$$



TS5 (B)

Es un Chebyshev pasabajo ∴ saco el "N" y elijo la peor condición (osea el "N" más grande)

- $N = \dfrac{\operatorname{arccosh}\left(\dfrac{\sqrt{10^{\frac{\alpha_{min\,dB}}{10}}-1}}{\varepsilon}\right)}{\operatorname{arccosh}(\omega_S)}$ $\quad \varepsilon \rightarrow 0{,}3493$

- $\varepsilon^2 = 10^{\frac{\alpha_{max}/dB}{10}} - 1$ $\quad \alpha_{max} \rightarrow 0{,}5\ dB$

$\varepsilon^2 = 0{,}122018$

$\boxed{\varepsilon = 0{,}3493}$

ω_S:

Ω_{S1}	Ω_{S2}
2,6073	5,1258
$\alpha_{min} = 16$	$\alpha_{min} = 24$

∴ $N_1 = 2{,}2161 \rightarrow 3$

$N_2 = 1{,}944 \rightarrow 2$

LA PEOR condición es con $N_1 = 3$

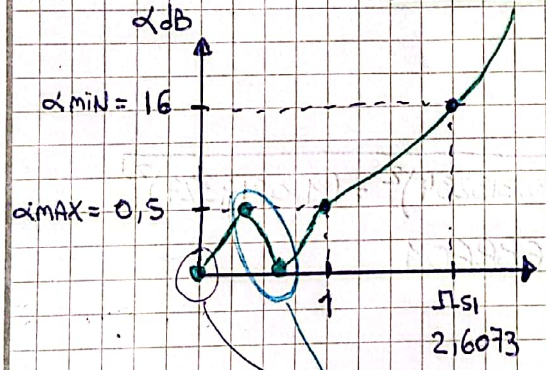
USO $\boxed{\Omega_{S1}}$ ∴ $\boxed{\alpha_{min} = 16}$, $\boxed{N = 3}$

$\varepsilon^2 = 0{,}122018$

$\boxed{\varepsilon = 0{,}3493}$

Chebyshev orden N=3

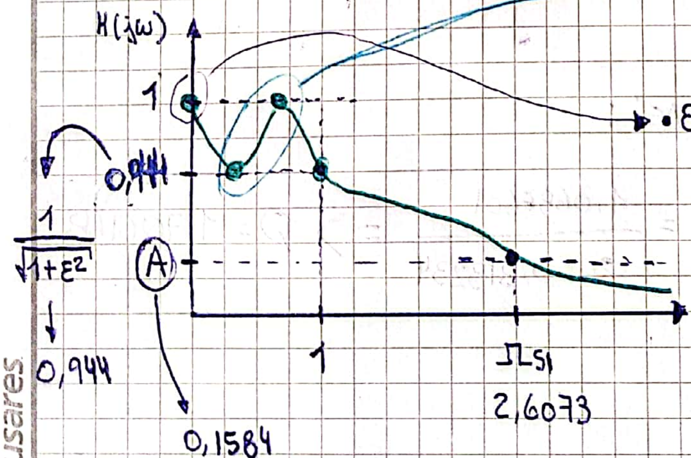
HAGO con esa información la plantilla del pasabajos de atenuación



- orden impar en atenuación empieza de abajo ya que es la inversa de la transferencia
- N - 1 = CANT REBOTES

→ 2 REBOTES

TRANSFERENCIA:



- En transferencia el orden impar (N=3) significa que parte desde arriba.

$20 \cdot \log(X) = -16$

$X = 0{,}1584$

$A = 0{,}1584$

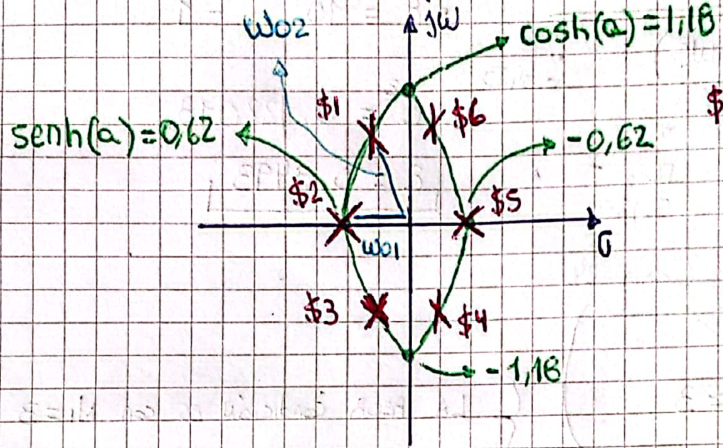
Con esa plantilla paso a diseño mi filtro Chevy orden 3

- $\varepsilon^2 = 0{,}122018$
- $\varepsilon = 0{,}3493$
- $N = 3$

- $\nu k = \frac{1}{N} \cdot \operatorname{arcsenh}\left(\frac{1}{\varepsilon}\right) \longrightarrow = 0{,}591388 = a$

$a = 0{,}591388$

- $\cosh(a) = 1{,}180026$
- $\operatorname{Senh}(a) = 0{,}6264678$



$1, $2, $3 son los polos de H($)

(los otros son de H(-$))

$\$k = \sigma k + j.\omega k \longrightarrow S_1 = \sigma_1 + j\omega_1$

$k=1$

$\sigma k = -\operatorname{senh}(a) . \operatorname{sen}\left(\frac{(2k-1)}{2.N} . \pi\right)$

$\omega k = \cosh(a) . \cos\left(\frac{(2k-1)}{2.N} . \pi\right)$

$\$_1 = -0{,}313234 + j.\ 1{,}0219327$

$\$_2 = -0{,}6264678 + 0.j$

$\$_3 = -0{,}313234 - 1{,}0219327.j$

$Wo1 = 0{,}6264678$

$Wo2 = \sqrt{(-0{,}313234)^2 + (1{,}0219327)^2}$

$Wo2 = 1{,}0688601$

ojo! Este φ no tiene nada que ver con el $\varphi = 5$ que era la selectividad del pasabanda... es otro φ distinto

$\varphi = \frac{1}{2.\cos(\theta)}$

$\tan(\theta) = \frac{op}{ady} \rightarrow Tg(\theta) = \frac{1{,}0219327}{0{,}313234} \longrightarrow \theta = 72{,}96$

$\varphi = 1{,}706$

Sino también podía sacarlo así:

$\varphi = \frac{WOK}{2.\sigma K} \longrightarrow \varphi = \frac{Wo2}{2.|\sigma_2|} = \frac{1{,}0688601}{2.\ 0{,}313234} \Rightarrow \varphi = 1{,}706168$

TS5 c

$$H(\$) = \frac{\omega_{01}}{\$ + \omega_{01}} \cdot \frac{\omega_{02}^2}{\$^2 + \frac{\omega_{02}}{Q_1}\cdot \$ + \omega_{02}^2}$$

PASABAJOS CHEVY ORDEN 3

$$H(\$) = \frac{0{,}6264678}{\$ + 0{,}6264678} \cdot \frac{(1{,}0688601)^2}{\$^2 + 0{,}6265 \cdot \$ + (1{,}0688601)^2}$$

PASABAJOS CHEVY ORDEN 3

NUCLEO DE TRANSFORMACIÓN A PASABANDA

$$S = \frac{1}{B}\cdot\frac{\$^2+\omega_0^2}{\$} = \frac{1}{0{,}2}\cdot\frac{\$^2+1}{\$}$$

$\omega_{0N}^2 = 1^2$

$$\boxed{S = 5 \cdot \frac{\$^2+1}{\$}}$$

$$H(\$) = \frac{\omega_{01}}{\left(5\cdot\frac{\$^2+1}{\$}\right) + \omega_{01}} \cdot \frac{\omega_{02}^2}{\left(5\cdot\frac{\$^2+1}{\$}\right)^2 + \frac{\omega_{02}}{Q_1}\cdot\frac{5\cdot(\$^2+1)}{\$} + \omega_{02}^2}$$

$$H(\$) = \frac{\omega_{01}}{\frac{5\cdot\$^2+5}{\$} + \omega_{01}} \cdot \frac{\omega_{02}^2}{\left(\frac{5\cdot\$^2+5}{\$}\right)^2 + \frac{\omega_{02}}{Q_1}\cdot 5\cdot\left(\$+\frac{1}{\$}\right) + \omega_{02}^2}$$

$$H(\$) = \frac{\omega_{01}}{5\cdot\$ + \frac{5}{\$} + \omega_{01}} \cdot \frac{\omega_{02}^2}{\frac{5^2\cdot\$^4 + 2\cdot5\cdot\$^2\cdot5 + 5^2}{\$^2} + \frac{\omega_{02}\cdot5}{Q_1}\cdot\$ + \frac{\omega_{02}\cdot5}{Q_1}\cdot\frac{1}{\$} + \omega_{02}^2}$$

$$H(\$) = \underbrace{\frac{\omega_{01}}{5\cdot\$ + \frac{5}{\$} + \omega_{01}}}_{A} \cdot \underbrace{\frac{\omega_{02}^2}{5^2\cdot\$^2 + 2\cdot5\cdot5 + \frac{5^2}{\$^2} + \frac{\omega_{02}\cdot5}{Q_1}\cdot\$ + \frac{\omega_{02}\cdot5}{Q_1}\cdot\frac{1}{\$} + \omega_{02}^2}}_{B}$$

$$H(\$) = A \cdot B$$

$$H(\$) = A \cdot \boxed{\frac{\$}{\$}} \cdot B \cdot \boxed{\frac{\$^2}{\$^2}}$$

★ (A) $\cdot \frac{\$}{\$} \longrightarrow \frac{w_{01}}{5.\$ + \frac{5}{\$} + w_{01}} \cdot \frac{\$}{\$} \longrightarrow \frac{w_{01}.\$}{5.\$^2 + 5 + w_{01}.\$}$

$\rho = 5 \longrightarrow 1/\rho = B$

$$\boxed{\frac{\frac{w_{01}}{5}.\$}{\$^2 + \frac{w_{01}}{5}.\$ + 1}} \approx \boxed{\frac{(B.w_{01}).\$}{\$^2 + B.w_{01}.\$ + 1}}$$

★ (B) $\cdot \frac{\$^2}{\$^2} \longrightarrow \frac{w_{02}^2}{5^2.\$^2 + 2.5.5 + \frac{5^2}{\$^2} + \frac{w_{02}.5}{\rho_1}.\$ + \frac{w_{02}.5}{\rho_1}.\frac{1}{\$} + w_{02}^2} \cdot \frac{\$^2}{\$^2}$

$$\frac{w_{02}^2.\$^2}{5^2.\$^4 + 2.5.5.\$^2 + 5^2 + \frac{w_{02}.5}{\rho_1}.\$^3 + \frac{w_{02}.5}{\rho_1}.\$ + w_{02}^2.\$^2}$$

Lo dejo monico

$$\frac{\frac{w_{02}^2}{5^2}.\$^2}{\$^4 + 2.\$^2 + 1 + \frac{w_{02}}{\rho_1.5}.\$^3 + \frac{w_{02}}{\rho_1.5}.\$ + \frac{w_{02}^2}{5^2}.\$^2}$$

Lo ordeno

$$\frac{\frac{w_{02}^2}{5^2}.\$^2}{\$^4 + \frac{w_{02}}{\rho_1.5}.\$^3 + \left(2 + \frac{w_{02}^2}{5^2}\right).\$^2 + \frac{w_{02}}{\rho_1.5}.\$ + 1}$$

$$\frac{B^2.w_{02}^2.\$^2}{\left[\$^4 + B.w_{02}.\frac{1}{\rho_1}.\$^3 + (2 + B^2.w_{02}^2).\$^2 + B.w_{02}.\frac{1}{\rho_1}.\$ + 1\right]^2}$$

$$\left[\$^4 + 0,125.\$^3 + 2,045698.\$^2 + 0,125.\$ + 1\right]$$

SACO LOS POLOS CON CALCULADORA:

- $0,9029 < 91,78 \longrightarrow -0,02807081 + 0,9025.i$
- $0,9029 < -91,78 \longrightarrow -0,02807081 - 0,9025.i$

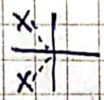
Complejos Conjugados ①

- $1,1074 < 91,78 \longrightarrow -0,034429 + 1,106944.i$
- $1,1074 < -91,78 \longrightarrow -0,034429 - 1,106944.i$

Complejos Conjugados ②

TS 5 (d)

$\$_1 = -A + Bj$
$\$_2 = -A - Bj$
Raíces complejas conjugadas



$(\$ - \$_1).(\$ - \$_2)$

$(\$ - (-A + Bj)).(\$ - (-A - Bj))$

$(\$ + A - Bj).(\$ + A + Bj)$

$\$^2 + \$A + \$Bj + \$A + A^2 + ABj - \$Bj - ABj - (Bj)^2$

$\$^2 + \$.(A + \cancel{Bj} + A - \cancel{Bj}) + (A^2 + \cancel{ABj} - \cancel{ABj} + B^2)$

$\$^2 + (2.A).\$ + (A^2 + B^2)$

Si fueran raíces a la derecha que obviamente

$\$_1 = A + Bj \qquad \$_2 = A - Bj$

$(\$ - \$_1).(\$ - \$_2)$

$(\$ - A - Bj).(\$ - A + Bj)$

$\$^2 - \$A + \$.Bj - \$A + A^2 - ABj - B.\$j + ABj - (Bj)^2$

$\$^2 + (-2.A).\$ + (B^2 + A^2)$

$\$^4 + 0{,}125.\$^3 + 2{,}045698.\$^2 + 0{,}125.\$ + 1 =$

$=$

$(\$^2 + 0{,}0561416.\$ + 0{,}81529422).(\$^2 + 0{,}068858.\$ + 1{,}22651037)$

$$H(\$) = \frac{(B.\omega_{01}).\$}{\$^2 + (B.\omega_{01}).\$ + 1} \cdot \frac{(B.\omega_{02}).\$}{\$^2 + 0{,}0561416.\$ + 0{,}81529422} \cdot \frac{(B.\omega_{02}).\$}{\$^2 + 0{,}068858.\$ + 1{,}22651037}$$

$$H(\$) = \frac{0{,}12529.\$}{\$^2 + 0{,}12529.\$ + 1} \cdot \frac{0{,}213772.\$}{\$^2 + 0{,}0561416.\$ + 0{,}81529422} \cdot \frac{0{,}213772.\$}{\$^2 + 0{,}068858.\$ + 1{,}22651037}$$

los términos lineales del numerador y denominador los dejo iguales para el pasabanda

$K_1 . 0{,}0561416 = 0{,}213772$

$K_1 = 3{,}80773$

$K_2 . 0{,}068858 = 0{,}213772$

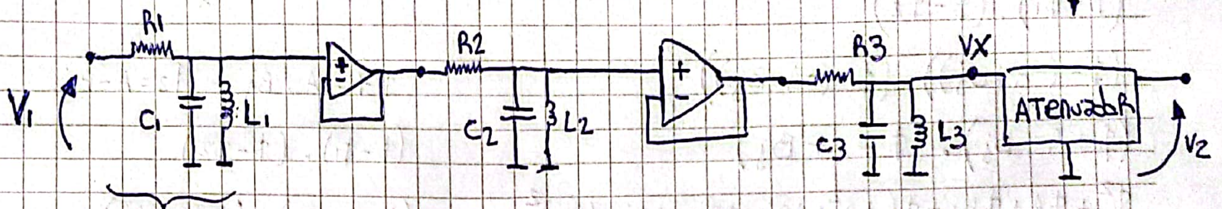
$K_2 = 3{,}10453397$

$$H(\$) = K_1 . K_2 . \frac{0{,}12529.\$}{\$^2 + 0{,}12529.\$ + 1} \cdot \frac{0{,}0561416.\$}{\$^2 + 0{,}0561416.\$ + 0{,}81529422} \cdot \frac{0{,}068858.\$}{\$^2 + 0{,}068858.\$ + 1{,}22651037}$$

$$H(\$) = K \cdot \frac{0{,}12529 \cdot \$}{\$^2 + 0{,}12529 \cdot \$ + 1} \cdot \frac{0{,}0561416 \cdot \$}{\$^2 + 0{,}0561416 \cdot \$ + 0{,}81529422} \cdot \frac{0{,}068858 \cdot \$}{\$^2 + 0{,}068858 \cdot \$ + 1{,}2265107}$$

$K = K_1 \cdot K_2$

$K = 11{,}821227$ → mi circuito gana esta cantidad de veces ∴ Tengo que atenuar



$$H(\$) = \frac{\frac{1}{RC} \cdot \$}{\$^2 + \frac{1}{RC} \cdot \$ + \frac{1}{LC}}$$

Circuito A

Circ A : $\frac{1}{C_1 \cdot R_1} = 0{,}12529$ → si $R_1 = 1$ → $C_1 = 7{,}98148296$

∴ $\frac{1}{LC} = 1$ → $L_1 = 0{,}12529$

Circ B : $\frac{1}{R_2 C_2} = 0{,}0561416$ → si $R_2 = 1$ → $C_2 = 17{,}81210368$

∴ $L_2 = 0{,}0561416$

Circ C : $\frac{1}{R_3 C_3} = 0{,}068858$ → si $R_3 = 1$ → $C_3 = 14{,}5226408$

∴ $L_3 = 0{,}068858$

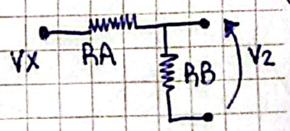
★ Desnormalizo por Z y W

Circ A
- $R_N = \frac{R}{R_O}$ → como $R_N = 1$, si $R_O = 1000$ ∴ $\underline{R_1 = 1000\ \Omega}$
- $C_N = C \cdot R_O \cdot \Omega_O$ $\Omega_O = W_O = 2\pi \cdot 22\ KHz$ ∴ $\underline{C_1 = 57{,}74\ nF}$
- $L_N = \frac{L}{R_O} \cdot \Omega_O$ ∴ $\underline{L_1 = 906{,}3874\ MHY}$

Circ B
→ $R_2 = 1000\ \Omega$
→ $C_2 = 128{,}8584\ nF$
→ $L_2 = 406{,}14605\ MHY$

Circ C
→ $R_3 = 1000\ \Omega$
→ $C_3 = 105{,}06\ nF$
→ $L_3 = 498{,}1405\ MHY$

Atenuador:
Resistivo



$V_2 = V_X \cdot \frac{R_B}{R_A + R_B}$

$\frac{V_2}{V_X} = \frac{R_B}{R_A + R_B}$

$\frac{1}{K} = \frac{R_B}{R_A + R_B}$

$0{,}0845935874S = \frac{R_B}{R_A + R_B}$

$Num \cdot (R_A + R_B) = R_B$

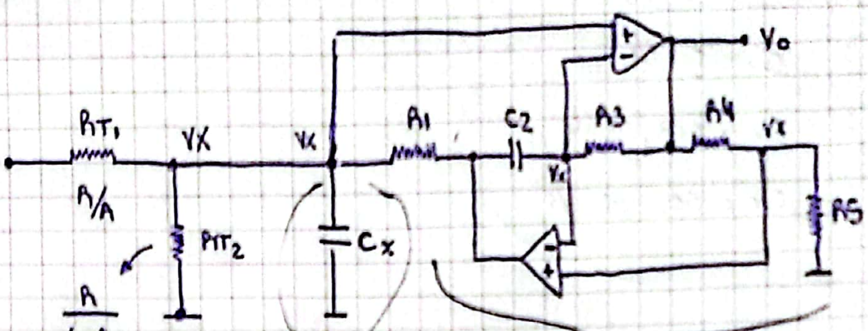
$R_A = \frac{R_B}{Num} - R_B$

Si $R_B = 1000\ \Omega$

$R_A = 10821{,}2\ \Omega$

TS5 (e)

Me piden AHORA activar las redes pasivas mediante la red propuesta:



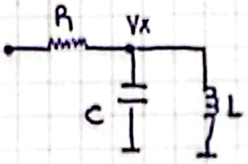
Veo que esto funciona como resistencia y atenuador

Ese es mi capacitor

Y todo esto veo que es un Fliegue utilizado como GIC ya que Z_2 es capacitor y las demás son R

$Z = R^2 . C . S$ } Es una bobina en derivación.

∴ Veo que son pasabandas:



Pero veo que al salir por Vo voy a generar más ganancia ya que:

$$V_X = V_o \cdot \frac{R_5}{R_4+R_5} \quad \text{si } R_4 = R_5$$

$$\frac{V_o}{V_X} = \frac{R_4+R_5}{R_5} = \frac{2\cancel{R}}{\cancel{R}} = 2$$

$$\boxed{K_{GIC} = 2}$$

SOS 1	SOS 2	SOS 3
$K_{GIC} = 2$ ∴ $AT = 1/2$	$K_{SOS2} = K_1 . K_{GIC}$ ∴ $AT = \frac{1}{K_{SOS2}}$	$K_{SOS3} = K_2 . K_{GIC}$ ∴ $AT = \frac{1}{K_{SOS3}}$

$K_{SOS1} = 2$

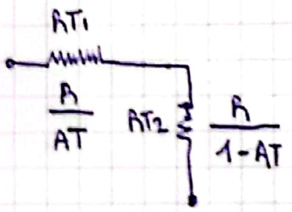
$AT_{SOS1} = 1/2$

$K_{SOS2} = 7{,}61546$

$AT_{SOS2} = 0{,}13131183$

$K_3 = 6{,}20906794$

$AT_{SOS3} = 0{,}1610547686$



SOS 1: $RT_1 = \frac{R}{AT} = \frac{1000}{1/2} = 2000\ \Omega$

$RT_2 = \frac{R}{1-AT} = 2000\ \Omega$

SOS2 : $R_{T1} = 7615,46\ \Omega$

$R_{T2} = 1151,161066\ \Omega$

SOS3 : $R_{T1} = 6209,0679\ \Omega$

$R_{T2} = 1191,9729\ \Omega$

SOS1 : $C_x = 57,74\ nF$

SOS 2 : $C_x = 128,8584\ nF$

SOS 3 : $C_x = 105,06\ nF$

$Z = R^2 . C . \$$ → PARA SOS1 → L - Tiene que daR 906,3874 MHY

∴ si $R = 1000\ \Omega$ → $C_2 = 906,3874\ pF$ del SOS1

SOS1 = $C_2 = 906,3874.\ pF$

SOS 2 = $C_2 = 406,14605\ pF$

SOS 3 = $C_2 = 498,1405\ pF$

- Todas las otras R las hago por ejemplo de 1K.