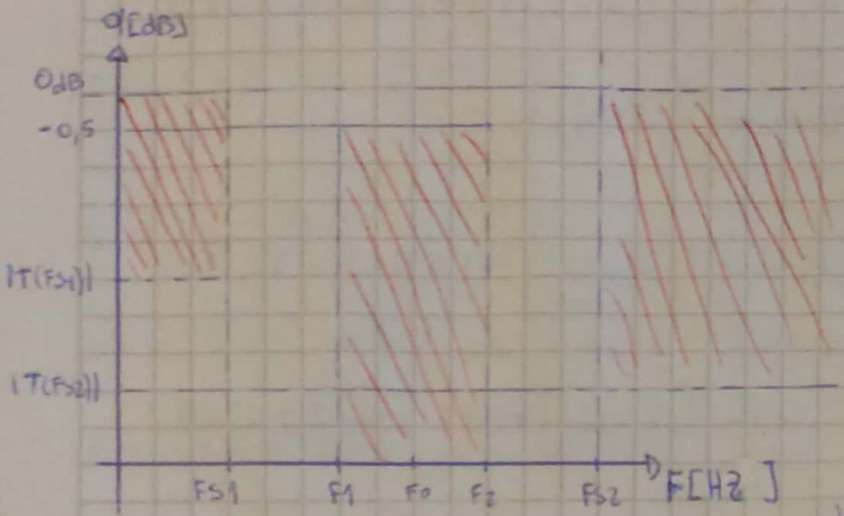
TAREA SEMANAL 4 BIS 2



$|T(FS1)| = -16dB$; $FS1 = 17KHz$

$|T(FS2)| = -24dB$; $FS2 = 36KHz$

$W_0 = 2\pi \cdot 22KHz$

$Q = 5$; $\alpha_{max} = 0,5\ dB$

$BW = 0,2 = WP2 - WP1$

$1 = \sqrt{WP1 \cdot WP2} \rightarrow WP1 = 1/WP2$

$\frac{WP2^2 - 1}{WP2} = 0,2 \rightarrow WP2\_1 = 1,105$; $WP2\_2 = -0,90$ ✗

$\boxed{WP1\_N = 0,905}$; $\boxed{WP1 = 19,90KHz}$ $\boxed{WP2 = 24,31K}$

a)

$WS2\_N = 2\pi . FS2 / 2\pi . 22KHz \Rightarrow \boxed{WS2\_N = 1,64}$

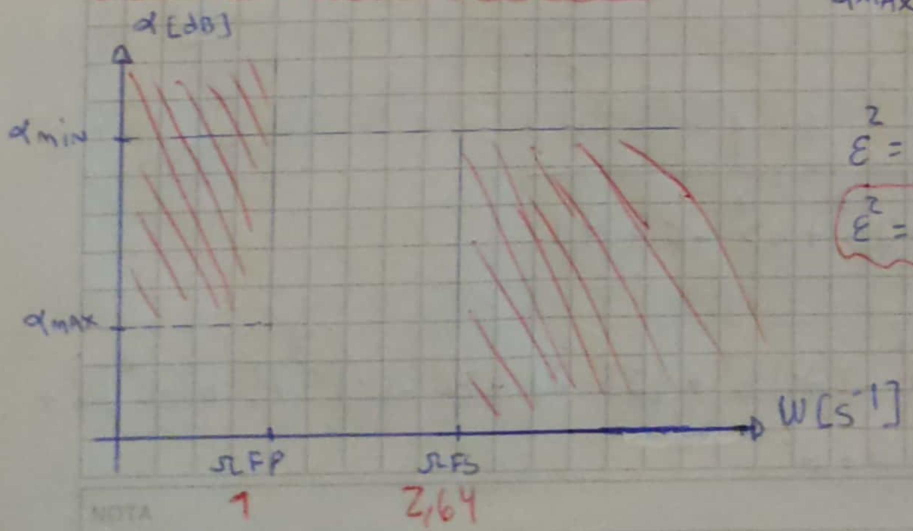
$WS1\_N = 2\pi\ FS1 / 2\pi\ 22KHz \Rightarrow \boxed{WS1\_N = 0,77}$

$\Omega_{S1} = Q \frac{(WS1\_N^2 - 1)}{WS1\_N} \Rightarrow \Omega S1 = 5 \frac{(0,77^2 - 1)}{0,77} \Rightarrow \boxed{\Omega S1 = -2,64}$

$\Omega S2 = Q \frac{(WS2\_N^2 - 1)}{WS2\_N} \Rightarrow \Omega S2 = 5 \frac{(1,64^2 - 1)}{1,64} \Rightarrow \boxed{\Omega S2 = 5,15}$

Elijo $A \Omega S = 2,64$

a) PLANTILLA PASABAJOS PROTOTIPO



$\alpha_{MAX} = 0,5dB$; $\alpha_{min} = 16dB$ → FS1

$\varepsilon^2 = 10^{0,5/10} - 1$

$\boxed{\varepsilon^2 = 0,122} \rightarrow \boxed{\varepsilon = 0,349}$

$\alpha_{min}(n) = 10\log\left[\left(1+\varepsilon^2 \cosh^2\left(n \cosh^{-1}(\Omega ws)\right)\right)\right]$

$\alpha_{min1} = 10\log\left(1+\varepsilon^2 \Omega s^2\right) = 10\log\left(1+0{,}122 \cdot 2{,}64^2\right) \Rightarrow \alpha_{min1} = 2{,}67\,dB$

$\alpha_{min2} = 10\log\left[\left(1+\varepsilon^2 \cosh^2\left(2 \cosh^{-1}(\Omega ws)\right)\right)\right]$

$\alpha_{min2} = 10\log\left[\left(1+0{,}122 \cosh^2\left(2 \cosh^{-1}(2{,}64)\right)\right)\right] \Rightarrow \alpha_{min2} = 13{,}31\,dB$

$\alpha_{min3} = 10\log\left[\left(1+\varepsilon^2 \cosh^2\left(3 \cdot \cosh^{-1}(\Omega ws)\right)\right)\right] \Rightarrow \alpha_{min3} = 27{,}22\,dB$

$\hookrightarrow n=3$

b)

$$T(w) \cdot T(-w) = \frac{1}{1+C_3^2(w)} = \frac{1}{1+\varepsilon^2(4w^3-3w)^2} =$$

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

$$\text{si } w=s/s \Rightarrow T(s) \cdot T(-s) = \frac{1}{-16\varepsilon^2 s^6 - 24\varepsilon^2 s^4 - 9\varepsilon^2 s + 1} =$$

$$= \frac{1}{as^3+bs^2+cs+1} \quad \frac{1}{-as^3+bs^2-cs+1}$$

$$-a^2 s^6 + (ab-ab)s^5 + (b^2-2ac)s^4 + (ad-ad+bc-bc)s^3 + (2bd-c^2)s^2 +$$
$$+ (cd-cd)s + d^2$$

HOJA Nº

FECHA

IGUALAMOS COEFICIENTES:

$+a^2 = +\varepsilon^2 \cdot 16 \Rightarrow a = 4\varepsilon \to a = 1{,}396$; $d^2 = 1 \to d = 1$

$0 = ab - ab$

$-24\varepsilon^2 = (b^2 - 2ac) \to b^2 + 24\varepsilon^2 = 2ac = 8\varepsilon c \to \frac{1}{8\varepsilon} b^2 + 3\varepsilon = c$ ①

$0 = ad - ad + bc - bc$

$-9\varepsilon^2 = (2bd - c^2) \to c^2 = 2b + 9\varepsilon^2$ ②

$0 = cd - cd$

① en ② $\Rightarrow \left(\frac{1}{8\varepsilon} b^2 + 3\varepsilon\right)^2 = 2b + 9\varepsilon^2 \Rightarrow \frac{1}{64\varepsilon^2} b^4 + \frac{3}{4} b^2 + \cancel{9\varepsilon^2} = 2b + \cancel{9\varepsilon^2}$

$\cancel{b}\left(\frac{1}{64\varepsilon^2} b^3 + \frac{3}{4} b - 2\right) = 0 \Rightarrow 0{,}128\, b^3 + 0{,}75 b - 2 = 0$

$b = 1{,}75$ → SOLO ME QUEDO CON LA REAL

CALCULAMOS C:

① $c = \frac{1}{8\sqrt{0{,}122}} (1{,}75)^2 + 3 \cdot 0{,}349 \Rightarrow c = 2{,}14$

② $c^2 = 2 \cdot (1{,}75) + 9 \cdot 0{,}122 \Rightarrow c = 2{,}14$

$c = 2{,}14$

NOTA

Escaneado con CamScanner

ENTONCES:

$$T_{LP}(\$) = \frac{1 \cdot \frac{1}{2}}{1,396\,\$^3 + 1,75\,\$^2 + 2,14\,\$ + 1} \frac{1}{1/2} \Rightarrow T_{LP}(S) = \frac{0,716}{\$^3 + 1,25\,\$^2 + 1,53\,\$ + 0,716}$$

c) $$T_{BP}(S) = T_{LP}(\$)\Big|_{\$ = \frac{S^2+1}{S} \cdot Q} = \frac{0,716}{Q^3\left(\frac{S^2+1}{S^3}\right)^3 + \underset{1,25}{Q^2}\left(\frac{S^2+1}{S^2}\right)^2 + 1,53\left(Q\left(\frac{S^2+1}{S}\right)\right) + 0,716}$$

ANTES DE HALLAR LA T(S) DEL PASA BANDA, FACTORIZO $T_{LP}(S)$:

$$T_{LP}(\$) = \frac{1,1390}{\$^2 + 0,6216\,\$ + 1,1390} \cdot \frac{0,628}{\$ + 0,628}$$

$(\$ - (-0,3108 + j\,1,021))(\$ - (-0,3108 - j\,1,021))$; $(a + jB) \cdot (a - jB) = a^2 + B^2$

$\$^2 + 0,6216\,\$ + 1,1390$; $0,716 = wo_2^2 \cdot 0,628 \rightarrow wo_2^2 = 1,14$

$$TBP(S) = \frac{1,1390}{Q^2\frac{(S^2+1)^2}{S^2} + Q\frac{(S^2+1)}{S} \cdot 0,6216 + 1,1390} \cdot \frac{0,628}{Q\frac{(S^2+1)}{S} + 0,628}$$

CON $Q = 5$

$$T_{BP}(S) = \frac{1{,}139\, S^2}{1{,}1390\, S^2 + 0{,}6216 \cdot Q\, (S^2+1)S + Q^2 (S^2+1)^2} \cdot \frac{0{,}628\, S}{Q(S^2+1) + 0{,}628\, S}$$

$$T_{BP}(S) = \frac{1{,}1390\, S^2}{Q^2 S^4 + 2Q^2 S^2 + Q^2 + 0{,}6216\, Q\,(S^2+1)S + 1{,}1390\, S^2} \cdot \frac{0{,}628\, S}{Q S^2 + 0{,}628\, S + Q}$$

0,04556

$$T_{BP}(S) = \frac{1{,}139\, S^2 \cdot \frac{1}{25}}{(25 S^4 + 3{,}108 S^3 + 51{,}139 S^2 + 3{,}108 S + 25) \cdot \frac{1}{25}} \cdot \frac{0{,}628\, S}{5 S^2 + 0{,}628 S + 5}$$

FACTORIZAMOS DENOMINADOR:

$$\frac{25 S^4 + 3{,}108 S^3 + 51{,}139 S^2 + 3{,}108 S + 25}{25} = 0$$

$\rightarrow S_{1,2} = -0{,}034 \pm j1{,}107 \rightarrow (S - (-0{,}034 + j1{,}107))(S - (-0{,}034 - j1{,}107))$ ①

$\rightarrow S_{3,4} = -0{,}02792 \pm j0{,}9026 \rightarrow (S - (-0{,}02792 + j0{,}9026))(S - (0{,}02792 - j0{,}9026))$ ②

① $S^2 + 0{,}068 S + 1{,}2266$; ② $S^2 + 0{,}05584 S + 0{,}8234$

$$T_{BP}(S) = \underbrace{\frac{0{,}2134\, S}{S^2 + 0{,}068 S + 1{,}2266}}_{q_1 = 16{,}28} \cdot \underbrace{\frac{0{,}2134\, S}{S^2 + 0{,}05584 S + 0{,}8234}}_{q_2 = 16{,}25} \cdot \underbrace{\frac{(0{,}628/5)\, S}{S^2 + 0{,}1256 S + 1}}_{q_3 = 7{,}96}$$

$q_1 = 16{,}28$, $w_{01} = 1{,}107$

$q_2 = 16{,}25$, $w_{02} = 0{,}907$

$q_3 = 7{,}96$, $w_{03} = 1$

POR PYTHON:

$$T_{bp}(s) = \frac{s \cdot 1{,}207 \frac{1}{7{,}981}}{s^2 + \frac{1}{7{,}981} s + 1^2} \quad \frac{s \cdot 2{,}045 \frac{1{,}107}{16{,}05}}{s^2 + \frac{1{,}107}{16{,}05} + 1{,}107^2} \quad \frac{s \, 4{,}768 \cdot \frac{0{,}903}{16{,}05}}{s^2 + \frac{0{,}903}{16{,}05} s + 0{,}903^2}$$

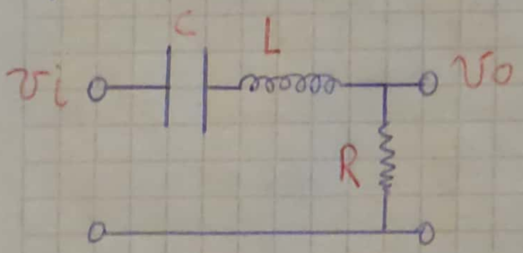
$\rightarrow q_1 = 7{,}981$ $\quad$ $\rightarrow q_2 = 16{,}05$ $\quad$ $\rightarrow q_3 = 16{,}05$

SE VERIFICAN DISTINTAS COSAS:

$q_2 = q_3$ → CORRESPONDIENTE ALAS ETAPAS PASA BAJOS SEGUNDO ORDEN.

$w_{o2} \cdot w_{o3} = 1{,}107 \cdot 0{,}903 \cong 1$ → VERIFICA

d) CIRCUITO RLC



$$\rightarrow T(s) = \frac{R}{R + sL + 1/sC}$$

$$T(s) = \frac{sCR}{s^2 LC + sCR + R}$$

$$T(s) = \frac{s \frac{R}{L}}{s^2 + \frac{R}{L} s + 1/LC}$$

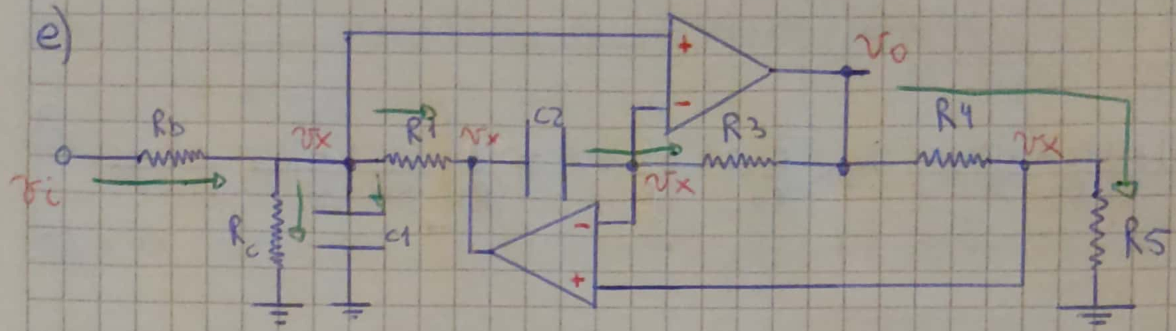
$\rightarrow w_o^2 = 1/LC$

$LC = w_o^{-2}$

$\frac{w_o}{Q} = \frac{R}{L} \xrightarrow{\text{Si } R=1} \frac{w_o}{Q} = \frac{1}{L} \rightarrow L = Q/w_o$

$C = 1/(Q w_o)$; $R = 1$

e)



NODOS:

$$v_x\left(\frac{1}{R_b}+\frac{1}{R_c}+sC_1+\frac{1}{R_1}\right)-\frac{1}{R_b}v_i-\frac{1}{R_1}v_y=0$$

$$v_x\,\frac{R_1(R_b+R_c)+R_bR_c+sC_1R_1R_bR_c}{R_1R_bR_c}-\frac{1}{R_b}v_i=\frac{1}{R_1}v_y$$

$$\frac{R_1(R_b+R_c)+R_bR_c+sR_1R_bR_cC_1}{R_bR_c}v_x-\frac{R_1}{R_b}v_i=v_y \quad (1)$$

$$v_x\left(sC_2+\frac{1}{R_3}\right)-sC_2v_y-\frac{1}{R_3}v_o=0 \Rightarrow v_y.sC_2=\frac{sC_2R_3+1}{R_3}-\frac{1}{R_3}v_o$$

$$v_y=\frac{(sC_2R_3+1)v_x}{sC_2R_3}-\frac{1}{sC_2R_3}v_o \quad (2)$$

$$v_x\left(\frac{1}{R_4}+\frac{1}{R_5}\right)-\frac{1}{R_4}v_o=0 \;;\; v_x=\frac{R_5}{R_4+R_5}v_o \quad (3)$$

② en ①

$$\frac{R_1(R_b+R_c)+R_bR_c+sR_1R_bR_cC_1}{R_bR_c}v_x - \frac{R_1}{R_b}v_i = v_y = \left[\frac{(sC_2R_3+1)v_x}{sC_2R_3} - \frac{1}{sC_2R_3}v_o\right]$$

$$v_x\left[\frac{R_1(R_b+R_c)+R_bR_c+sR_1R_bR_cC_1}{R_bR_c} - \frac{(sC_2R_3+1)}{sC_2R_3}\right] = \frac{R_1 v_i}{R_b} - \frac{1}{sC_2R_3}v_o$$

$$v_x\,\frac{s^2C_1C_2R_1R_3R_bR_c + s\left[C_2R_3\left(R_1(R_b+R_c)+\cancel{R_bR_c}\right) - R_bR_c(\cancel{sC_2R_3}+1)\right]}{sC_2R_3R_bR_c} = \frac{R_1}{R_b}v_i - \frac{1}{sC_2R_3}v_o$$

$$v_x\,\frac{s^2C_1C_2R_1R_3R_bR_c + sC_2R_3R_1(R_b+R_c) - R_bR_c}{sC_2R_3R_bR_c} = \frac{R_1}{R_b}v_i - \frac{1}{sC_2R_3}v_o$$

④

③ en ④

$$\frac{R_5}{R_4+R_5}v_o\,\frac{s^2C_1C_2R_1R_3R_bR_c + sC_2R_3R_1(R_c+R_b) - R_bR_c}{sC_2R_3R_bR_c} + \frac{1}{sC_2R_3}v_o = \frac{R_1}{R_b}v_i$$

$$v_o\,\frac{s^2C_1C_2R_1R_3R_bR_cR_5 + sC_2R_3R_1R_5(R_c+R_b) \cancel{-R_bR_cR_5} + R_bR_c(R_4+\cancel{R_5})}{sC_2R_3\cancel{R_b}R_c(R_4+R_5)} = \frac{R_1}{\cancel{R_b}}v_i$$

$$T(s) = \frac{sC_2R_3R_1R_c(R_4+R_5)}{s^2C_1C_2R_1R_3R_bR_cR_5 + sC_2R_3R_1R_5(R_c+R_b) + R_bR_cR_4}$$

FINALMENTE:

$$T(S)=\frac{\frac{R4+R5}{C1RbR5}\,S\,\frac{Rc+Rb}{Rc+Rb}\,\frac{Rc}{Rc}}{S^2+\frac{Rc+Rb}{C1RcRb}S+\frac{R4}{R1R3C1C2R5}}\;;\quad Rc+Rb=\frac{R}{1-a}+\frac{R}{a}$$

$$Rc+Rb=\frac{R(1-a)+Ra}{(1-a)\,a}$$

$$T(S)=\frac{\frac{(R4+R5)Rc}{(Rc+Rb)R5}\,\frac{Rc+Rb}{RcC1Rb}\,S}{S^2+\frac{Rc+Rb}{C1RcRb}S+\frac{R4}{R1R3C1C2R5}}\;;\quad Rc+Rb=\frac{R}{(1-a)\,a}$$

$$Rc\cdot Rb=\frac{R^2}{(1-a)\cdot a}$$

DONDE: $w_0^2=\frac{R4}{R1R3R5C1C2}$; $\frac{w_0}{Q}=\frac{Rc+Rb}{RcRbC1}$; $K=\frac{Rc}{R5}\,\frac{R4+R5}{Rc+Rb}$

Si $R1=R3=1$, $C1=C2=C$ $\rightarrow w_0^2=\frac{R4}{C^2\,R5}$ $\rightarrow C^2=\frac{R4}{w_0^2R5}$ (1)

$\frac{w_0}{Q}=\frac{1}{Rc}$; Si $R5=1 \rightarrow C^2=R4/(w_0^2)$

$\rightarrow C^2=\frac{Q^2}{w_0^2R^2}$ (2)

(1)=(2) $\frac{Q^2}{\cancel{w_0^2}R^2}=\frac{R4}{\cancel{w_0^2}} \rightarrow R4=\frac{Q^2}{R^2} \rightarrow R^2=Q^2/R4$

$K=a(R4+1) \rightarrow R4=\frac{K}{a}-1$; $R^2=Q^2\cdot\frac{1}{\frac{K}{a}-1} \rightarrow R=Q\sqrt{\frac{a}{K-a}}$

$$C^2=\cancel{Q^2}\,\frac{1}{w_0^2\cancel{Q^2}\left(\sqrt{\frac{a}{K-a}}\right)^2} \Rightarrow C=\frac{1}{w_0}\sqrt{\frac{K-a}{a}}$$

NOTA

SIENDO $\Omega w = 2\pi \cdot 22KHz$ Y $\Omega z = 1K\Omega$

CASO RLC

$R = \Omega z = 1K$; $C = \frac{1}{Qw_0} \cdot \frac{1}{\Omega z \cdot \Omega w_0}$; $L = \frac{Q}{w_0} \cdot \frac{\Omega z}{\Omega w_0}$

PARA LAS 3 ETAPAS

ETAPA N°1: $Q_1 = 7{,}981$; $w_{0_1} = 1$

$C1 = \frac{1}{7{,}981} \cdot \frac{1}{\Omega z \cdot \Omega w_0} \Rightarrow C1 = 0{,}91nF$; $L1 = 57{,}74 mHY$

ETAPA N°2: $Q_2 = 16{,}05$; $w_{0_2} = 0{,}903$

$C2 = 0{,}5nF$; $L2 = 128{,}58 mHY$

ETAPA N°3: $Q_3 = 16{,}05$; $w_{03} = 1{,}107$

$C3 = 0{,}41nF$; $L3 = 104{,}89 mHY$

HOJA Nº

FECHA

CASO RLC CON GIC

$R1 = R3 = R5 = \Omega z = 1K\Omega$; $R = Q\sqrt{\frac{\partial}{K - \partial}} \cdot \Omega z$

→ PARA TODAS LAS ETAPAS

$C1 = C2 = C = \frac{1}{w_0} \sqrt{\frac{K-\partial}{\partial}} \frac{1}{\Omega z}$; $R4 = \left(\frac{K}{\partial} - 1\right) \cdot \Omega z$

ETAPA Nº1: $Q1 = 7,981$; $w_{o1} = 1$; $\partial = 0,5$; $K1 = 1,207$

$R = 6,71 K\Omega$; $C1 = C2 = C = 8,60 nF$; $R4 = 1,41 K\Omega$

ETAPA Nº2: $Q2 = 16,05$; $w_{o2} = 0,903$; $\partial = 0,5$; $K2 = 2,045$

$R = 9,13 K\Omega$; $C1 = C2 = C = 14,083 nF$; $R4 = 3,09 K\Omega$

ETAPA Nº3: $Q3 = 16,05$; $w_{o3} = 1,107$; $\partial = 0,5$; $K3 = 4,768$

$R = 5,49 K\Omega$; $C1 = C2 = C = 19,09 nF$; $R4 = 8,54 K\Omega$