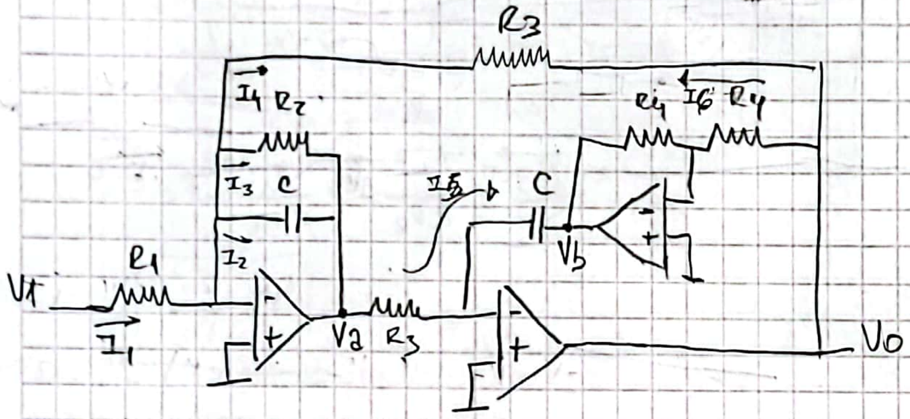
TS2

HOJA Nº 1

FECHA




$$I_1 = I_2 + I_3 + I_4$$

$$I_1 = \frac{V_1}{R_1}$$

$$I_2 = -V_a\, Sc$$

$$I_3 = \frac{-V_a}{R_2}$$

$$I_4 = \frac{-V_0}{R_3}$$

$$I_5 = \underbrace{\frac{V_a}{R_3} = -V_b Sc}\ \Rightarrow\ V_b = -\frac{V_a}{SCR_3} \ ;\ V_0 = -V_b \Rightarrow V_0 = \frac{V_a}{SCR_3} \rightarrow V_a = V_0\, SCR_3$$

$$\frac{V_1}{R_1} = -V_a Sc - \frac{V_a}{R_2} - \frac{V_0}{R_3}$$

$$\frac{V_1}{R_1} = -V_0\, SCR_3 \cdot Sc - \frac{V_0\, SCR_3}{R_2} - \frac{V_0}{R_3}$$

$$\frac{V_1}{R_1} = -V_0\left(S^2C^2R_3 + \frac{SCR_3}{R_2} + \frac{1}{R_3}\right)$$

$$\frac{V_0}{V_1} = -\frac{1}{R_1}\cdot\frac{1}{S^2C^2R_3 + \frac{SCR_3}{R_2} + \frac{1}{R_3}} = -\frac{1}{R_1}\,\frac{1}{\frac{S^2C^2R_3^2R_2 + SCR_3^2 + R_2}{R_2R_3}}$$

$$\frac{V_0}{V_1} = -\frac{1}{R_1}\,\frac{R_2R_3}{S^2C^2R_3^2R_2 + SCR_3^2 + R_2}\,\frac{C^2R_3^2R_2}{C^2R_3^2R_2} = -\underbrace{\frac{R_3}{R_1}}_{K}\,\frac{\frac{1}{C^2R_3^2}}{S^2 + S\frac{1}{CR_2} + \frac{1}{C^2R_3^2}}$$

NOTA

$$\boxed{T(s) = \frac{V_O(s)}{V_i(s)} = -K \frac{1/C^2R_3^2}{s^2 + s\frac{1}{CR_2} + \frac{1}{C^2R_3^2}}}$$

$$K = \frac{R_3}{C^2 R_1}$$

$$\omega_0^2 = \frac{1}{C^2R_3^2} \Rightarrow \boxed{\omega_0 = \frac{1}{CR_3}}$$

$$\frac{\omega_0}{Q} = \frac{1}{CR_2} \Rightarrow \frac{1}{\cancel{C}R_3}\cancel{C}R_2 = Q$$

$$\boxed{Q = \frac{R_2}{R_3}}$$

$\omega_0 = 1$
$Q = 3$

$$\frac{1}{CR_3} = 1$$

$$3 = \frac{R_2}{R_3} \rightarrow \text{Adopto } \boxed{R_3 = 1k}$$

$$\boxed{R_2 = 3K} \qquad \boxed{C = \frac{1}{R_3} = 1mF}$$

$$|T(0)| = 20\ dB \qquad 20\ dB = 10$$

$$T(j\omega) = \frac{-K}{-\omega^2 + j\omega\frac{1}{CR_2} + \frac{1}{C^2R_3^2}}$$

$$|T(j\omega)| = \frac{K}{\sqrt{\left(\frac{1}{C^2R_3^2} - \omega^2\right)^2 + \left(\omega\frac{1}{CR_2}\right)^2}}$$

$$|T(0)| = \frac{-K}{\frac{1}{C^2R_3^2}} = \frac{-1}{\cancel{C^2}\cancel{R_3}R_1 \cdot \frac{1}{\cancel{C^2}R_3^{\cancel{2}}}} = -\frac{R_3}{R_1} = 20\ dB$$

$$\cancel{20}\log\left|-\frac{R_3}{R_1}\right| = \cancel{20}^{1}\ dB \Rightarrow$$

$$\frac{R_3}{R_1} = 10 \rightarrow \boxed{R_1 = \frac{1k}{10} = 100\ \Omega}$$

NOTA

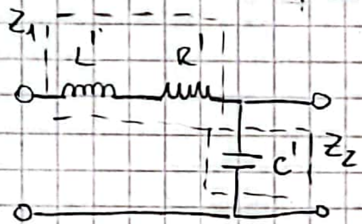
Escaneado con CamScanner

Normalización en frecuencia:

$\$ = \frac{s}{\omega_0}$ $\qquad T(s) = -k \frac{\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$ $\qquad \omega_0^2 = \frac{1}{C^2R_3^2}$ $\qquad \omega_0 = \frac{1}{CR_3}$

$\frac{\omega_0}{Q} = \frac{1}{CR_2}$ $\qquad Q = R_2/R_3$

$$T(\$) = -k \frac{\omega_0^2}{\$^2\omega_0^2 + \$\frac{\omega_0^2}{Q} + \omega_0^2} = -\frac{1}{\$^2 + \$\frac{1}{Q} + 1}$$

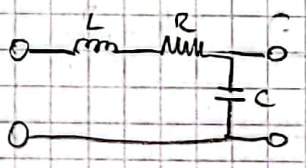



$Z_1 = sL + R \to Z_1(\$) = \$\omega_0 L + R$

$Z_2 = \frac{1}{sC} \to Z_2(\$) = \frac{1}{\$\omega_0 C}$

$\boxed{L' = \omega_0 L = \frac{L}{CR_3}}$ $\qquad \boxed{C' = \omega_0 C = \frac{\cancel{C}}{\cancel{C}R_3} = R_3}$

Normalización en impedancia




$Z_1 = sL + R \to$
$Z_2 = 1/sC \to$ $\quad Z = \frac{Z_2}{Z_1 + Z_2} = \frac{1/sC}{sL + R + 1/sC} = \frac{1}{s^2LC + sCR + 1}$

$\Omega_Z = R$

$\not Z = \frac{Z}{\Omega_Z}$

$\not Z = \frac{1}{\Omega_Z} \cdot \frac{1}{s^2LC + sCR + 1}$

$$\boxed{\not Z = \frac{1}{s^2LCR + sCR^2 + 1}}$$

Sensibilidades

$$S_C^{w_o} = \frac{C}{w_o}\,\frac{\partial w_o}{\partial C} \qquad \frac{\partial}{\partial C}\left[\frac{1}{CR_3}\right] = -\frac{1}{R_3 C^2}$$

$$= \frac{\cancel{C}}{1/\cancel{CR_3}} \cdot -\frac{1}{R_3 \cancel{C^2}} = -1 \qquad \boxed{S_C^{w_o} = -1}$$

$$S_{R_2}^{Q} = \frac{R_2}{Q}\,\frac{\partial Q}{\partial R_2} \qquad \frac{\partial}{\partial R_2}\left[R_2/R_3\right] = 1/R_3$$

$$= \frac{\cancel{R_2}}{\cancel{R_2/R_3}} \cdot \frac{1}{\cancel{R_3}} \Rightarrow \boxed{S_{R_2}^{Q} = 1}$$

$$S_{R_3}^{Q} = \frac{R_3}{Q}\,\frac{\partial Q}{\partial R_3} \qquad \frac{\partial}{\partial R_3}\left[R_2/R_3\right] = -\frac{R_2}{R_3^2}$$

$$S_{R_3}^{Q} = \frac{\cancel{R_3^2}}{\cancel{R_2}} \cdot -\frac{\cancel{R_2}}{\cancel{R_3^2}} \Rightarrow \boxed{S_{R_3}^{Q} = -1}$$

Recalculo para Butterworth

$$T_{2(s)} = \frac{1}{s^2 + s\,2\underbrace{\cos\left(\frac{\pi}{4}\right)}_{\sqrt{2}/2} + 1}$$

$$\Rightarrow Q = \frac{1}{\sqrt{2}} \quad y \quad w_0 = 1 \Rightarrow \frac{1}{CR_3} = 1 \qquad \text{Adopto } \boxed{C = 1} \to \boxed{R_3 = 1}$$

$$\frac{1}{\sqrt{2}} = \frac{R_2}{R_3} \to \boxed{R_2 = 0{,}707}$$

$$K = \frac{R_3}{R_1} = 1 \to \boxed{R_1 = R_3 = 1}$$

NOTA

TS2

HOJA Nº 3

FECHA

Circuito Pasobanda con componentes originales. Con que parametros puedo diseñado?

$$R_3 = R_4 = \frac{1}{w_0 C} \longrightarrow \boxed{w_0 = \frac{1}{R_3 C} = \frac{1}{1 \cdot 1} = 1}$$

$$R_3 = R_1 = Q \cdot R_2 \longrightarrow \frac{R_1}{R_2} = Q \rightarrow \boxed{Q = \frac{1}{0{,}707} = 1{,}41}$$

NOTA