6) datos: $f_{ci} = 1600\ KHz$

$f_{cs} = 2500\ KHz$

max planicidad en Banda de paso → Butter

$K_{real} = 10\,dB = 3{,}16$ veces

$\alpha_{max} = 3\,dB$

$\alpha_{min} = 20\,dB \to f_1 = 1250\ KHz$

$\to f_2 = 3200\ KHz$

TPL6 (1)

6.1) si $W_0^2 = W_{cs} \cdot W_{ci}$

$f_0^2 = f_{cs} \cdot f_{ci} \to f_0 = 2000\ KHz$

si normalizo respecto f_0

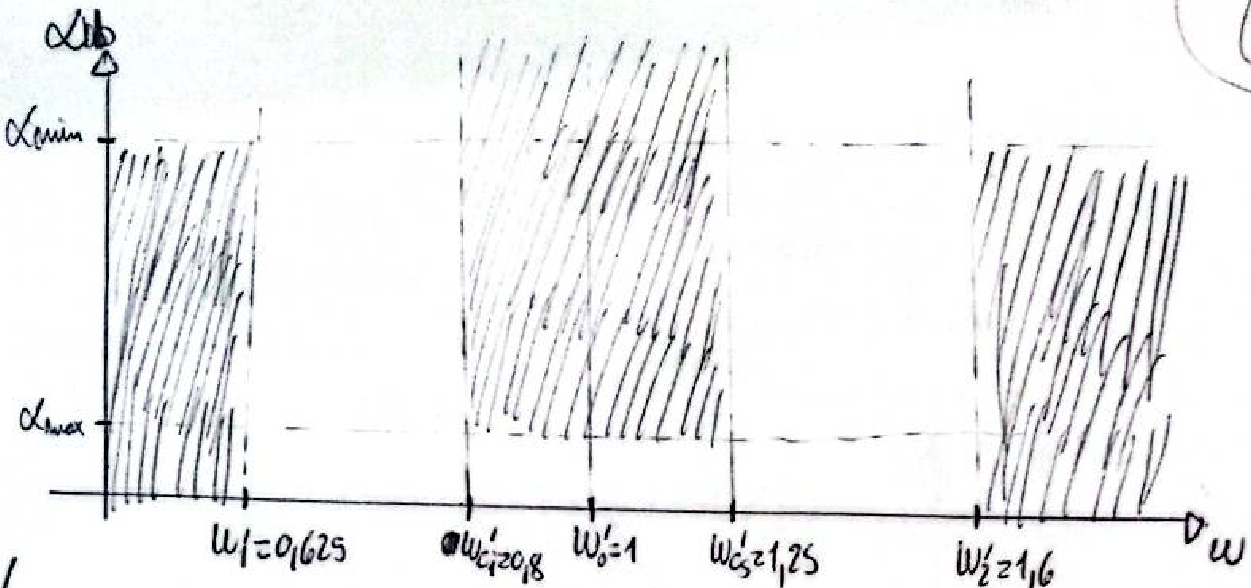
$W_0' = 1$

$W_1' = 0{,}625$

$W_2' = 1{,}6$

$W_{ci}' = 0{,}8$

$W_{cs}' = 1{,}25$



→ si $B = f_{cs} - f_{ci} \rightarrow B = 900\ KHz$

→ si $Q = \dfrac{f_0}{B} \rightarrow Q = 2,22$ → medido en Hz

→ si el nucleo de transformación

→

$$\Omega = \frac{\omega^2 - \omega_0^2}{\omega} \cdot \frac{Q}{\omega_0}$$

→ lo normalizo en ω_0

→

$$\Omega' = \frac{\omega^2 - 1}{\omega^2} \cdot \frac{Q}{1}$$

$|\Omega_2'| = 2,1645$ → elijo cualquiera ya que son iguales

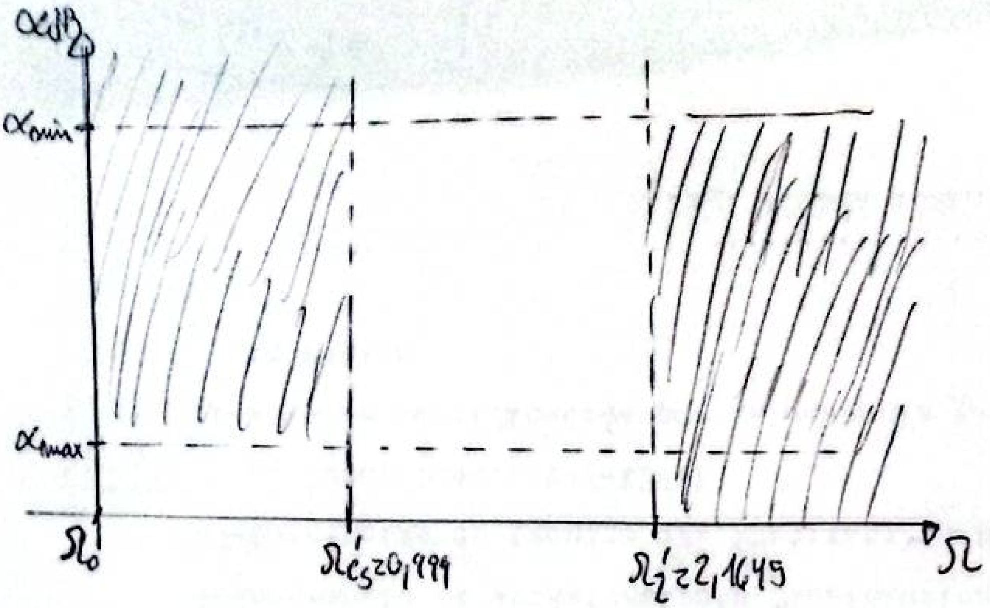
$|\Omega_1'| = 2,1645$

$|\Omega_{ci}'| = 0,999$

$|\Omega_{cs}'| = 0,999$

$\Omega_0' = 0$

TP6 3



6.2) Calculo el orden del pasabajo en Butter

si $\alpha_{max} = 3dB \rightarrow \varepsilon^2 = 10^{\frac{\alpha_{max}}{10}} - 1 \rightarrow \varepsilon^2 = 0,995$

si $\alpha_{dB} = 10 \cdot \log\left(1 + \varepsilon^2 \cdot \Omega_2'^{2 \cdot n}\right)$

$\alpha dB_{n=1} = 7,53 dB$ X $< \alpha_{min}$

$\alpha dB_{n=2} = 13,586 dB$ X $< \alpha_{min}$

$\alpha dB_{n=3} = 20,14 dB$ ✓ $> \alpha_{min}$ → es de orden $n=3$

TPL6

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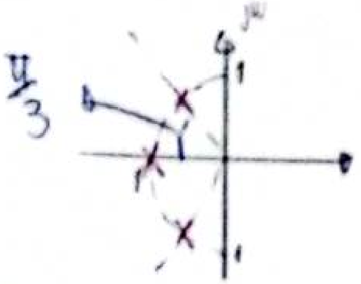
Si es Butter de orden 3



$\cancel{Q = 2\cos(\frac{\pi}{3}) \to Q = 2}$

$$Q = \frac{1}{2\cdot\underbrace{\cos(\frac{\pi}{3})}_{=1/2}} \to Q_{PB} \simeq \quad \to \frac{1}{Q_{PB}} = 1$$

$$\boxed{T(\$) = \frac{1}{\$+1}\cdot\frac{1}{s^2+s\cdot\ +1}}$$

si $\Omega = \frac{\omega^2-\omega_0^2}{\omega^2}\cdot\frac{Q}{\omega_0}$

si $\omega = \frac{s}{j}$

$$\$ = \frac{-s^2-\omega_0^2}{-s}\cdot\frac{Q}{\omega_0}$$

normalizo núcleo de transformación en $\omega_0 \to S = s\cdot\omega_0$

$$\$ = \frac{s^2+1}{s}\cdot$$

↳ veo el resultado de la etapa ~~[illegible]~~ 1° Orden

$$T_1(s) = \frac{1}{\left(\frac{s^2+1}{s}\right)\cdot\text{[redacted]} + 1} = \frac{1}{\frac{s^2+1+s\cdot\text{[redacted]}}{s\cdot\text{[redacted]}}} \rightarrow T_1(s) = \frac{s\cdot\text{[redacted]}}{s^2+s\cdot\text{[redacted]}+1}$$

↳ veo el resultado de la etapa de 2° Orden

$$T_2(s) = \frac{1}{\left(\frac{s^2+1}{s\cdot\text{[redacted]}}\right)^2 + \left(\frac{s^2+1}{s\cdot\text{[redacted]}}\right)\cdot\text{[redacted]} + 1}$$

$$\left(\frac{s^2+1}{s\cdot\text{[redacted]}}\right)\cdot\left(\frac{s^2+1}{s\cdot\text{[redacted]}}\right) = \frac{s^4+s^2+s^2+1}{s^2\cdot\text{[redacted]}} = \frac{s^4+s^2\cdot 2+1}{s^2\cdot\text{[redacted]}}$$

$$T_2(s) = \frac{1}{\frac{s^4+s^2\cdot 2+1}{s^2\cdot\text{[redacted]}} + \frac{s^2+1}{s\cdot\text{[redacted]}} + 1} = \frac{1}{\frac{s^4+s^2\cdot 2+1+(s^2+1)\cdot s\text{[redacted]}+s^2\cdot\text{[redacted]}}{s^2\cdot\text{[redacted]}}}$$

$$T_2(s) = \frac{s^2\cdot\text{[redacted]}}{s^4+s^3\cdot\text{[redacted]}+s^2\cdot 3\text{[redacted]}+s\cdot\text{[redacted]}+1}$$

$$T(s) = T_1(s)\cdot T_2(s)$$

$$T(s) = \frac{s\cdot\text{[redacted]}}{s^2+s\cdot\text{[redacted]}+1}\cdot\frac{s^2\cdot\text{[redacted]}}{s^4+s^3\cdot\text{[redacted]}+s^2\, 3\text{[redacted]}+s\cdot\text{[redacted]}+1}\cdot K$$

TPL N°6

$$T(s) = \frac{s^3 \cdot K}{s^6 + s^5 + s^4 \cdot 3 + s^3 + s^2 + s^5 + s^4 + s^3 \cdot 3 + s^2 + s + s^4 + s^3 + s^2 \cdot 3 + s + 1}$$

$$T(s) = \frac{s^3 \cdot K}{s^6 + s^5 \cdot 2 + s^4 \cdot 5 + s^3 \cdot 5 + s^2 \cdot 5 + s \cdot 2 + 1}$$

factorizado en python

$\to K = 3{,}16$

$$T(s) = \underbrace{\left(\frac{K \cdot s}{s^2 + s + 1}\right)}_{T_1(s)} \cdot \underbrace{\left(\frac{s \cdot 2{,}369}{s^2 + s \cdot 0{,}7032 + 2{,}369}\right)}_{T_2(s)} \cdot \underbrace{\left(\frac{s \cdot 0{,}4221}{s^2 + s \cdot 0{,}2968 + 0{,}4221}\right)}_{T_3(s)}$$

$T_1(s)$
- $\to K = 3{,}16$
- $\to \omega_0^2 = 1$
- $\to Q = 1$

$T_2(s)$
- $\to \omega_0^2 = 2{,}369 \to \omega_0 = 1{,}539$
- $\to K = 1$
- $\to \frac{\omega_0}{Q} = 0{,}7032 \to Q = 2{,}189$

$T_3(s)$
- $\to K = 1$
- $\to \omega_0^2 = 0{,}4221 \to \omega_0 = 0{,}6497$
- $\to \frac{\omega_0}{Q} = 0{,}2968 \to Q = 2{,}189$

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· Si en una configuración Ackerberg-Mossberg

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

$$W_0 = \frac{1}{C \cdot R_3} \quad ; \quad K = \frac{R_3}{R_1} \quad ; \quad Q = \frac{R_2}{R_3}$$

R_4 no influye y uso $\underline{R_Z} = R_3 \rightarrow R_3' = R_4' = 1$

si $K = \frac{R_3}{R_1} \rightarrow R_1' = \frac{1}{K}$; si $Q = \frac{R_2}{R_3} \rightarrow R_2' = Q$

si $W_0 = \frac{1}{C \cdot R_3} \rightarrow C' = \frac{1}{w_0}$