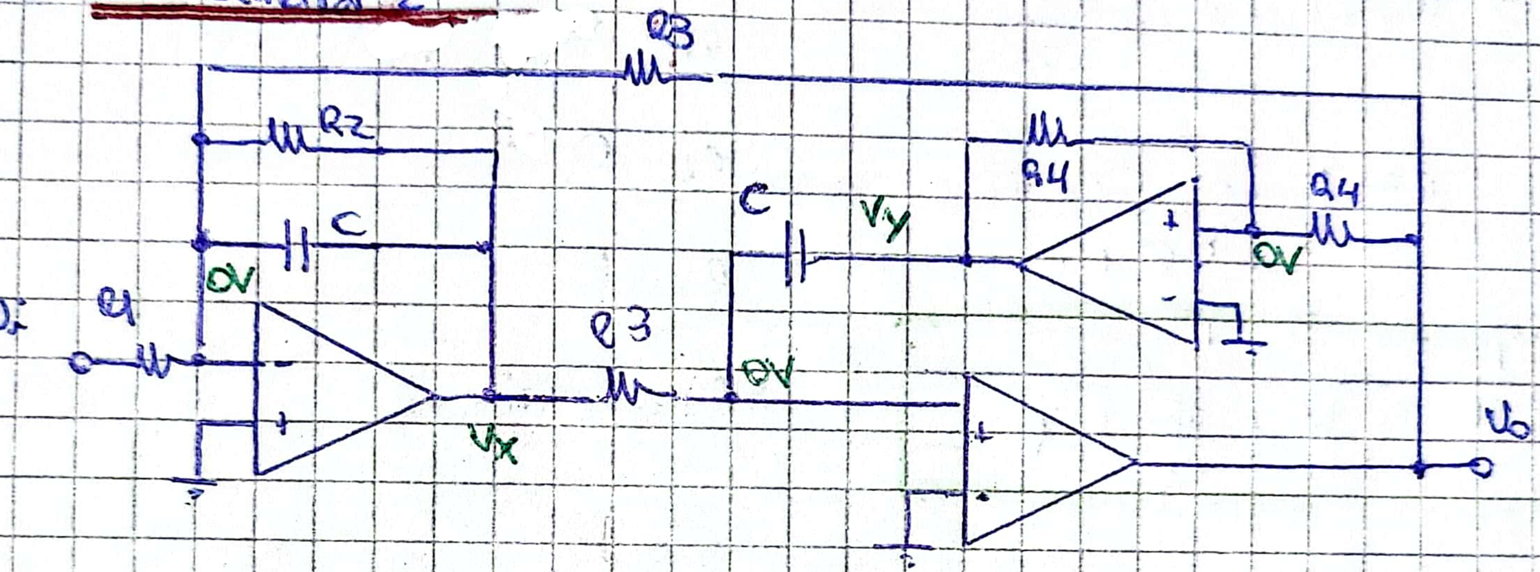
TP Semanal 2



$$V_y = -V_o \cdot \frac{R4}{R4}$$

$$\frac{V_x}{R3} = V_o \cdot sC \rightarrow V_x = V_o \cdot sC\,R3$$

$$\frac{V_i}{R1} = \frac{-V_o}{R3} - \frac{V_x}{R2} - V_x \cdot sC$$

$$\frac{V_i}{R1} = \frac{-V_o R2}{R3\,R2} - \frac{V_o\, sC R3^2}{R2\,R3} - \frac{(sC)^2\, R3^2\, V_o\, R2}{R2\,R3}$$

$$\frac{V_x}{R3} = -V_y \cdot sC$$

$$\frac{V_o}{V_i} = -\frac{R2\,\cancel{R3}}{R1} \cdot \frac{1 / C^2 R3^2 \cancel{R2}}{\frac{s^2 C^2 R3^2 R2}{C^2 R3^2 R2} + \frac{s\,C\,R3^2}{C^2 R3^2 R2} + \frac{R2}{C^2 R3^2 R2}}$$

NOTA

$$\frac{V_o}{V_i} = \frac{-\frac{1}{C^2 R_3^2} \cdot \frac{R_3}{R_4}}{s^2 + s\frac{R_3}{C R_2 R_3} + \frac{1}{C^2 R_3^2}}$$

$K = (R_3/R_4)$

$\omega_0 = \frac{1}{C R_3}$

$\frac{\omega_0}{Q} = \frac{1}{C R_3} \cdot \frac{1}{\left(\frac{R_2}{R_3}\right)} \rightarrow Q = \frac{R_2}{R_3}$

$$\boxed{\frac{V_o}{V_i} = \frac{\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2} \cdot K}$$

b) $\omega_0 = 1 \frac{rad}{seg}$

$Q = 3 \rightarrow 3R_3 = R_2$

$R_3 = 1K$

$R_2 = 3K$

$C = 1000 \mu F$

R1 puede tomar cualquier valor

c) $|T(0)| = 20dB = 10$ $\quad \lim_{s \to 0} \frac{V_o}{V_i} = 10$

$20 \log(K) = 20 \rightarrow K = 10$

$$\left|T(s = j\omega = 0)\right| = \frac{\omega_0^2}{(j0)^2 + j \cdot 0 + \omega_0^2} \cdot K = K = \frac{1K}{R_4} \rightarrow R_4 = 100\,\Omega$$

Bonus:

d) Normalización: $\omega_0^2 = 1 \rightarrow C = \frac{1}{R_3}$

$R_3 = 1 \rightarrow Q = R_2$
$\rightarrow C = 1$

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

Red Normalizada:

R1 = Arbitrario (Ajusta K)

R2 = Q

R3 = 1

R4 = Arbitrario

C = 1

e) Sensibilidad

$$S^{w_0}_{C} = \frac{C}{w_0} \cdot \frac{dw_0}{dC} = \cancel{C} \cdot \frac{1}{\frac{1}{\cancel{C} \cancel{R_3}}} \cdot \frac{\cancel{-1}}{\cancel{C}^2 R_3} \cdot (-1) = -1$$

$$\boxed{w_0 = \frac{1}{CR_3} \qquad Q = \frac{R_2}{R_3}}$$

$$S^{Q}_{R_2} = \frac{R_2}{Q} \cdot \frac{dQ}{dR_2} = \frac{R_2}{Q} \cdot \frac{1}{R_3} = \frac{Q}{Q} = 1$$

$$S^{Q}_{R_3} = \frac{R_3}{Q} \cdot \frac{dQ}{R_3} = \frac{\cancel{R_3}}{\cancel{Q}} \cdot R_2 \cdot (-1) \cdot \frac{1}{R_3^2} = -1$$

f) Red Butterworth $\rightarrow$ $Q = \frac{1}{\sqrt{2}}$ $\rightarrow$ $R_2 = 1K$

$R_3 = 1{,}41\,K$

g) Si tomamos la salida de V_1, tomaremos una salida paso banda. Los parámetros w_0, Q siguen siendo iguales dado que el sistema sigue siendo el mismo, y no dependen de la salida que tomemos sino que dependen de los componentes.

$$T_{PB_W} = \frac{V_x}{V_i} = \frac{V_0\, sCR_3}{V_i} = T_{PB} \cdot sCR_3 = \frac{-\frac{1}{CR_3} \cdot \frac{R_3}{R_1} \cdot sCR_3}{s^2 + s \cdot \frac{1}{CR_2} + \frac{1}{CR_3}}$$

$$T_{PB} = \frac{-s \cdot \frac{1}{CR_2} \cdot \frac{R_2}{R_1}}{s^2 + s \cdot \frac{1}{CR_2} + \frac{1}{CR_3}} = \frac{s\, w_0/Q}{s^2 + s \cdot \frac{w_0}{Q} + \frac{1}{w_0^2}} \cdot K$$

$$w_0 = \frac{1}{CR_3} \qquad Q = \frac{R_2}{R_3} \qquad K = -\frac{R_2}{R_1}$$

NOTA