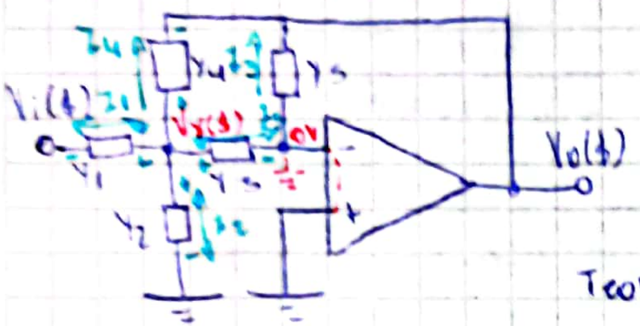


Nodo x:

$$V_x(\$)\,(Y_1(\$)+Y_2(\$)+Y_3(\$)+Y_4(\$)) = V_i(\$).Y_1(\$)+V_o(\$).Y_4(\$)$$

Teoría nodos:

$$I_1(\$)+I_2(\$)+I_3(\$)+I_4(\$)=0$$

$$[V_x(\$)-V_i(\$)].Y_1(\$)+V_x(\$).Y_2(\$)+V_x(\$).Y_3(\$)+(V_x(\$)-V_o(\$)).Y_4(\$)$$

Ecuaciones:

$$\begin{cases} V_x(\$).[Y_1(\$)+Y_2(\$)+Y_3(\$)+Y_4(\$)] = V_i(\$).Y_1(\$)+V_o(\$).Y_4(\$) & (1) \\ I_3(\$) = V_x(\$).Y_3(\$) = -V_o(\$).Y_5(\$) \end{cases}$$

$$\rightarrow V_x(\$) = -\frac{Y_5(\$)}{Y_3(\$)}.V_o(\$) \quad (2)$$

(2) en (1): $$-\frac{Y_5}{Y_3}V_o.(Y_1+Y_2+Y_3+Y_4) = V_i.Y_1+V_o.Y_4$$

$$-V_o.\left[\frac{Y_5}{Y_3}.(Y_1+Y_2+Y_3+Y_4)+Y_4\right] = V_i.Y_1$$

$$-V_o.\left[\frac{Y_5.(Y_1+Y_2+Y_3+Y_4)+Y_3.Y_4}{Y_3}\right] = V_i.Y_1$$

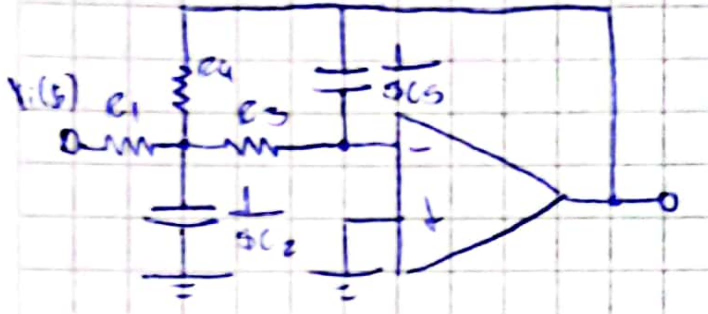
NOTA

Escaneado con CamScanner

Genérico MFB: $H(s) = \dfrac{V_0(s)}{V_i(s)} = \dfrac{-Y_3(s)\cdot Y_1(s)}{Y_5(s)\left[Y_1(s)+Y_2(s)+Y_3(s)+Y_4(s)\right]+Y_3(s)Y_4(s)}$

Particularización:

- Pasabajos MFB



$Y_1(s) = \dfrac{1}{R_1} = G_1$; $Y_2(s) = sC_2$

$Y_3(s) = G_3$, $Y_4(s) = G_4$; $Y_5(s) = sC_5$

$$H(s) = \frac{V_0(s)}{V_i(s)} = \frac{-G_3 \cdot G_1}{sC_5\cdot(G_1+G_3+G_4+sC_2)+G_3\cdot G_4}$$

$$H(s) = \frac{-G_1\cdot G_3}{s^2 C_2 C_5 + sC_5(G_1+G_3+G_4)+G_3 G_4}$$

$$H(s) = \frac{-G_1\cdot G_3}{C_2 C_5\cdot\left(s^2+\dfrac{s\,C_5}{C_2 C_5}(G_1+G_3+G_4)+\dfrac{G_3\cdot G_4}{C_2 C_5}\right)}$$

$$H(s) = \frac{\dfrac{1}{R_1 R_3 C_2 C_5}}{s^2 + s\cdot\dfrac{1}{C_2}\left(\dfrac{1}{R_1}+\dfrac{1}{R_3}+\dfrac{1}{R_4}\right)+\dfrac{1}{R_3 R_4 C_2 C_5}}$$

Escaneado con CamScanner

- Calculo $H(s)$ con los datos:

$R_1 = R_3 = R_4 = 1\,\Omega$; $C_2 = 1F$; $C_5 = 0{,}01F$

$$H(s) = \frac{-100}{s^2 + 3s + 100}$$

$W_0^2 = 100 \rightarrow W_0 = 10\ r/s$

$\frac{W_0}{Q} = 3 \rightarrow Q = 3{,}33 = 10{,}45\ dB$

b) $W_0 = 1000\ r/s$; 4700 pF y 47 pF

$$W_0^2 = \frac{1}{R_3 R_4 C_2 C_5} = (1000)^2$$

Para mantener $Q \rightarrow \frac{W_0}{Q} = 300$ ↱ Wo aumentó 100 veces

$$\frac{W_0}{Q} = \frac{1}{C_2}\left(\frac{1}{R_1} + \frac{1}{R_3} + \frac{1}{R_4}\right) = 300$$

$C_2 = 4700pF$; $C_5 = 47\ pF$; $R_3 = 10K\Omega$

- $$W_0^2 = \frac{1}{10K\Omega \cdot 4700pF \cdot 47pF \cdot R_4} = 1 \cdot 10^6\ r^2/s^2 \rightarrow R_4 = 452M\Omega$$

Propongo R_3 mayor, $R_3 = 1M\Omega \rightarrow R_4 = 4{,}52M\Omega$

- $$\frac{1}{C_2} \cdot \left(\frac{1}{R_1} + \frac{1}{R_3} + \frac{1}{R_4}\right) = 300$$

$$\frac{1}{4700pF} \cdot \left(\frac{1}{R_1} + \frac{1}{1M\Omega} + \frac{1}{4{,}52M\Omega}\right) = 300 \rightarrow R_1 = 5{,}29M\Omega$$

Escaneado con CamScanner