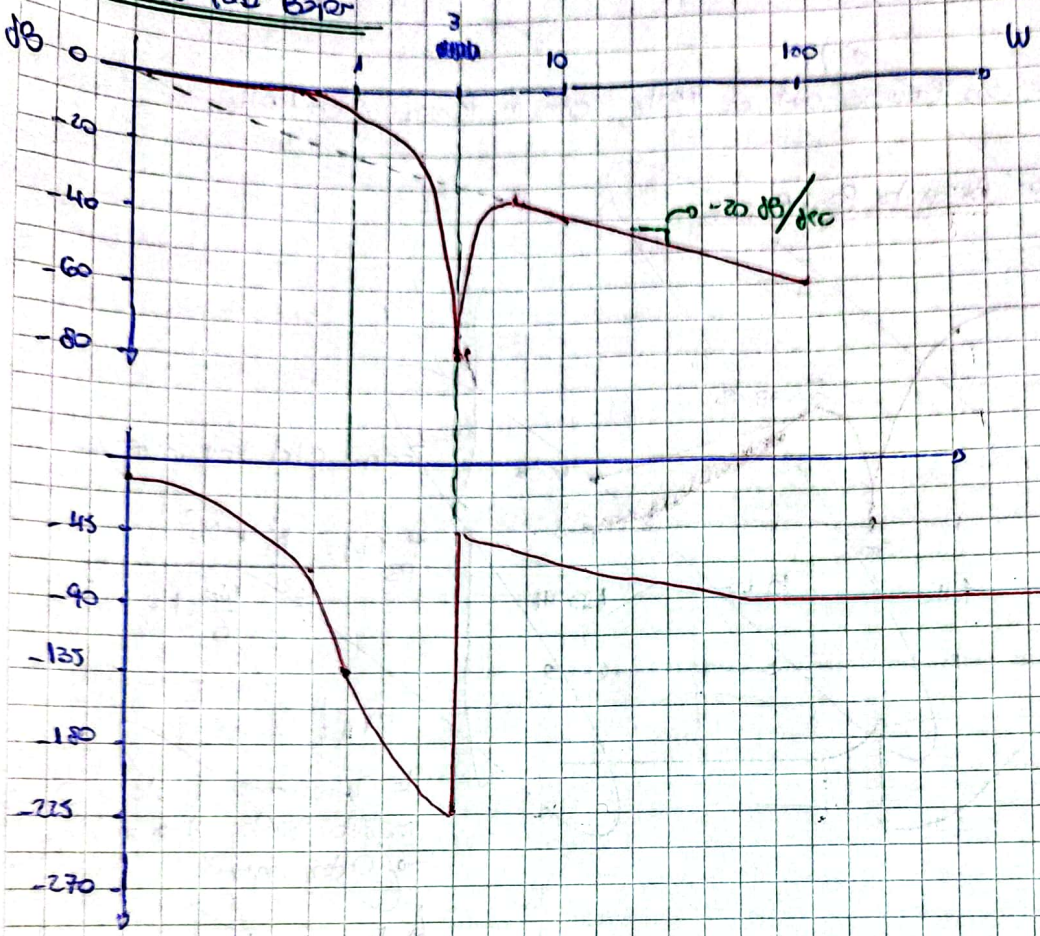
Tarea Semanal 5

Filtro Pasa Bajos



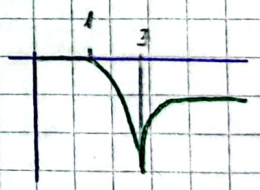
Parte de un Filtro pasa banda simétrico

$$T(\$) = \frac{(\$^2 + w_z^2)\cdot k}{\$^2 + \frac{w_0}{Q}\cdot \$ + w_0^2}$$

$w_z = 3$ → Aguja en $w = 3$

$k = \frac{1}{w_z^2}$ → Para ajustar 0dB en banda de paso

$Q = \frac{\sqrt{2}}{2}$ → Butter



Para hacer que caiga -20dB/dec es necesario agregar un polo en w = 1

$$T(\$) = \frac{\$^2 + w_3^2}{\$^2 + \sqrt{2}\cdot \$ + 1} \cdot \frac{1}{3^2} \cdot \frac{1}{1 + \$}$$

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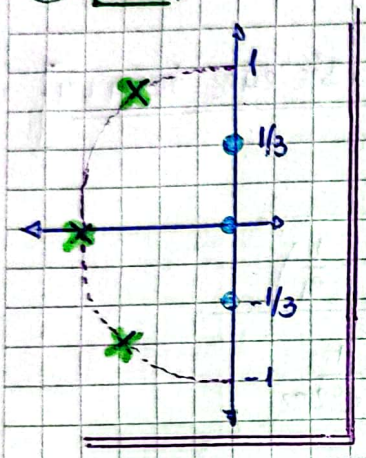
(*) Transformo a pasa alto → $k(\$) = 1/\$$

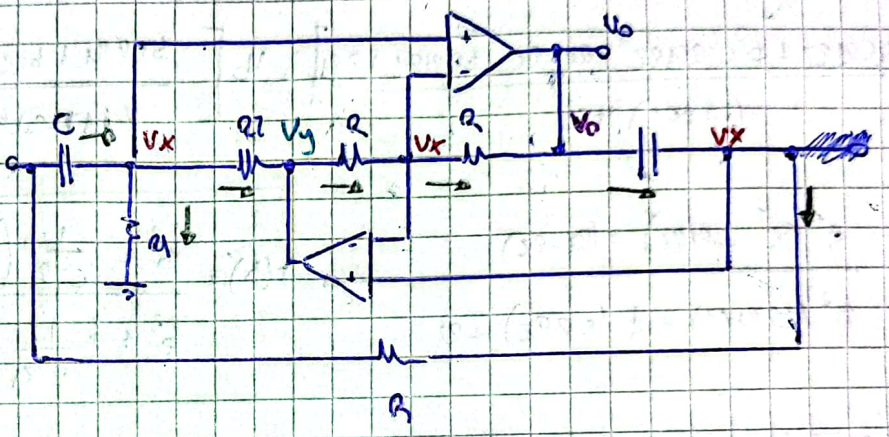
$$T_{HP}(\$) = \frac{(k(\$)^2 + 3^2)\,\$^2}{(k(\$)^2 + \sqrt{2}\cdot k(\$) + 1)\,\$^2} \cdot \frac{1}{3^2} \cdot \frac{1+\$}{(k(\$)+1)\,\$}$$

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

(*) Pz-Nbp



(*) Implementación



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

(2) (*) $\frac{V_y - V_o}{R} = \frac{V_x - V_o}{R} \rightarrow V_y = 2V_x - V_o$

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

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

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

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

Ejemplo 3 en 2

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

④ **Reemplazo 2 y 3 en 1**

$$V_i \cdot sC = V_x \cdot \frac{R_2+R_1+sCR_1R_2}{R_1R_2} - V_y \cdot \frac{1}{R_2}$$

$$\frac{(1+sCR_2)R_1R_2}{(1+sCR_2)R_1R_2}(V_i \cdot sC) = \left(V_0 \cdot \frac{sCR}{1+sCR} + V_i \cdot \frac{1}{1+sCR_2}\right)\left(\frac{R_2+R_1+sCR_1R_2}{R_1R_2}\right) + \left(-V_0 \cdot \frac{sCR-1}{R_2(1+sCR)} + V_i \cdot \frac{2}{(1+sCR)R_2}\right)\cdot\frac{1}{R_2}$$

$$V_i\left[sC \cdot \frac{(1+sCR_2)R_1R_2}{(1+sCR_2)R_1R_2} - \frac{1}{1+sCR_2}\,\frac{R_2+R_1+sCR_1R_2}{R_1R_2} + \frac{2R_1}{(1+sCR)R_2R_1}\right] = V_0\left(\frac{sCR}{1+sCR}\,\frac{R_1+R_2+sCR_1R_2}{R_1R_2} + \frac{(sCR-1)R_1}{(1+sCR)R_2R_1}\right)$$

$$V_i\left[\frac{sCR_1R_2 + s^2C^2RR_1R_2 - R_1 - R_2 - sCR_1R_2 + 2R_1}{(1+sCR)R_1R_2}\right] = V_0\left[\frac{sCRR_1 + sCRR_2 + s^2C^2RR_1R_2 - sCR_1 + R_1}{(1+sCR_2)R_1R_2}\right]$$

$$\frac{V_0}{V_i} = \frac{s^2(C^2RR_1R_2) + (R_1-R_2)}{s^2(CRR_1R_2) + s(CRR_2) + R_1} \longrightarrow T(s) = \frac{s^2 + \frac{1}{C^2R}\left(\frac{1}{R_2} - \frac{1}{R_1}\right)}{s^2 + s\frac{1}{C\cdot R_1} + \frac{1}{C^2RR_2}}$$

⑤ **Adopto valores igualando términos**

↳ Etapa segundo orden

$$\frac{s^2 + (1/3)^2}{s^2 + \sqrt{2}\cdot s + 1} = \frac{s^2 + \frac{1}{C^2R}\left(\frac{1}{R_2} - \frac{1}{R_1}\right)}{s^2 + s\cdot\frac{1}{CR_1} + \frac{1}{C^2R_2R}}$$

④ Adopto $C = 1$

$$\frac{1}{9} = \frac{1}{C^2R}\left(\frac{1}{R_2} - \frac{1}{R_1}\right) \longrightarrow \frac{1}{9} = R_2\left(\frac{1}{R_2} - \frac{1}{R_1}\right) \longrightarrow R_2 = \frac{1-1/9}{\sqrt{2}} = 0{,}62854$$

$$\longrightarrow R = 1{,}59099$$

$$\sqrt{2} = \frac{1}{CR_1} \longrightarrow R_1 = \frac{\sqrt{2}}{2} = R = 0{,}7071$$

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

Desnormalización

$$R_{REAL} = \Omega_t \cdot R$$

$$C_{REAL} = \frac{1}{\Omega_t \cdot \Omega_W} \cdot C$$

$$L_{REAL} = \frac{\Omega_t}{\Omega_W} \cdot L$$

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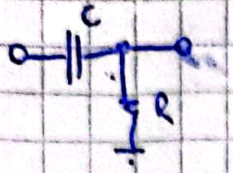
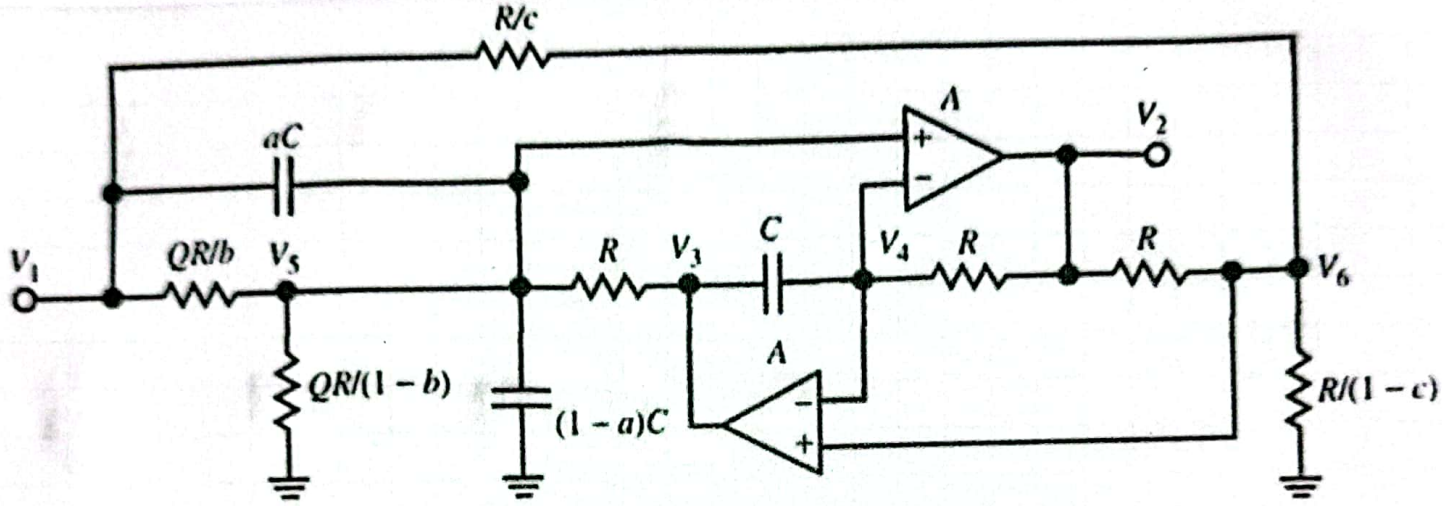
4. Etapa Primer Orden



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

$C = 1$

5. Implementación Schowmann



$2a - c = 1$

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

$2b - c = 0$

$2b = c$

$= \frac{1}{9}\omega_0^2 \rightarrow c = 1/9$

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

$a = 5/9$ $\quad Q = 0{,}70711$

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

$c = 1/9$