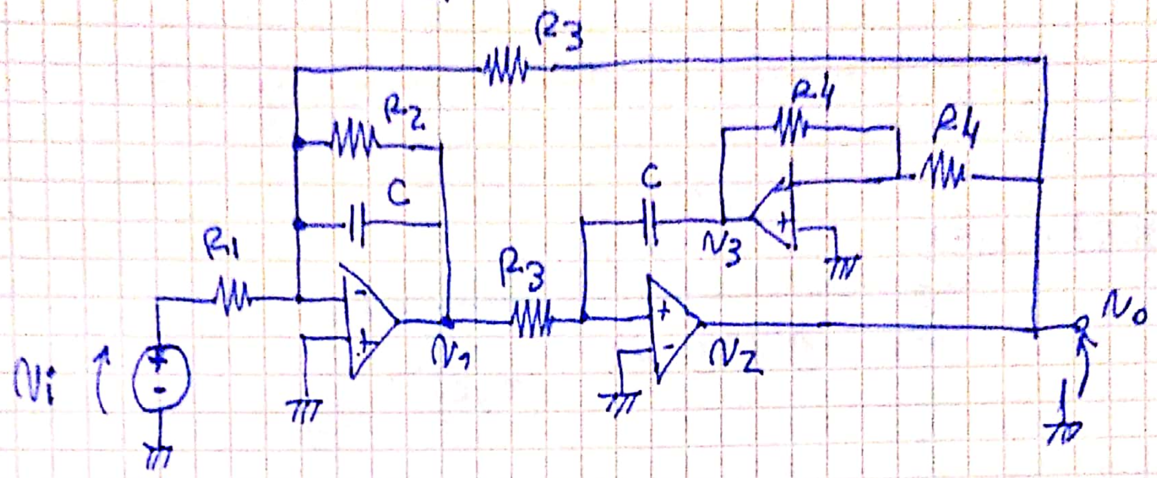
① Hallar transferencia



- $V_i\, G_1 + V_1\, SC + V_1\, G_2 + V_2\, G_3$

- $V_1 \cdot G_3 + V_3\, SC = 0$

- $(V_2 \cdot G_4 + V_3\, G_4) = 0$.

- $V_2 = V_o$.

$\therefore\; V_3 = -V_o \dfrac{G_4}{G_4} = -V_o$.

$V_1 = -V_3 \dfrac{SC}{G_3} = +V_o \dfrac{SC}{G_3}$.

$\therefore\; V_o \left(\dfrac{(SC)^2}{G_3} + \dfrac{G_2}{G_3} \cdot SC + G_3 \right) = -V_i\, G_1$.

$$H(s) = -\frac{G_1}{G_3} \cdot \frac{G_3}{\frac{(SC)^2}{G_3} + \frac{G_2}{G_3} SC + G_3}$$

$$\boxed{H(s) = -\frac{G_1}{G_3} \cdot \frac{G_3^2/C^2}{s^2 + s\frac{G_2}{C} + \frac{G_3^2}{C^2}}}$$

$\therefore$ y

$$H(s) = -\frac{R_3}{R_1} \cdot \frac{1/(R_3C)^2}{s^2 + s\frac{1}{R_2C} + \frac{1}{(R_3C)^2}}$$

$\therefore$ $K = -\frac{R_3}{R_1}$ $\quad W_0 = \frac{1}{R_3C}$ $\quad \frac{W_0}{Q} = \frac{1}{R_2C}$.

$$\rightarrow Q = \frac{R_2C}{W_0^{-1}} = \frac{R_2C}{(1/R_3C)^{-1}} = \frac{R_2}{R_3}$$

$$\boxed{K = -\frac{R_3}{R_1} \quad W_0 = \frac{1}{R_3C} \quad Q = \frac{R_2}{R_3}}$$

$\rightarrow$ Parametrizo los valores $\quad R_3 = R = R_4$

$\therefore$

- $R_1 = \frac{R}{K}$

- $R_2 = Q \cdot R$.

- $C = \frac{1}{W_0 R}$.

NOTA

HOJA Nº

FECHA

Si $w_0 = 1$, $Q = 3$.

- $R_1 = \frac{R}{K} = \frac{R}{10}$
- $R_2 = QR = 3R$
- $R_3 = R$
- $R_4 = R$
- $C = \frac{1}{w_0 R} = \frac{1}{R}$

Si $R = 1\Omega \rightarrow$
- $R_1 = 0{,}1\Omega$
- $R_2 = 3\Omega$
- $R_3 = 1\Omega$
- $R_4 = 1\Omega$
- $C = 1F$.

- Sensibilidad.
- Butterworth

$\rightarrow$ Si $V_6 = V_1$.

$$V_i\, G_1 + V_0\, SC + V_0\, G_2 + \frac{V_0\, G_3^2}{SC}$$

$$SC\, V_i\, G_1 = -V_0\left((SC)^2 + G_2 SC + G_3^2\right).$$

$$H(S) = \frac{-SCG_1}{(SC)^2 + G_2 SC + G_3^2} = \frac{-\frac{G_1}{C} \cdot S}{S^2 + S\frac{G_2}{C} + \frac{G_3^2}{C^2}}$$

$$\boxed{H(S) = -\frac{G_1}{G_2} \cdot \frac{G_2/C\; S}{S^2 + S\,G_2/C + G_3^2/C^2}}$$

NOTA

$$H(s) = K \frac{Q S}{S^2 + Q S + \omega_0^2}$$

$\rightarrow K = -\frac{R_2}{R_1}$ $\omega_0 = \frac{1}{R_3 C}$ $Q = \frac{R_2}{R_3}$

ω_0 y Q del filtro se mantienen. Salvo a K.
que pasa de $-\frac{R_3}{R_1}$ a $-\frac{R_2}{R_1}$

- Sensibilidad

$$S_{C}^{\omega_0} = \frac{C}{\omega_0}\frac{\partial \omega_0}{\partial C} = \frac{\cancel{C}}{\frac{\cancel{G_3}}{\cancel{C}}\cancel{\sqrt{\frac{G_4}{G_5}}}} \cdot (-1)\frac{\cancel{G_3}}{\cancel{C^2}}\cancel{\sqrt{\frac{G_4}{G_5}}}$$

$$S_{C}^{\omega_0} = -1$$

$$S_{R_2}^{Q} = \frac{R_2}{Q}\frac{\partial Q}{\partial R_2} = \frac{\cancel{R_2}}{\cancel{G_3}\cancel{R_2}\cancel{\sqrt{\frac{G_4}{G_5}}}} \cancel{G_3}\cancel{\sqrt{\frac{G_4}{G_5}}} = 1$$

$$S_{R_3}^{Q} = \frac{R_3}{Q}\frac{\partial Q}{\partial R_3} = \frac{\cancel{R_3}}{\cancel{\sqrt{\frac{G_4}{G_5}}}\cdot\frac{\cancel{1}}{\cancel{G_2 R_3}}} \cancel{\sqrt{\frac{G_4}{G_5}}}\cdot\frac{1}{\cancel{G_2}}(-1)\cdot\frac{\cancel{1}}{\cancel{R^3}} = -1$$

NOTA

• Recalcular para Butterworth

$$|H(w)|^2 = H(w) \cdot H^*(w) = \left|\frac{-1}{-w^2 + \frac{jw}{Q} + 1}\right|^2 = \left(\frac{1}{\sqrt{\left(\frac{w}{Q}\right)^2 + (1-w^2)^2}}\right)^2$$

$$|H(w)|^2 = \frac{1}{\frac{w^2}{Q^2} + 1^2 - 2w^2 + w^4} = \frac{1}{1 + w^4 + w^2\left(\frac{1}{Q^2} - 2\right)}$$

Para ser Butterworth $\boxed{1/Q^2 - 2 = 0}$ $\Rightarrow Q = \frac{\sqrt{2}}{2}$

~~$Q^{-1} = 4 \rightarrow Q = 1/4$. graficar~~

CamScanner