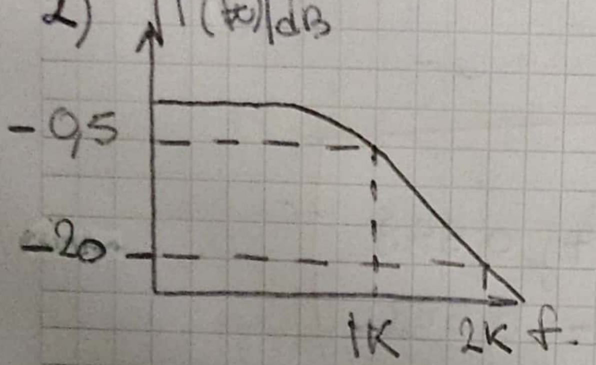
Guía 2 TCII

2)



$\omega_p = 2\pi . 1k$

$\omega_s = 2\pi\, 2K \rightarrow \omega_{sN} = 2$

$\alpha_{MAX} = +0,5\,dB$

$\alpha_{MIN} = +20\,dB$

Normalizando por ω_p.

$\omega_N = \dfrac{\omega}{\Omega\omega} = \dfrac{\omega}{\omega_p}$

$$\Rightarrow |T(\omega_N)|^2 = \frac{1}{1+\varepsilon^2 \omega_N^{2n}}$$

$$\varepsilon^2 = 10^{\frac{\alpha_{MAX}}{10}} - 1$$

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

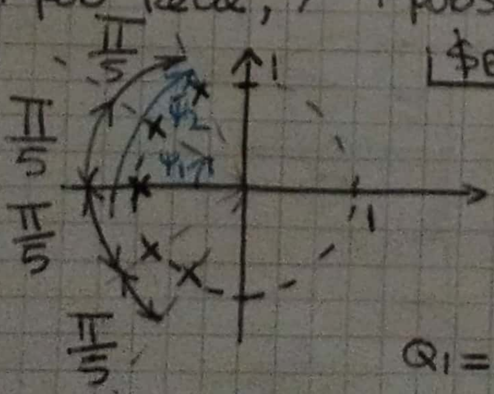
$$|T(\omega_{sN})| = \frac{1}{1+\varepsilon^2 \omega_{sN}^{2n}}$$

$$-20\,dB = -10\,dB \log(1+\varepsilon^2 \omega_{sN}^{2n})$$

$$+2 = \log(1+0,122 \,.\, 2^{2n})$$

a- $\boxed{n = 5}$

b- HAY un polo real, y 4 polos complejos, separados $\frac{\pi}{5}$:



LSB.

donde $\omega_B = \dfrac{\omega_N}{\varepsilon^{-1/n}} = \dfrac{\omega}{\Omega\omega\,\varepsilon}$

$$\boxed{\Omega_B = \Omega\omega\, \varepsilon^{-1/n}}$$

$$Q_1 = \frac{1}{2\cos\varphi_1} = \frac{1}{2\cos\frac{\pi}{5}}$$

$$\boxed{Q_1 = 0,62}$$

$$Q_2 = \frac{1}{2\cos\varphi_2} = \frac{1}{2\cos\frac{2\pi}{5}}$$

$$\boxed{Q_2 = 1,618.}$$

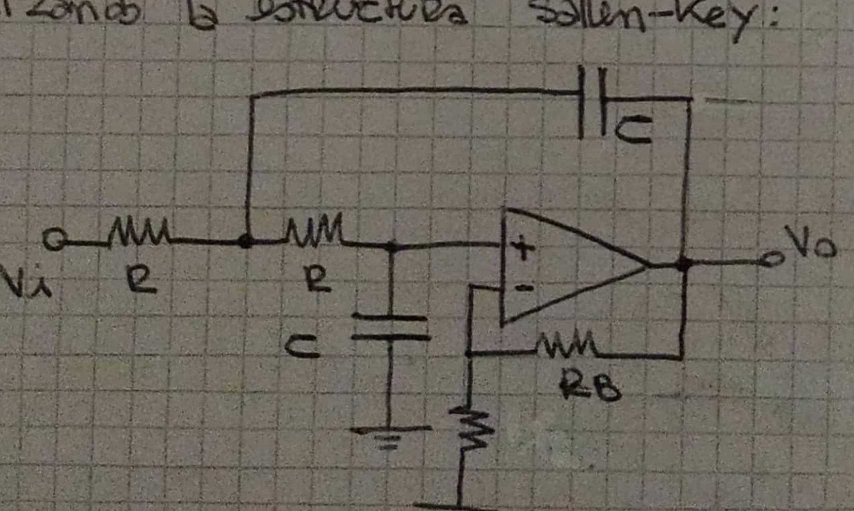
$$\boxed{\begin{aligned}
P_1 &= -1 \\
P_2 &= -\cos\frac{\pi}{5} + j\sin\frac{\pi}{5} = -0,809 + j\,0,588 \\
P_3 &= -\cos\frac{\pi}{5} - j\sin\frac{\pi}{5} = -0,809 - j\,0,588 \\
P_4 &= -\cos\left(\frac{2\pi}{5}\right) + j\sin\left(\frac{2\pi}{5}\right) = -0,309 + j\,0,951 \\
P_5 &= -\cos\left(\frac{2\pi}{5}\right) - j\sin\left(\frac{2\pi}{5}\right) = -0,309 - j\,0,951
\end{aligned}}$$

$$T(S_B) = \frac{1}{S_B+1}\quad\frac{1}{S_B^2 + S_B\frac{1}{0,62}+1}\quad\frac{1}{S_B^2 + S_B\frac{1}{1,618}+1}$$

Como la ganancia en la banda de paso es 20dB

$$\Rightarrow T(S_B) = 10\underbrace{\frac{1}{S_B+1}}_{T1}\;\underbrace{\frac{1}{S_B^2 + S_B\frac{1}{0,62}+1}}_{T2}\;\underbrace{\frac{1}{S_B^2 + S_B\frac{1}{1,618}+1}}_{T3}$$

utilizando la estructura sallen-Key:



$$T(s) = \frac{R+R_B}{R}\;\frac{\frac{1}{C^2R^2}}{s^2 + s\,\frac{2R-R_B}{CR^2} + \frac{1}{C^2R^2}}$$

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Normalizando el sallen-key en $\Omega = \frac{1}{C \cdot R}$ $\quad \$ = \frac{s}{\frac{1}{CR}}$

$$T(\$) = \frac{R+RB}{R} \cdot \frac{\frac{1}{C^2R^2}}{\left(\$\frac{1}{CR}\right)^2 + \$\frac{1}{CR}\cdot\frac{2R-RB}{CR^2} + \frac{1}{C^2R^2}}$$

$$T(\$) = \frac{R+RB}{R} \cdot \frac{1}{\$^2 + \cancel{CR}\,\frac{2R-RB}{\cancel{CR^2}} + 1}$$

$$T(\$) = \frac{R+RB}{R} \cdot \frac{1}{\$^2 + \frac{2R-RB}{R} + 1}$$

- $\frac{1}{CR} = \Omega B = \Omega w \cdot \varepsilon^{-1/n}$

$$\frac{1}{CR} = 2\pi 1K \cdot \varepsilon^{-1/5}$$

$$\frac{1}{CR} = 7754{,}20 \frac{rad}{s}$$

- $\underline{\underline{T2}}$

$$\frac{1}{0{,}62} = \frac{2R-RB}{R} = 2 - \frac{RB}{R}$$

$$\frac{RB}{R} = 0{,}387$$

$$\begin{cases} RB = 0{,}387 \cdot R \\ \frac{R+RB}{R} = 1 + \frac{RB}{R} = 1 + 0{,}387 = \underline{\underline{1{,}387}} = K2 \end{cases}$$

$\boxed{R = 1K} \Rightarrow \boxed{RB = 387\,\Omega}$

$\Rightarrow \boxed{C = \frac{1}{\Omega B \cdot R} = 128{,}96\,nF}$

$\boxed{C = 128{,}96\,nF}$

NOTA

T3

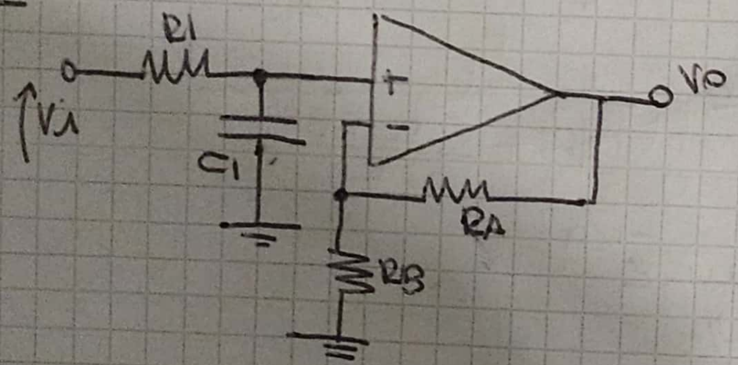
$$\frac{1}{1{,}618} = 2 - \frac{RB}{R}.$$

$$\frac{RB}{R} = 1{,}382.$$

$RB = 1{,}382\,R. \rightarrow \boxed{R = 1K}$ $\boxed{RB = 1{,}382\,K}$

$\hookrightarrow \boxed{K3 = 2{,}382} \Rightarrow \boxed{C = 128{,}96\,nF}$

T1



$$T1(s) = \left(1 + \frac{RA}{RB}\right) \frac{\frac{1}{C1\,R1}}{s + \frac{1}{C1\,R1}}$$

$$T_1(s) = \left(1 + \frac{RA}{RB}\right) \frac{1}{s + 1}, \quad \frac{1}{C1\,R1} = 7754{,}20\ \frac{rad}{s}$$

$\boxed{R1 = 1K}$

$\Rightarrow \boxed{C1 = 128{,}96\,nF}$

$K = 10 = K1\,K2\,K3.$

$10 = K1 . 1{,}387\ 2{,}382.$

$\Rightarrow K1 = 3{,}026 \Rightarrow \frac{RA}{RB} = 2{,}026.$

$\boxed{RA = 20{,}26\,K}$

$\boxed{RB = 10\,K}$

NOTA

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7)

FILTRO PASABANDAS:

$\omega_{p_1} = 2\pi \cdot 1600\,KHz$
$\omega_{p_2} = 2\pi \cdot 2500\,KHz$

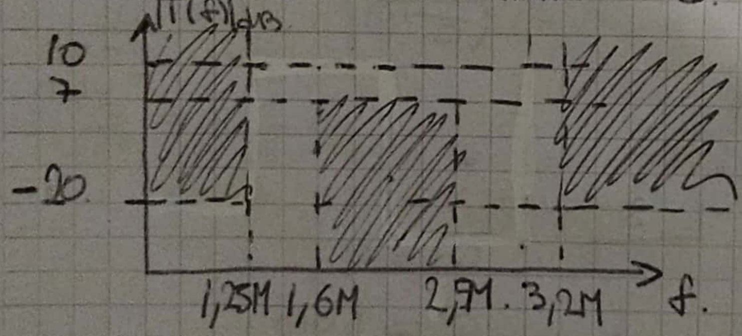
$\omega_0 = 2\pi \cdot 2MHz$
$BW = 2\pi \cdot 900\,KHz$
$Q = 2,\overline{2}$

$\omega_{s1} = 2\pi \cdot 1250\,KHz$
$\omega_{s2} = 2\pi \cdot 3200\,KHz$

$\sqrt{1250\,KHz \cdot 3200\,KHz} = 2MHz$

$\Rightarrow$ se mapean a la misma frec.

- $\alpha_{MIN} = 20dB$ y $\alpha_{MAX} = 3dB$. $K_{MAX} = 10dB$



Norma de frecuencia $\Omega_\omega = \omega_0$

- $\omega_{s1_N} = 0,625$
- $\omega_{s2_N} = 1,6$

Núcleo de transformación $K(\$) = \frac{\$^2+1}{\$} 2,\overline{2}$

- $\Omega_s = \frac{0,625^2 - 1}{0,625} \cdot 2,\overline{2}$ $\quad \Omega = \frac{\omega_N^2 - 1}{\omega_N} Q$

$\Omega_s = 2,167$

PARA MÁXIMA PLANICIDAD

$$|T(\Omega)|^2 = \frac{1}{1+\varepsilon^2 \Omega^{2n}}$$

NOTA

$$\varepsilon^2 = 10^{\frac{3}{10}} - 1$$

$$\boxed{\varepsilon^2 = 0,995}$$

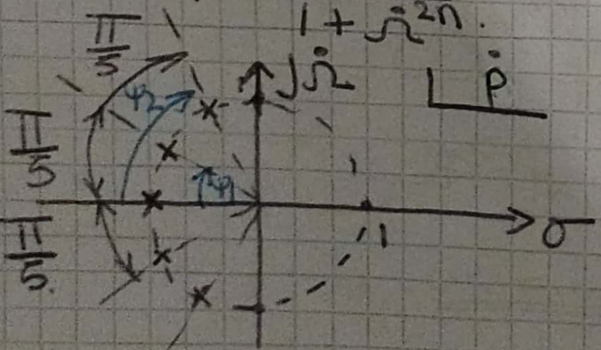
$$\gamma_0\,dB = 10\,dB \log\left(1+\varepsilon^2 \cdot \Omega_s^{2n}\right)$$

$$\gamma_0\,dB = 10\,dB \log\left(1+0,995 \cdot 2,167^{2n}\right)$$

$$\boxed{n = 5}$$

$$\Rightarrow \left|T(\Omega)\right|^2 = \frac{1}{1+\varepsilon^2\Omega^{2n}} = \frac{1}{1+\left(\frac{\Omega}{\varepsilon^{-1/n}}\right)^{2n}} \qquad \dot{\Omega} = \frac{\Omega}{\varepsilon^{-1/n}}$$

$$\left|T(\dot{\Omega})\right|^2 = \frac{1}{1+\dot{\Omega}^{2n}} \qquad \Omega_B = \varepsilon^{-1/n}$$



$Q1 = 0,62$

$Q2 = 1,618$

$$T(\dot{p}) = \frac{1}{\dot{p}+1} \; \frac{1}{\dot{p}^2+\dot{p}\frac{1}{0,62}+1} \; \frac{1}{\dot{p}^2+\dot{p}\frac{1}{1,618}+1}$$

$$T(p) = \frac{1}{\frac{p}{\varepsilon^{-1/n}}+1} \; \frac{1}{\left(p\frac{1}{\varepsilon^{-1/n}}\right)^2+p\frac{1}{\varepsilon^{-1/n}}\frac{1}{0,62}+1} \; \frac{1}{\left(p\frac{1}{\varepsilon^{-1/n}}\right)^2+p\frac{1}{\varepsilon^{-1/n}}\frac{1}{\ }+1}$$

$$T(p) = \frac{1}{\varepsilon^{1/n}} \; \frac{1}{p+\varepsilon^{1/n}} \; \frac{1}{(\varepsilon^{1/n})^2 \cdot p^2+p\frac{\varepsilon^{1/n}}{0,62}+(\varepsilon^{1/n})^2} \; \frac{1}{(\varepsilon^{1/n})^2\left(p^2+p\frac{\varepsilon^{1/n}}{\ }+(\varepsilon^{-1/n})\right)}$$

$$\varepsilon^{-1/5} \cong 1$$

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$$T(p) = \frac{1}{p+1} \quad \frac{1}{p^2 + p\frac{1}{0{,}62} + 1} \quad \frac{1}{p^2 + p\frac{1}{1{,}618} + 1}$$

$$T(\$) = \frac{1}{\left(\frac{\$^2+1}{\$}\right)Q + 1} \quad \frac{1}{\left(\frac{\$^2+1}{\$}Q\right)^2 + \left(\frac{\$^2+1}{\$}\right)\frac{Q}{0{,}62} + 1} \quad \frac{1}{\left(\frac{\$^2+1}{\$}Q\right)^2 + \left(\frac{\$^2+1}{\$}\right)\frac{1}{1{,}618} +}$$

$$T(\$) = \frac{\$}{(\$^2+1)Q + \$} \quad \frac{\$^2}{\$^4 Q^2 + 2Q^2\$^2 + Q^2 + \$^3 1{,}61Q + \$ 1{,}61Q + \$^2}$$

$$\cdot \frac{\$^2}{s^4 Q^2 + 2Q^2\$^2 + Q^2 + \$^3 0{,}62Q + \$ 0{,}62Q + \$^2}$$

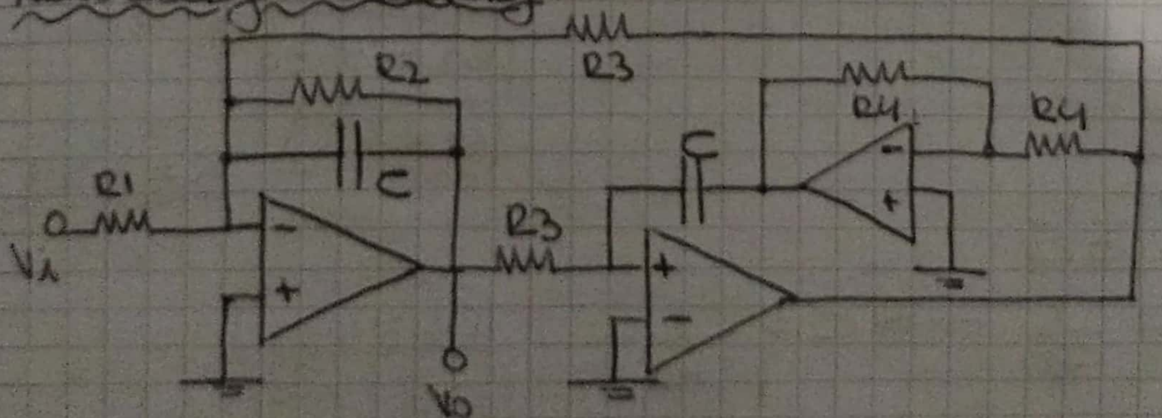
$$T(\$) = \underbrace{\frac{\$\frac{1}{Q}}{\$^2 + \$\frac{1}{Q} + 1}}_{T1} \quad \frac{\$^2\frac{1}{Q^2} \cdot \frac{0{,}11}{0{,}11} \cdot \frac{0{,}169}{0{,}169}}{\underbrace{(\$^2 + 0{,}11\$ + 0{,}653)}_{T2}\underbrace{(\$^2 + 0{,}169\$ + 1{,}53)}_{T3}}$$

$$\frac{\$^2\frac{1}{Q^2}\frac{0{,}314}{0{,}314} \cdot \frac{0{,}412}{0{,}412}}{\underbrace{(\$^2 + 0{,}314\$ + 0{,}763)}_{T4}\underbrace{(\$^2 + 0{,}412\$ + 1{,}31)}_{T5}}$$

$$K = \frac{1}{Q^4\, 0{,}11\; 0{,}169\; 0{,}314\; 0{,}412}$$

$K = 17{,}05$

Ackerberg - Mossberg



$$\omega_0 = \frac{1}{CR_3}$$

$$T(s) = -\frac{R_2}{R_1}\,\frac{\frac{s}{C \cdot R_2}}{s^2 + s\frac{1}{CR_2} + \frac{1}{C^2 R_3^2}}$$

$$Q = \frac{R_2}{R_3}$$

NOTA

I1

$$\begin{cases} \frac{1}{Q} = \frac{1}{CR_2} \\ 1 = \frac{1}{CR_3} \end{cases}$$

$R_2 = \frac{Q}{C} = \frac{2{,}22}{C} \Rightarrow R$

$\Rightarrow C = \frac{1}{R_3}$ Adopto $\boxed{R_3 = 1\Omega}$

$\Rightarrow \boxed{C = 1F}$

$\Rightarrow \boxed{R_2 = 2{,}22\Omega}$

$\boxed{R_1 = 1\Omega}$

$\underline{K = 2{,}22\Omega}$

I2

$$\begin{cases} 0{,}11 = \frac{1}{CR_2} \\ \sqrt{0{,}653} = \frac{1}{CR_3} \end{cases}$$

$\Rightarrow C = \frac{1}{\sqrt{0{,}653}\,R_3} \Rightarrow$ Adopto $\boxed{R_3 = 1}$

$\Rightarrow \boxed{C = 1{,}237F}$

$\Rightarrow \boxed{R_2 = 7{,}35\Omega}$

$\boxed{R_1 = 1\Omega}$

$\underline{K = 7{,}35\Omega}$

I3

$$\begin{cases} 0{,}169 = \frac{1}{CR_2} \\ \sqrt{1{,}53} = \frac{1}{CR_3} \end{cases}$$

$\rightarrow C = \frac{1}{\sqrt{1{,}53}\,R_3}$, $\boxed{R_3 = 1\Omega}$

$\boxed{C = 0{,}808\ F}$

$\boxed{R_2 = 7{,}319}$

$\boxed{R_1 = 1\Omega}$

$\underline{K = 7{,}319}$

I4

$$\begin{cases} 0{,}34 = \frac{1}{CR_2} \\ \sqrt{0{,}763} = \frac{1}{CR_3} \end{cases}$$

$\longrightarrow C = \frac{1}{\sqrt{0{,}763}\,R_3}$; $\boxed{R_3 = 1\Omega}$

$\boxed{C = 1{,}14F}$

$\boxed{R_2 = 2{,}782\Omega}$

$\boxed{R_1 = 1\Omega}$

$\underline{K = 2{,}782}$

NOTA

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I5

$$0,412 = \frac{1}{CR2}$$

$$\sqrt{1,31} = \frac{1}{CR3} \rightarrow \boxed{R3 = 1\Omega}$$

$$\boxed{C = 0,874F}$$

$$\boxed{R2 = 2,778\Omega}$$

$$K' = 2,22 \cdot 7,35 \cdot$$

$$7,314 \cdot 2,782 \frac{R2}{R1}$$

$$K' = 332,24 \frac{R2}{R1}$$

$$K = 17,05 = 332,24 \cdot \frac{R2}{R1}$$ → esto da 0dB en w_p.

Pero en la banda de paso gana máx 10dB → 3,162

$$\Rightarrow \quad 17,05 \rightarrow 1$$

$$53,91 \leftarrow 3,162$$

$$332,24 \cdot \frac{R2}{R1} = 53,91\Omega$$

$$\Rightarrow \boxed{R1 = 17,12}$$

Desnormalizando por w_0:

$$C_{T1} = \frac{1}{2\pi 2MHz} = 79,58nF$$

$$C_{T2} = \frac{1,237}{2\pi \cdot 2MHz} = 98,44nF$$

$$C_{T3} = \frac{0,808}{2\pi 2MHz} = 64,3nF$$

$$C_{T4} = \frac{1,14}{2\pi 2MHz} = 90,72nF$$

$$C_{T5} = \frac{0,874}{2\pi 2MHz} = 69,55nF$$

NOTA