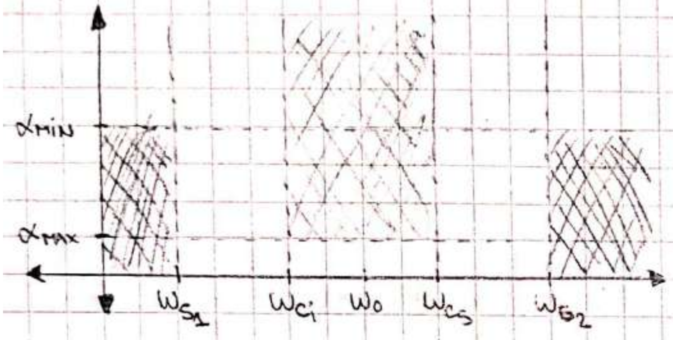
TRABAJO SEMANAL 4 BIS

$f_{ci} = 1600$ kHz $\qquad f_{cs} = 2500$ kHz $\qquad$ • Máxima Planicidad

$\alpha_{MAX} = 3$ dB $\qquad \alpha_{MIN} = 20$ dB $\rightarrow$ 1250 kHz $\qquad$ • Ganancia = 10 dB

$\hookrightarrow$ 3200 kHz



$w_{S_1} = 2\pi \cdot 1250$ kHz $= 2500\pi$

$w_{ci} = 2\pi \cdot 1600$ kHz $= 3200\pi$

$w_{cs} = 2\pi \cdot 2500$ kHz $= 5000\pi$

$w_{S_2} = 2\pi \cdot 3200$ kHz $= 6400\pi$

$\boxed{BW = 900 \text{ kHz}}$. $\qquad \boxed{Q = \frac{w_0}{BW} = \frac{20}{9}} \qquad w_0 = \sqrt{w_{ci} \cdot w_{cs}} = 4000\pi$ (2000 kHz)

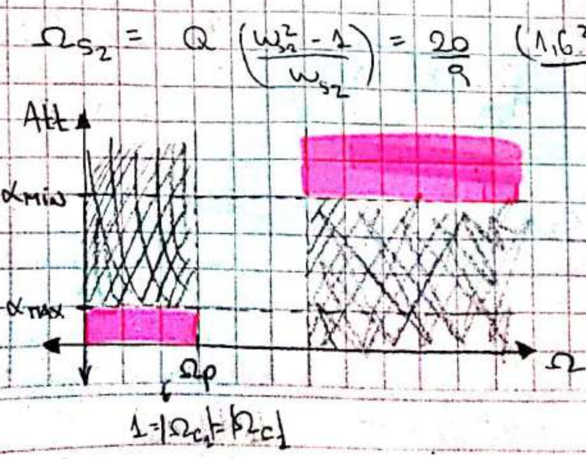
① Normalizo según w_0 //

$w_{0_N} = 1 \qquad \begin{cases} w_{S_1N} = 0{,}625 \; \overset{5/8}{} \\ w_{S_2N} = 1{,}6 \; 8/5 \end{cases} \qquad \begin{cases} w_{ciN} = 0{,}8 \; \overset{4/5}{} \\ w_{csN} = 1{,}25 \; 5/4 \end{cases}$

② Ω_{S_1}, Ω_{S_2}

$$\Omega_{S_1} = \underbrace{\overset{\nearrow 1/BW}{Q}}_{}\cdot\frac{(w^2 - 1)}{\underbrace{w}_{w_0 = 1}} = \frac{20}{9} \cdot \frac{(0{,}625^2 - 1)}{0{,}625} = -2{,}1\hat{6}$$ } Es menor, más exigente

$$\Omega_{S_2} = Q\left(\frac{w_{S_2}^2 - 1}{w_{S_2}}\right) = \frac{20}{9} \; \frac{(1{,}6^2 - 1)}{1{,}6} = 2{,}1\hat{6}$$



$1 = |\Omega_{c_1}| = |\Omega_c|$

$\boxed{n = 3}$ $\wedge$ $\boxed{\epsilon = 1}$

$\downarrow$ 1 redondeo $\qquad \hookrightarrow \alpha_{MAX} = 3$dB $\Rightarrow$ Butterworth

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

$$T(s)_{LP} = \frac{1}{s+1} \cdot \frac{1}{s^2 + s + 1} \Big\} \text{ Aplico } K(s) = Q \cdot \frac{(s^2+1)}{s}$$

$$T(s)_{BP} = \frac{K_0 \cdot s\, ^1/_Q}{s^2 + s\, \frac{1}{Q} + 1} \cdot \frac{K_1 \cdot s\, ^{w_{o1}}/_Q}{s^2 + s\, \frac{w_{o1}}{Q} + 1} \cdot \frac{K_2 \cdot s\, ^1/_{Q w_{o1}}}{s^2 + s^2\, \frac{1}{Q \cdot w_{o1}} + 1}$$

con $\left[Q = \frac{20}{9}\right] \wedge w_{o1} \cdot w_{o2} = 1 \rightarrow \left[w_{o2} = \frac{1}{w_{o1}}\right]$

- De la simulación y el cálculo en Python se obtiene

$$T(s)_{BP} = \frac{s\, ^9/_{20} \cdot \overset{1{,}021}{K_0}}{s^2 + s \cdot \frac{9}{20} + 1} \cdot \frac{s\; 0{,}3362}{s^2 + s\; 0{,}2693 + 1{,}476} \cdot \frac{s \cdot 0{,}5864}{s^2 + s\; 0{,}1917 + 0{,}6773}$$

Analizando: $Q_1 = \frac{20}{9}$ $\quad w_0 = 1$ } Proviene del Pasabajo orden 1

$1{,}476 = w_{o1}^2 \rightarrow \left[w_{o1} = 1{,}21\right] \wedge \left[w_{o2} = \frac{1}{w_{o1}} = 0{,}823\right]$

$0{,}2693 = \frac{w_{o1}}{Q_2} \rightarrow \left[Q_2 = \frac{1{,}21}{0{,}2693} = \boxed{4{,}5}\right]$ ↳ es el mismo Q para ambos SOS que salieron del LP 2° orden.

Entonces:

$$T(s)_{BP} = \frac{K_0 \cdot s \cdot ^1/_{2{,}22}}{s^2 + s\, \frac{1}{2{,}22} + 1} \cdot \frac{K_1 \cdot s\, ^{1{,}21}/_{4{,}5}}{s^2 + s\, \frac{1{,}21}{4{,}5} + (1{,}21)^2} \cdot \frac{K_2 \cdot s\, ^{0{,}823}/_{4{,}5}}{s^2 + s\, \frac{0{,}823}{4{,}5} + (0{,}823}$$

con $K_0 = 1{,}021$, $K_1 = 1{,}2577 \wedge K_2 = 3{,}2$

$10\,dB \rightarrow 10\,dB = 20\log(T_{BP}) \rightarrow T_{BP} = 10^{1/2} = 3{,}16$ //

$$T_{BP}(1) = 3{,}16 = K \cdot \frac{919}{4900} \cdot 0{,}123 \cdot 0{,}315$$

$$3{,}16 = K \cdot 0{,}00727 \rightarrow K = 434{,}25$$

Analizo Modulo $|T_{BP}(w)|$ en $w=1$

$$|T_{BP}(w)|\Big|_{w=1} = \left\| \frac{\cancel{j}0{,}4595}{\cancel{-1} + \cancel{j}0{,}45 + \cancel{1}} \cdot \frac{j\,0{,}3382}{-1 + j\,0{,}2693 + 1{,}476} \cdot \frac{j\,0{,}5864}{-1 + j\,0{,}1917 + 0{,}6773} \right\|$$

$$|T_{BP}(1)| = 1{,}021 \cdot \frac{0{,}3382}{\sqrt{0{,}476^2 + 0{,}2693^2}} \cdot \frac{0{,}5864}{\sqrt{(-0{,}3227)^2 + 0{,}1917^2}}$$

$$= 1{,}021 \cdot 0{,}6189 \cdot 1{,}5834 = 1{,}0005$$ //

Multiplico por K tal que $1{,}0005 \cdot K = 3{,}16$

$$\boxed{K = 3{,}158}$$

- Como es una $T(s)$ de 0 dB, en $w_0 = 1$ vale 1
  - → ganar 10 dB equivale a $T(s) \cong 3$ (3,16 en realidad) → Entonces se que mi K (ganancia) debe ser 3 ó 3,16.

CS Escaneado con CamScanner