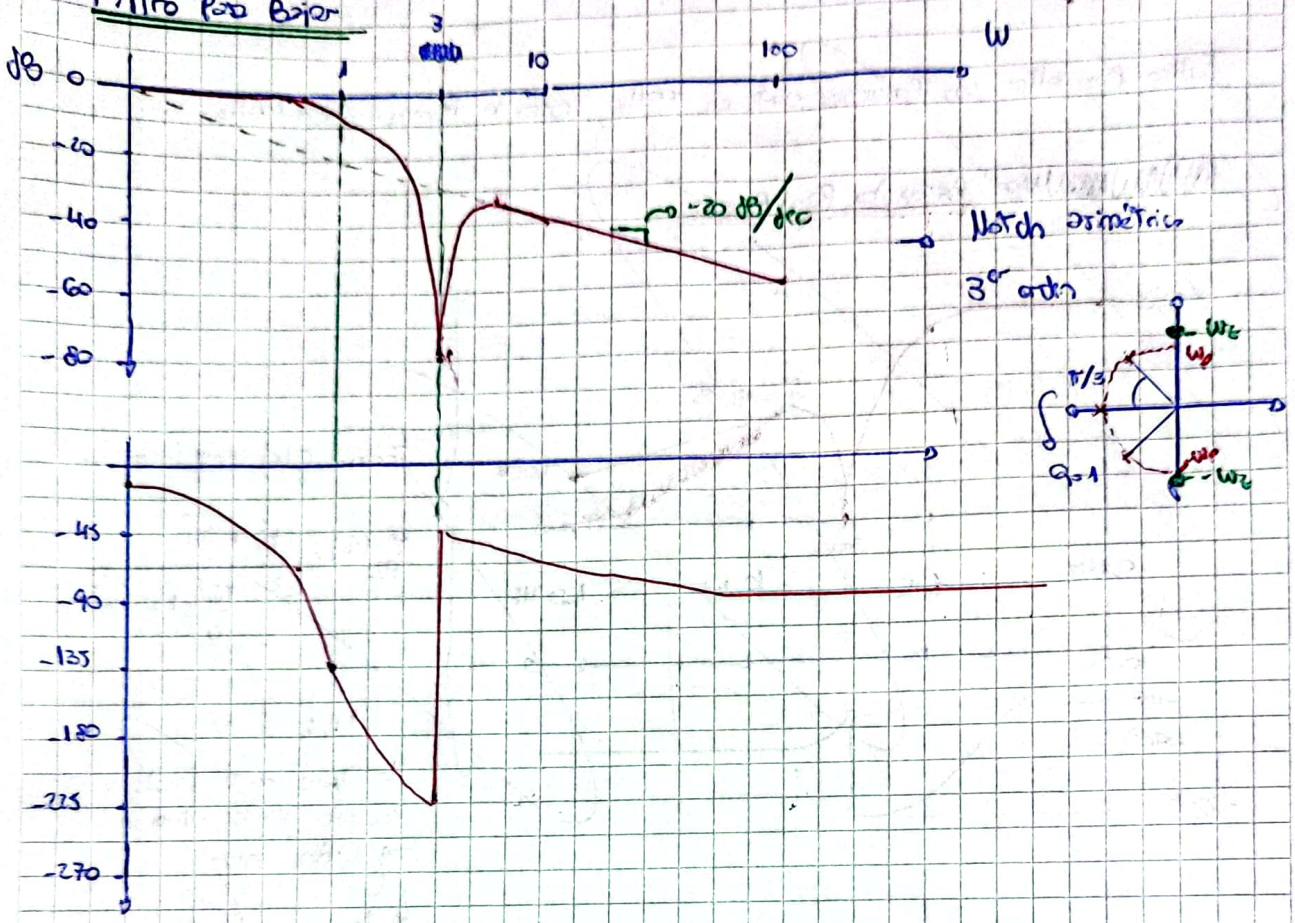
Tarea Semanal 5

Filtro Pasa Bajos



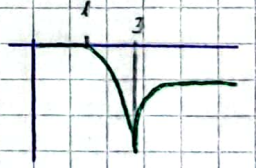
Fase de un Filtro notch asimétrico

$$T(\$) = \frac{(\$^2 + w_2^2)\cdot K}{\$^2 + \frac{w_0}{q}\cdot \$ + w_0^2}$$

$w_2 = 3$ → Agujero en $w = 3$

$K = \frac{1}{w_2^2}$ → Para asegurar 0dB en banda de paso

$Q = 1$ → Butter orden 3



Para hacer que caiga $-20\frac{dB}{dec}$ es necesario agregar un polo en $w = 1$

$$T(\$) = \frac{\$^2 + 3^2}{\$^2 + \ldots\$ + 1} \cdot \frac{1}{3^2} \cdot \frac{1}{1 + \$}$$

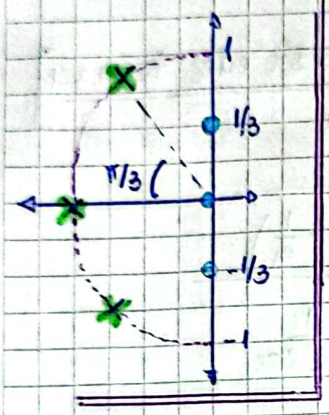
NOTA

Transformo a pasa alto → $k(\$) = 1/\$$

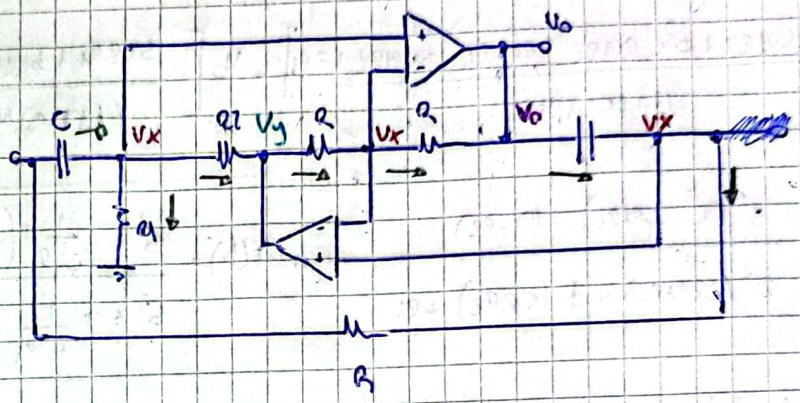
$$T_{HP}(\$) = \frac{(k(\$)^2 + 3^2)\,\$^2}{(k(\$)^2 + \;\cdot k(\$) + 1)\,\$^2} \cdot \frac{1}{3^2} \cdot \frac{1+\$}{(k(\$)+1)\,\$}$$

$$T_{HP}(\$) = \frac{(3^2\$^2 + \;1)\cdot 1/3^2}{1 + \;1.\;\$ + \$^2} \cdot \frac{\$}{\$+1} \Rightarrow \boxed{T_{HP}(\$) = \frac{\$^2 + 1}{\$^2 + \;\$ + 1} \cdot \frac{\$}{\$+1}}$$

PZ - H_{HP}



Implementación



① ② $(V_i - V_x)\,\$C = \frac{V_x}{R_1} + \frac{V_x - V_y}{R_2} \rightarrow V_i\,\$C = V_x\left(\frac{1}{R_1} + \frac{1}{R_2} + \$C\right) - \frac{V_y}{R_2}$

② ③ $\frac{V_y - V_o}{R} = \frac{V_x - V_o}{R} \rightarrow V_y = 2V_x - V_o$

③ $(V_o - V_x)\,\$C = \frac{V_x - V_i}{R}$

$V_o\,\$CR - V_x\,\$CR = V_x - V_i$

$V_o\,\$CR + V_i = V_x(1 + \$CR)$

$$V_x = V_o \cdot \frac{\$CR}{1+\$CR} + V_i \cdot \frac{1}{1+\$CR}$$

Reemplazo 3 en 2

$$V_y = V_o\left(\frac{2\,\$CR}{1+\$CR} - 1\right) + V_i \cdot \frac{2}{1+\$CR} = V_o\left(\frac{\$CR - 1}{\$CR + 1}\right) + V_i\left(\frac{2}{1+\$CR}\right)$$

NOTA

⑥ Reemplazo 2 y 3 en 1

$$V_i \cdot pC = V_x \cdot \frac{R_2+R_1+pCR_1R_2}{R_1R_2} - V_y \cdot \frac{1}{R_2}$$

$$\frac{(1+pCR_1)R_1R_2}{(1+pCR_1)R_1R_2}(V_i\, pC) = \left(V_o \cdot \frac{pCR_1}{1+pCR_1} + V_i \cdot \frac{1}{1+pCR_1}\right)\left(\frac{R_2+R_1+pCR_1R_2}{R_1R_2}\right) + \left(-\frac{V_o \cdot pCR_1 - 1}{R_2(1+pCR_1)} + V_i \cdot \frac{2}{(1+pCR_1)R_2}\right)\cdot\frac{1}{R_2}$$

$$V_i\left[pC \cdot \frac{(1+pCR_1)R_1R_2}{(1+pCR_1)R_1R_2} - \frac{1}{1+pCR_1}\,\frac{R_2+R_1+pCR_1R_2}{R_1R_2} + \frac{2R_1}{(1+pCR_1)R_2R_1}\right] = V_o\left(\frac{pCR_1}{1+pCR_1}\,\frac{R_1+R_2+pCR_1R_2}{R_1R_2} + \frac{(pCR_1+1)R_1}{(1+pCR_1)R_2R_1}\right)$$

$$V_i\left[\frac{pCR_1R_2 + p^2C^2RR_1R_2 - R_1 - R_2 - pCR_1R_2 + 2R_1}{(1+pCR_1)R_1R_2}\right] = V_o\left[\frac{pCRR_1 + pCRR_2 + p^2C^2RR_1R_2 - pCRR_1 + R_1}{(1+pCR_1)R_1R_2}\right]$$

$$\frac{V_o}{V_i} = \frac{p^2(C^2RR_1R_2) + (R_1-R_2)}{p^2(CRR_1R_2) + p(CRR_2) + R_1} \longrightarrow T(p) = \frac{p^2 + \frac{1}{C^2R}\left(\frac{1}{R_2}-\frac{1}{R_1}\right)}{p^2 + p\frac{1}{CR_1} + \frac{1}{C^2RR_2}}$$

⑦ Adopto valores igualando términos

↳ Etapa segundo orden

$$\frac{p^2 + (1/3)^2}{p^2 + [illegible]\, p + 1} = \frac{p^2 + \frac{1}{C^2R}\left(\frac{1}{R_2}-\frac{1}{R_1}\right)}{p^2 + p\cdot\frac{1}{CR_1} + \frac{1}{C^2R_2R}}$$

⑧ Adopto $C = 1$

$$\frac{1}{9} = \frac{1}{C^2R}\left(\frac{1}{R_2}-\frac{1}{R_1}\right) \to \frac{1}{9} = R_2\left(\frac{1}{R_2}-\frac{1}{R_1}\right) \to R_2 = 1 - 1/9 = 8/9$$

$$\to R = 9/8$$

$$1 = \frac{1}{CR_1} \to R_1 = 1 = R$$

$$1 = \frac{1}{C^2R_2 \cdot R} \to 1 = \frac{1}{R_2 \cdot R} \to R = \frac{1}{R_2}$$

Desnormalización

$R_{real} = R_z \cdot R$

$C_{real} = \frac{1}{R_z \cdot \Omega_w} \cdot C$

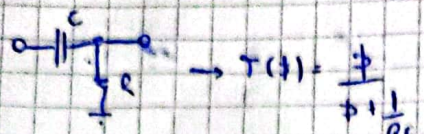
$L_{real} = \frac{R_z}{\Omega_w} \cdot L$

NOTA

HOJA N°

FECHA

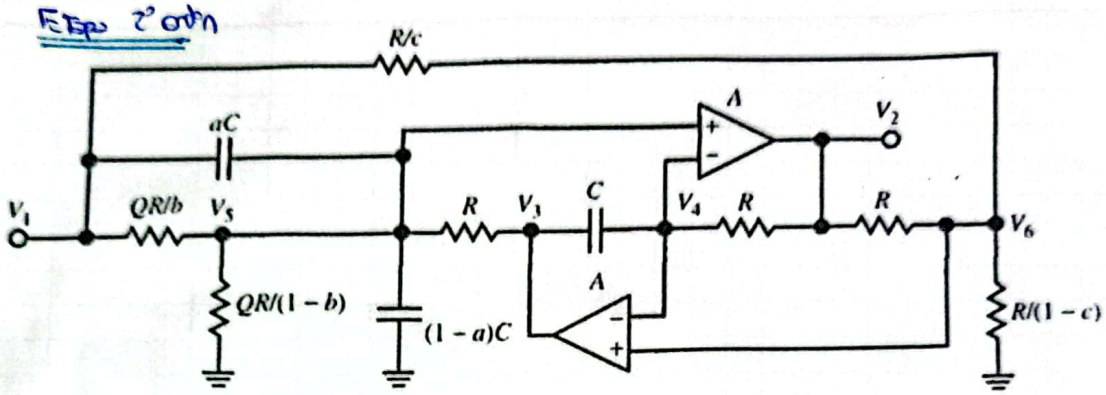
Etapa Primer Orden



$\rightarrow T(s) = \frac{s}{s + \frac{1}{RC}} \rightarrow \frac{1}{RC} = 1 \rightarrow R = 1$, $C = 1$

Implementación Schauman

Etapa 2° orden



$2a - c = 1$ $\quad 2b - c = 0$ $\quad = \frac{1}{9}\omega_0^2 \rightarrow c = 1/9$

$a = \frac{c+1}{2}$ $\quad 2b = c$

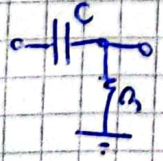
$$T(s) = \frac{V_2}{V_1} = \frac{s^2(2a - c) + s(\omega_0/Q)(2b - c) + c\omega_0^2}{s^2 + s\omega_0/Q + \omega_0^2}$$

$a = 5/9$ $\quad Q = 1$

$b = 1/18$ $\quad \omega_0 = 300.2\pi\,Hz = \frac{1}{R \cdot C}$

$c = 1/9$

Etapa 1° Orden



$\frac{1}{RC} = \omega_0 \rightarrow R = R$, $C = C$ } parámetros de la otra etapa

NOTA