1

a) Necesitamos una H(s) que permita rotar fase de 1er orden sin alterar Módulo.

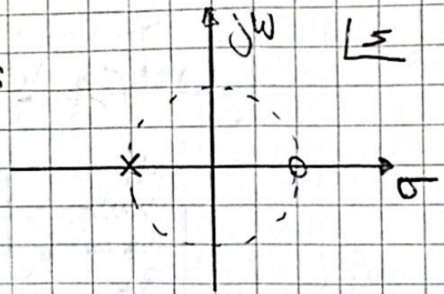
$$H(s) = \frac{s-\sigma}{s+\sigma} \longrightarrow \begin{cases} H(\omega \to 0) = -1 & \longleftrightarrow |H(0)| = 1 \text{ y } \theta(0) = \pi \\ H(\omega \to \infty) = 1 & \longleftrightarrow |H(\omega \to \infty)| = 1 \text{ y } \theta(\omega \to \infty) = 0 \end{cases}$$

$$\boxed{\theta(\omega) = \overset{\pi +}{Tg^{-1}}\left(\frac{\omega}{-\sigma}\right) - Tg^{-1}\left(\frac{\omega}{\sigma}\right) = \pi - 2\,Tg^{-1}\left(\frac{\omega}{\sigma}\right)} \longrightarrow$$

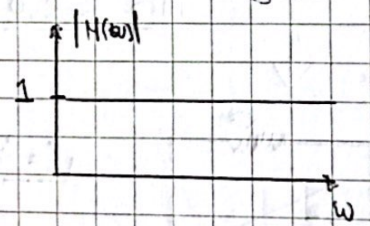
Recordar que debemos usar atan2(w)

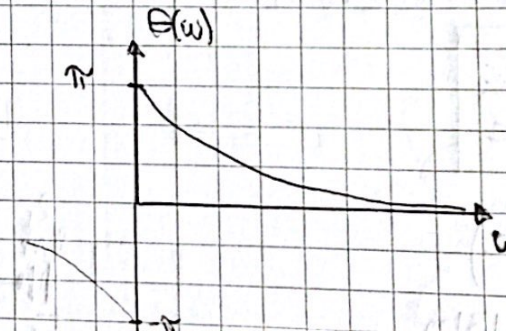
$$atan2(\omega) = \begin{cases} Tg^{-1}(\omega) & R > 0 \\ Tg^{-1}(\omega) + \pi & R < 0 \;\; Im \geq 0 \\ Tg^{-1}(\omega) - \pi & R < 0 \;\; Im < 0 \\ \pi/2 & R = 0 \;\; Im > 0 \\ -\pi/2 & R = 0 \;\; Im < 0 \\ \text{Indet.} & R = 0 \;\; Im = 0 \end{cases}$$

Diagrama de Polos y Ceros:



Respuesta en Módulo y fase





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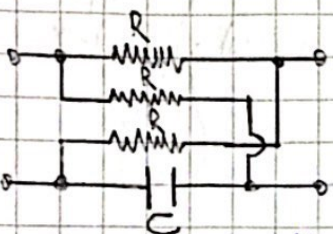
Retardo de grupo:

$$\tau(\omega) = -\frac{d\theta(\omega)}{d\omega} = \frac{d\left(2\,Tg^{-1}\left(\frac{\omega}{\sigma}\right)\right)}{d\omega} = 2\cdot\frac{1}{1+\frac{\omega^2}{\sigma^2}} = 2\cdot\frac{\sigma^2}{\omega^2+\sigma^2}$$

(b) Nos Piden Topologías Activas y Pasivas que Implementen $H(s)$ para lograr un desfasaje de $180° - 15° = \underline{165°}$ en $\underline{\omega = 1}$

Lattice



No Coincide 100%

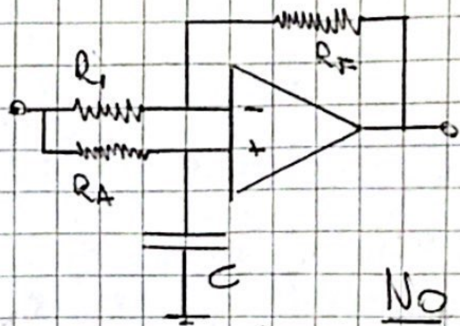
$$\boxed{H(s) = \frac{1}{2}\cdot\frac{s-1/RC}{s+1/RC}}$$

$165° = 180° - 2\,Tg^{-1}(RC)$

$RC = Tg\left(\frac{15°}{2}\right) = 131m$

Si $C = 1F \Rightarrow R = 131m\Omega$

Lattice Activo

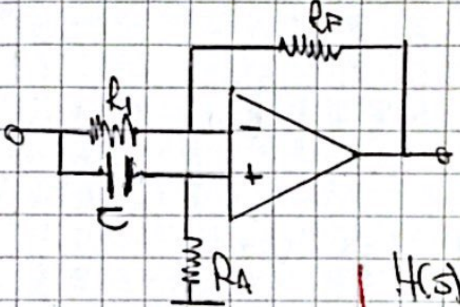


$K = R_F/R_1$

$$\boxed{H(s) = -K\,\frac{s-1/KR_AC}{s+1/R_AC}}$$

No sirve!

$\Downarrow$



$K = R_F/R_1$

$$\boxed{H(s) = K\cdot\frac{s-1/KR_AC}{s+1/R_AC}}$$

Tomamos $K = 1 \Rightarrow R_1 = R_F = 1$

Nuevamente $RC = 131m \Rightarrow C = 1$

$R_A = 131m$

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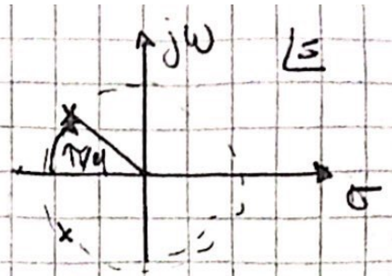
② a) $H_{LP}(\cancel{S}) = \dfrac{\omega_0^2}{\cancel{S}^2 + \cancel{S}\,\frac{\omega_0}{\sqrt{2}/2} + \omega_0^2}$



Supongamos lo Normalizado

$$\boxed{H_{LP}(\cancel{S}) = \frac{1}{\cancel{S}^2 + \cancel{S}\,\frac{2}{\sqrt{2}} + 1}}$$

$Q_p = \dfrac{1}{2\cos(\pi/4)} = \dfrac{\sqrt{2}}{2}$

$\cancel{S} = 1/s$

$$\boxed{H_{HP}(s) = \frac{1}{1/s^2 + 1/s\,\frac{2}{\sqrt{2}} + 1} = \frac{s^2}{s^2 + s\,\frac{2}{\sqrt{2}} + 1}}$$

En la Versión Desnormalizada:

$$\boxed{H_{HP}(s) = \frac{s^2}{s^2 + s\,\frac{1}{\omega_0}\,\frac{2}{\sqrt{2}} + \frac{1}{\omega_0^2}}}$$

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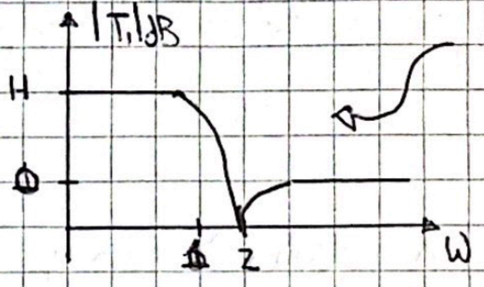
a) Filtro Notch Pasa Bajos



No quedo Bien el dibujo

Datos:

- $|T_1|(\omega \to \infty) = 1 \to$ sin Ganancia!
- $|T_1|(\omega \to 0) = H > 1$
- Cero de Tx en $\omega = 2$

Forma de $T_1(s)$:

$\cancel{\Omega_\omega = \frac{1}{\omega_{01}}}$ No voy a utilizar la Norma de Ω_{HP}.

Normalizado:

$$T_1(s) = \frac{s^2 + K^2\left(\frac{1}{\omega_0}\right)^2}{s^2 + s\left(\frac{1}{\omega_0}\right)\frac{2}{\sqrt{2}} + \frac{1}{\omega_0^2}} \longrightarrow \boxed{T_1(s) = \frac{s^2 + K^2}{s^2 + s\,\frac{2}{\sqrt{2}} + 1}}$$

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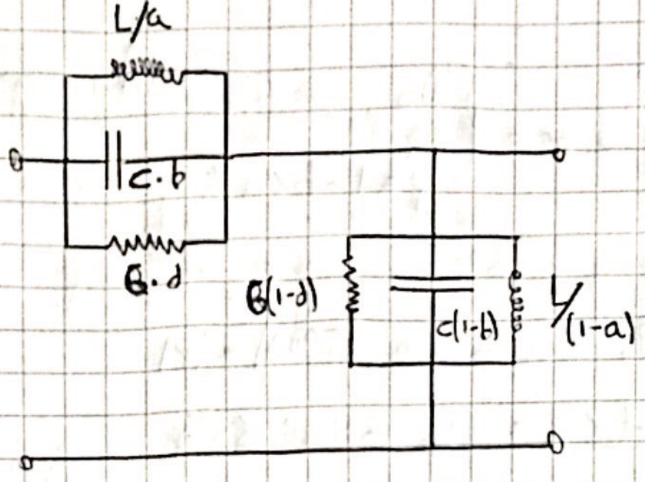


$$Y_1 = Gd + sCb + \frac{a}{sL} = \frac{s^2LCb + sLGd + a}{sL}$$

$$Y_2 = G(1-d) + sC(1-b) + \frac{(1-a)}{sL} =$$

$$Y_2 = \frac{s^2LC(1-b) + sLG(1-d) + (1-a)}{sL}$$

La ganancia es ≤ 1

$$\boxed{H(s) = \frac{Y_1}{Y_1+Y_2} = b \cdot \frac{s^2 + s\frac{G}{C}\cdot\frac{d}{b} + \frac{a}{LCb}}{s^2 + s\frac{G}{C} + \frac{1}{LC}} = b \cdot \frac{s^2 + s\left(\frac{1}{RC}\right)\frac{d}{b} + \frac{a}{b}\left(\frac{1}{LC}\right)}{s^2 + s\left(\frac{1}{RC}\right) + \frac{1}{LC}}}$$

Nuestra $T(s) = \frac{s^2 + k^2}{s^2 + s\frac{2}{\sqrt{2}} + 1} \Longrightarrow \underline{d=0}$ y $H(s) = b\,\frac{s^2 + \cancel{s(1/RC)\frac{d}{b}} + (1/LC)\frac{a}{b}}{s^2 + s(1/RC) + 1/LC}$

Si tomamos $\underline{C^\circ = 1} \Rightarrow \underline{L^\circ = 1}$ y $\underline{R^\circ = 0{,}707}$

Finalmente $\underline{a = 4 \cdot b}$ ya que para tener cero de Tx en $W=2 \Rightarrow \underline{k^\circ = 2}$

Si $\underline{b = 0{,}1} \Longrightarrow \underline{a = 0{,}4}$

$$\boxed{H(s) = 0{,}1 \cdot \frac{s^2 + 4}{s^2 + s\frac{2}{\sqrt{2}} + 1}}$$

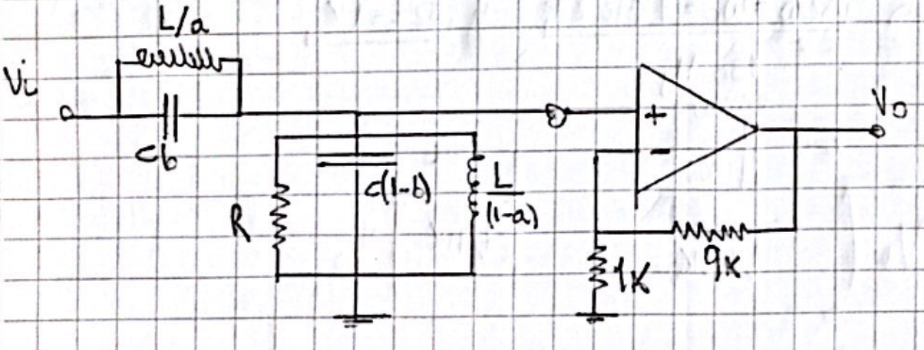
$H(\omega \to 0) = 0{,}4 \equiv -7{,}95\,dB$

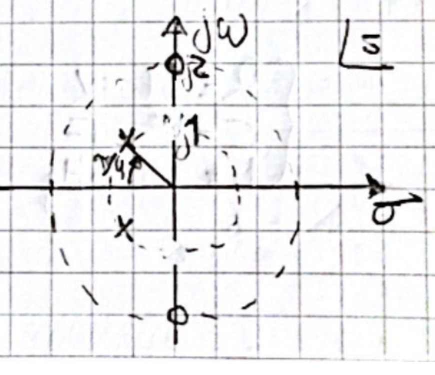
$H(\omega \to \infty) = 0{,}1 \equiv -20\,dB$

No se puede implementar con pasivos → Agregamos un No-inversor que gane 20dB.

Si desnormalizamos con $\Omega_Z = 1K$ y $\Omega_W = 2\pi \cdot 500\,Hz$:

$$\begin{cases} R = 0{,}707\,K\Omega \\ C = 0{,}32\,\mu F \\ L = 318\,mHy \end{cases} \rightarrow \begin{matrix} a = 0{,}4 \\ b = 0{,}1 \\ d = 0 \end{matrix}$$





(a2) Elimina Banda Normalizado (DIP)

Para Diseñar Un DIP Tenemos 3 parametros $\begin{cases} W_0 \\ Q \\ \rho = 1 - bKQ \neq 0 \end{cases}$ Para Ackerberg-Mossberg

En este Caso $Q = \sqrt{2}/2$ y $W_0 = 1$, así que solo podemos Tocar ρ para determinar la profundidad del DIP. Sabemos que $|T(w_0)| = |P|$

si $|T(w_0)| = -6dB \Rightarrow \underline{P = 1 - bKQ = 0,5}$

La Transferencia que necesitamos

$$H(s) = \frac{s^2 + s\frac{W_0}{Q} \cdot P + W_0^2}{s^2 + s\frac{W_0}{Q} + W_0^2} \quad \begin{cases} H(0) = 1 \\ H(w \to \infty) = 1 \\ H(w = w_0) = P = -6dB \end{cases}$$

$$\downarrow$$

$$\boxed{H(\$) = \frac{\$^2 + \$\, 1/Q \cdot P + 1}{\$^2 + \$\, 1/Q + 1}}$$ Transferencia Normalizada

(b) Utilizamos el mismo Circuito $\rightarrow H(s) = b \cdot \dfrac{s^2 + s(1/RC)\, d/b + \frac{a}{b}(1/LC)}{s^2 + s(1/RC) + (1/LC)}$

$$\begin{cases} W_0^2 = \dfrac{1}{LC} \\ Q = W_0 \cdot RC \end{cases}$$

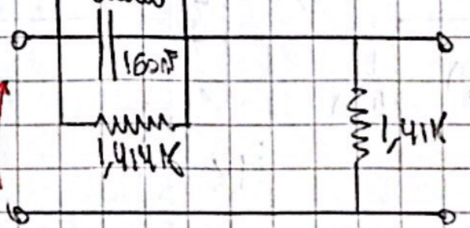
$\longrightarrow$ si $\underline{W_0^2 = 1} \Rightarrow \underline{L = 1}$ y $\underline{C = 1}$

Por Todo: $\underline{R = Q = 0,707}$

Ahora necesitamos: $\underline{a = b}$ y $\underline{\frac{d}{b} = 0,5} \Rightarrow \underline{a = b = 1}$, $\underline{d = 0,5}$

(c) Desnormalizamos Con $\underline{\Omega_W = W_0 = 1KHz \cdot 2\pi}$ y $\underline{\Omega_Z = 1K}$

$$\begin{cases} R = 0,707K \\ C = 160\,nF \\ L = 160\,mHy \end{cases}$$



③ Dada la siguiente Respuesta de Fase de una Transferencia:

$$\Theta(\omega) = \frac{\pi}{2} - Tg^{-1}\left(\frac{6\omega}{-\omega^2+4}\right)$$

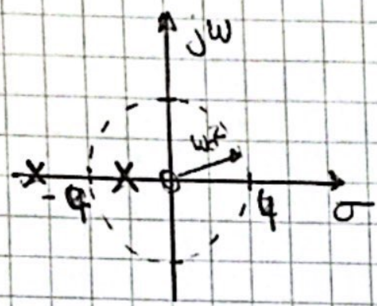
a) Obtener la expresión de H(s):

$$\Theta(\omega) = \alpha_z - \alpha_p \implies \alpha_z = \pi/2 \rightarrow \boxed{P(s) = s}$$

$$\hookrightarrow \alpha_p = Tg^{-1}\left(\frac{6\omega}{-\omega^2+4}\right) \rightarrow Q(\omega) = -\omega^2+4+j6\omega \rightarrow \boxed{Q(s) = s^2+6s+4}$$

$$\boxed{H(s) = \frac{s}{s^2+6s+4}} \rightarrow \omega_0 = 2 \text{ y } Q = 1/3 > 1/2 \rightarrow$$ No son Complejos Conjugados.

b)



$\cancel{Q = \frac{1}{2\cos(\psi)} \Rightarrow \cos(\psi) = \frac{3}{2} \Rightarrow \psi =}$

$$s_{1,2} = \frac{-6 \pm \sqrt{36-4\cdot4}}{2} = -3 \pm \sqrt{\frac{20}{4}} = \boxed{-3 \pm \sqrt{5}}$$

$\Theta(\omega \to 0) = \pi/2 \rightarrow$ Los Polos No aportan

$\Theta(\omega \to \infty) = -\pi/2 \rightarrow$ Los polos aportan $-\pi/2$ c/u.

c) Partimos del circuito con componentes levantados de masa:

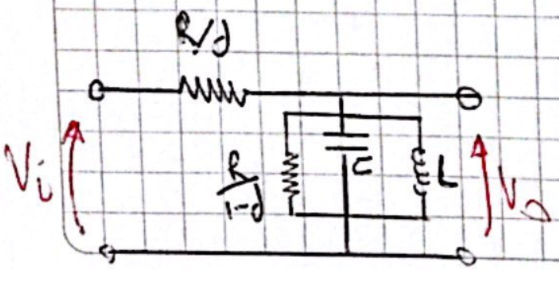
$$H(s) = b\,\frac{s^2 + s(1/RC)\,d/b + (1/LC)\,a/b}{s^2 + s(1/RC) + (1/LC)} = \frac{b\cdot s^2 + s(1/RC)\cdot d + (1/LC)\cdot a}{s^2 + s(1/RC) + (1/LC)}$$

con $b=0$ y $a=0$ $\implies$ $\boxed{H(s) = \frac{s(1/RC)\,d}{s^2 + s(1/RC) + (1/LC)}}$ $\rightarrow$

$1/RC = 6 \rightarrow C=1,\ R=1/6$

$1/LC = 4 \rightarrow L = 1/4$

$d(1/RC) = 1 \rightarrow d = 1/6$



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