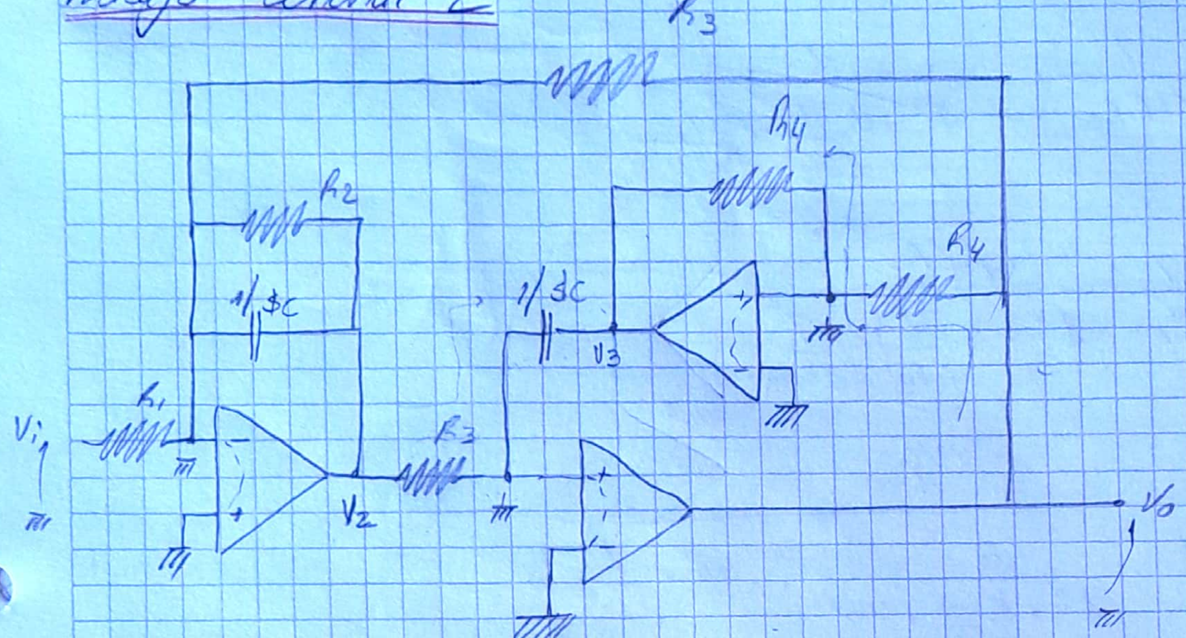
FECHA

Trabajo Semanal 2



1) Cálculo de Transferencia $T = \frac{V_o}{V_i}$, en función de ω_0 y Q.

$$V_i \cdot G_1 + V_2 (sC + G_2) + V_o \cdot G_3 = 0$$

$$V_2 \cdot G_3 = -V_3 \cdot sC \;;\; V_2 = -\frac{sC}{G_3} \cdot V_3 \quad (2)$$

$$V_o \cdot \cancel{G_4} = -V_3 \cdot \cancel{G_4} \;;\; V_3 = -V_o \quad (3)$$

(3) en (2) → $V_2 = +\frac{sC}{G_3} \cdot +V_o \quad (4)$

(4) en (1) → $V_i \cdot G_1 + \frac{sC}{G_3} \cdot V_o (sC + G_2) + V_o \cdot G_3 = 0$

$$V_i G_1 + V_o \left(\frac{s^2 C^2}{G_3} + sC \frac{G_2}{G_3} + G_3 \right) = 0$$

$$V_i G_1 + V_o \frac{s^2 C^2 + sC G_2 + G_3^2}{G_3} = 0$$

$$\frac{V_o}{V_i} = -\frac{G_1 G_3}{s^2 C^2 + sC G_2 + G_3^2}$$

NOTA

$$T(s) = \frac{V_o}{V_i} = \frac{-G_1 G_3}{s^2 C^2 + s C G_2 + G_3^2} = \frac{-G_1 G_3}{C^2\left(s^2 + s \cdot \frac{G_2}{C} + \frac{G_3^2}{C^2}\right)}$$

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

$$T(s) = \frac{-1}{CR_1} \cdot \frac{\overbrace{1/CR_3}^{\omega_0}}{s^2 + s.\underbrace{\frac{1}{CR_2}}_{\omega_0/\varphi} + \underbrace{\frac{1}{C^2 R_3^2}}_{\omega_0^2}} \; ; \; \frac{\omega_0}{\varphi}$$

$$\boxed{T(s) = -\frac{1}{CR_1} \cdot \frac{\omega_0}{s^2 + s \frac{\omega_0}{\varphi} + \omega_0^2} \; ; \; \omega_0 = \frac{1}{CR_3}} \; ;$$

2) $\omega_0 = \frac{1}{C.R_3}$, $\omega_0 = 1 \Rightarrow 1 = \frac{1}{CR_3}$, $\boxed{C = \frac{1}{R_3}}$

$\frac{\omega_0}{\varphi} = \frac{1}{CR_2}$, $\omega_0 = 1, \varphi = 3 \Rightarrow \frac{1}{3} = \frac{1}{CR_2}$; $R_2 = \frac{3}{C} = \frac{3}{\frac{1}{R_3}} \Rightarrow R_2 = 3R_3$

$\Rightarrow \boxed{C = \frac{1}{R_3} \; ; \; R_2 = 3R_3}$

Asignando $R_3 = 1$

$\Rightarrow \boxed{C = 1 \text{ y } R_2 = 3}$

3) $|T(0)| = 20dB$; $|T(0)|_{dB} = 20\log(|T(0)|)$,

$|T(0)| = 10^{\frac{|T(0)|_{dB}}{20}} = 10^{\frac{20}{20}} \Rightarrow \underline{|T(0)| = 10}$,

$|T(0)| = \frac{1}{C.R_1} \cdot \frac{1}{\omega_0} = \frac{1}{C.R_1} \cdot \frac{1}{\frac{1}{C.R_3}}$; $|T(0)| = \frac{R_3}{R_1}$; $R_1 = \frac{R_3}{|T(0)|}$

$\Rightarrow \boxed{R_1 = \frac{R_3}{10}}$, $si\ R_3 = 1 \Rightarrow \boxed{R_1 = \frac{1}{10}}$

FECHA

Bonus

4) $T(\$) = \frac{-1}{C R_1} \cdot \frac{w_0}{\$^2 + \$ \frac{w_0}{\varphi} + w_0^2} \cdot \frac{R_3}{R_3}$

$\therefore T(\$) = \frac{R_3}{R_1} \cdot \frac{w_0^2}{\$^2 + \$ \frac{w_0}{\varphi} + w_0^2} = \frac{-k \cdot w_0^2}{\$^2 + \$ \cdot \frac{w_0}{\varphi} + w_0^2}$

$\Rightarrow$ ① $w_0 = \frac{1}{C R_3}$

② $\frac{w_0}{\varphi} = \frac{1}{C R_2}$

③ $k = \frac{R_3}{R_1}$

Normalizo con $\Omega_R = R_3$ y $\Omega_w = w_0$

$w_0 = 1$ y $R_3 = 1$

$\therefore$ ① $\Rightarrow 1 = \frac{1}{C} \Rightarrow C = 1$

② $\Rightarrow \frac{1}{\varphi} = \frac{1}{C \cdot R_2} = \frac{1}{1 \cdot R_2} \Rightarrow R_2 = \varphi$

③ $\Rightarrow k = -\frac{1}{R_1} \Rightarrow R_1 = \frac{-1}{k}$

R4 no participa en la transferencia, le asigno arbitrariamente

$R_4 = R_3 = 1$

La red Normalizada en impedancia y frecuencia queda

$R_1 = 1/k$ $C = 1$

$R_2 = Q$

$R_3 = 1$

$R_4 = 1$

e implementa la transferencia

$T(\$) = \frac{-k}{\$^2 + \$ \frac{1}{\varphi} + 1}$

NOTA

5) Cálculo de Sensibilidades

$$\omega_0 = \frac{1}{CR_3} \; ; \; S_C^{\omega_0} = \frac{C}{\omega_0} \cdot \frac{\partial \omega_0}{\partial C} = \frac{\cancel{C}}{\omega_0} \cdot \frac{\phi - R_3}{C^2 R_3^2} = \frac{-1}{\omega_0} \cdot \frac{1}{CR_3} = -\frac{1}{\omega_0} \cdot \omega_0$$

$$\Rightarrow \boxed{S_C^{\omega_0} = -1}$$ Quiere decir que si $C \uparrow$, $\omega_0 \downarrow$ (Inversamente proporcional)

$$\frac{\omega_0}{\varphi} = \frac{1}{CR_2} \; ; \; \frac{1}{\varphi} \cdot \frac{1}{\cancel{C}R_3} = \frac{1}{\cancel{C}R_2} \; ; \; \varphi = \frac{R_2}{R_3}$$

$$S_{R_2}^{\varphi} = \frac{R_2}{\varphi} \cdot \frac{\partial \varphi}{\partial R_2} = \frac{R_2}{\varphi} \cdot \frac{1}{R_3} = \frac{\varphi}{\varphi} = 1$$

$$\Rightarrow \boxed{S_{R_2}^{\varphi} = 1}$$ Quiere decir que si $R_2 \uparrow$, $\varphi \uparrow$ (Directamente proporciona

$$S_{R_3}^{\varphi} = \frac{\varphi}{R_3} \cdot \frac{\partial \varphi}{\partial R_3} = \frac{\varphi}{R_3}.$$

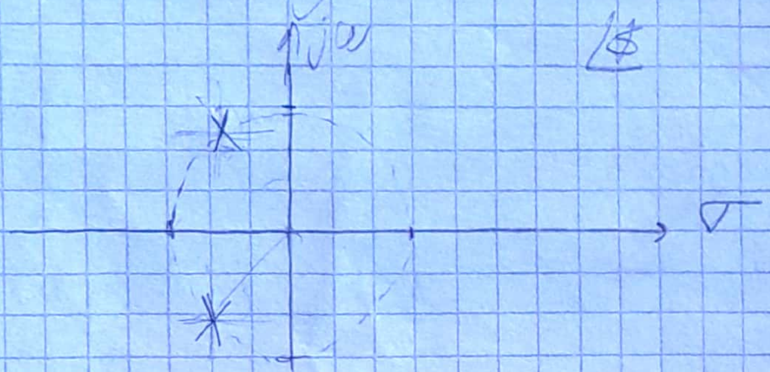
$$S_{R_3}^{\varphi} = \frac{R_3}{\varphi} \cdot \frac{\partial \varphi}{\partial R_3} = \frac{R_3}{\varphi} \cdot \frac{-R_2}{R_3^2} = \frac{-\varphi}{\varphi} = -1$$

$$\Rightarrow \boxed{S_{R_1}^{\varphi} = -1}$$: Inversamente proporcional

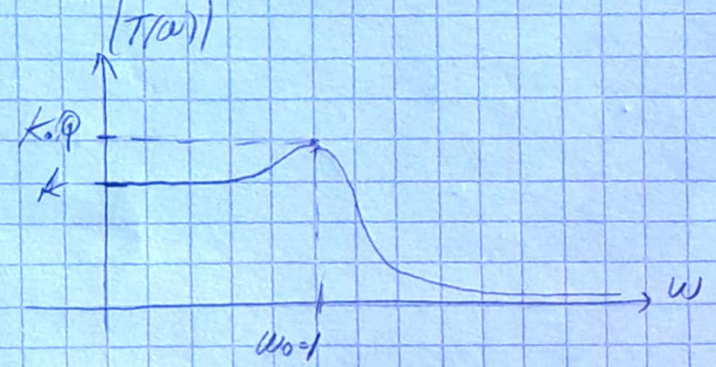
Anexo: Respuesta de módulo y fase aproximada del Pasabajos

A partir de la transferencia normalizada ?,

$$T(s) = \frac{-K}{s^2 + s\cdot\frac{1}{Q} + 1}$$



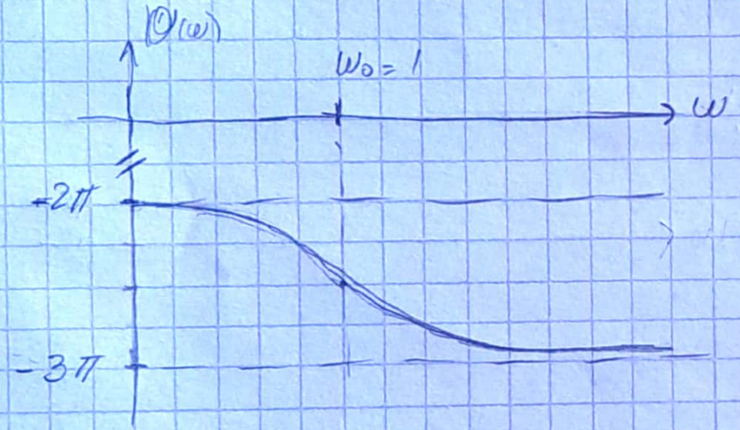
$$|T(\omega)| = \left|T(s)|_{s=j\omega}\right| = \frac{|-K|}{\left|(1-\omega^2) + j\frac{\omega}{Q}\right|}$$



$$|T(\omega)|_{\omega=0} = K$$

$$|T(\omega)|_{\omega=\omega_0=1} = K.Q$$

$$|T(\omega)|_{\omega\to\infty} = 0$$



$$\theta(\omega)|_{\omega=0} = \underbrace{0}_{\text{ceros}} - \underbrace{2\pi}_{\text{polos}}$$

$\theta(\omega)|_{\omega=0}$ = Mitad de excursión

$$\theta(\omega)|_{\omega\to\infty} = \underbrace{-3\pi}_{\text{polos}} = -3\pi$$

X