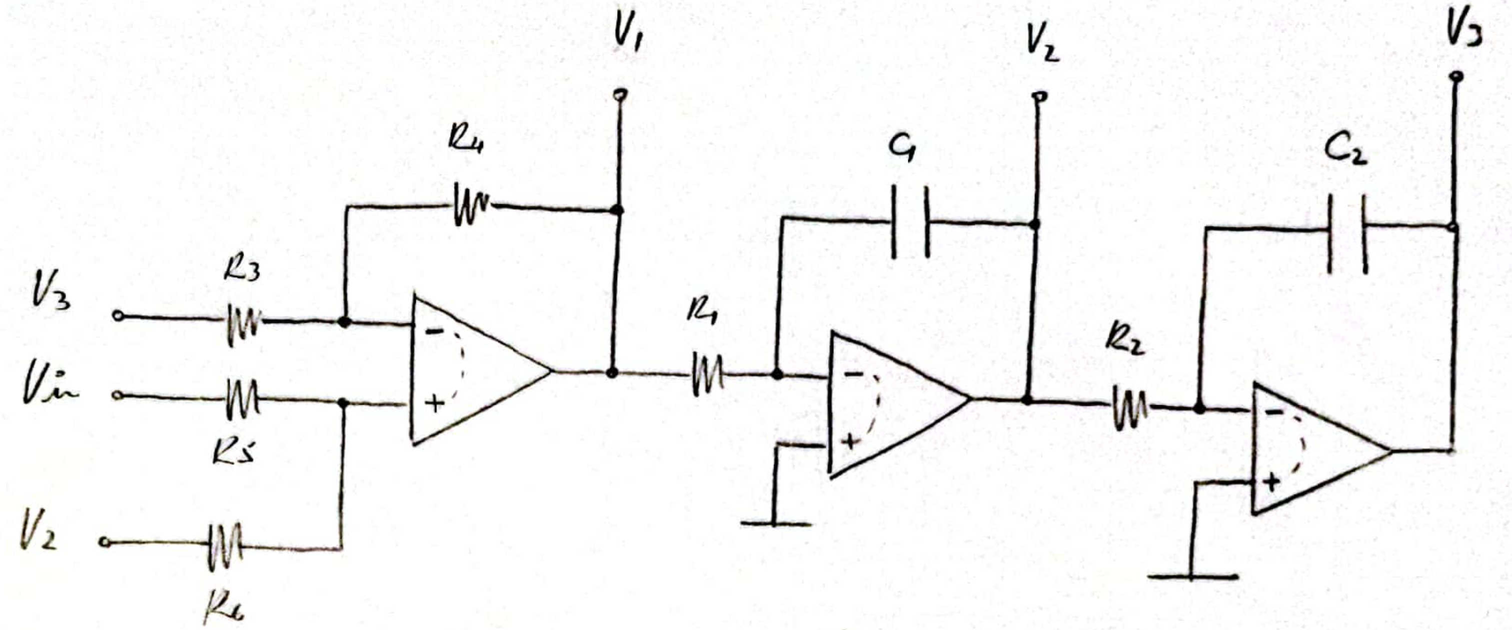
#08- Redibujamos el circuito.



$$V_1 = V_3\left(-\frac{R_4}{R_3}\right) + V_{in}\left(\frac{R_6}{R_5+R_6}\right) + V_2\left(\frac{R_5}{R_5+R_6}\right)$$

$$\underbrace{V_2 = -V_1 \frac{1}{sR_1C_1}}_{2} \qquad \underbrace{V_3 = -V_2 \frac{1}{sR_2C_2}}_{3}$$

$$\underbrace{V_1 = -V_2\, sR_1C_1}_{4} \qquad \underbrace{V_2 = -V_3\, sR_2C_2}_{5}$$

$$V_1 - V_2\left(\frac{R_5}{R_5+R_6}\right) - V_3\left(-\frac{R_4}{R_3}\right) = V_{in}\left(\frac{R_6}{R_5+R_6}\right) \quad (1)$$

$$V_1 - \left[\underbrace{-V_1 \frac{1}{sR_1C_1}}_{V_2}\left(\frac{R_5}{R_5+R_6}\right)\right] - \left[\underbrace{-\left(\underbrace{-V_1 \frac{1}{sR_1C_1}}_{V_2}\right)\frac{1}{sR_2C_2}}_{V_3}\left(-\frac{R_4}{R_3}\right)\right] = V_{in}\left(\frac{R_6}{R_5+R_6}\right)$$

Escaneado con CamScanner

$$V_1\left[1+\frac{R_5}{sR_1C_1(R_5+R_6)}+\frac{R_4}{s^2R_1R_2R_3C_1C_2}\right]=V_{in}\frac{R_6}{R_5+R_6}$$

$$V_1\left[\frac{s^2R_1R_2R_3(R_5+R_6)C_1C_2+sR_2R_3R_5C_2+R_4(R_5+R_6)}{s^2R_1R_2R_3\cancel{(R_5+R_6)}C_1C_2}\right]=V_{in}\frac{R_6}{\cancel{R_5+R_6}}$$

$$\frac{V_1}{V_{in}}=\frac{s^2R_1R_2R_3R_6C_1C_2}{s^2R_1R_2R_3(R_5+R_6)C_1C_2+sR_2R_3R_5C_2+R_4(R_5+R_6)}$$

$$\frac{V_1}{V_{in}}=\frac{\cancel{R_1}\cancel{R_2}\cancel{R_3}R_6\cancel{C_1}\cancel{C_2}}{\cancel{R_1}\cancel{R_2}\cancel{R_3}(R_5+R_6)\cancel{C_1}\cancel{C_2}}\;\frac{s^2}{s^2+s\dfrac{\cancel{R_2}\cancel{R_3}R_5\cancel{C_2}}{R_1\cancel{R_2}\cancel{R_3}(R_5+R_6)C_1\cancel{C_2}}+\dfrac{R_4\cancel{(R_5+R_6)}}{R_1R_2R_3\cancel{(R_5+R_6)}C_1C_2}}$$

$$\boxed{\frac{V_1}{V_{in}}=\underbrace{\frac{R_6}{R_5+R_6}}_{k}\;\frac{s^2}{s^2+s\underbrace{\dfrac{R_5}{R_1(R_5+R_6)C_1}}_{\frac{\omega_0}{Q}}+\underbrace{\dfrac{R_4}{R_1R_2R_3C_1C_2}}_{\omega_0^2}}}$$

$$\left|T_1(s)\right|_{s=j\omega} = \left| k \frac{(j\omega)^2}{(j\omega)^2 + j\omega \frac{R_5}{R_1(R_5+R_6)C_1} + \frac{R_4}{R_1R_2R_3C_1C_2}} \right|$$

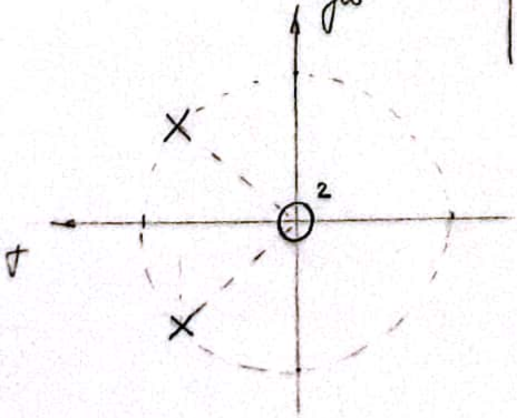
$$= \left| k \frac{-\omega^2}{-\omega^2 + j\omega \frac{\omega_0}{q} + \omega_0^2} \right| = \left| k \frac{-\omega^2}{\omega_0^2 - \omega^2 + j\omega \frac{\omega_0}{q}} \right|$$

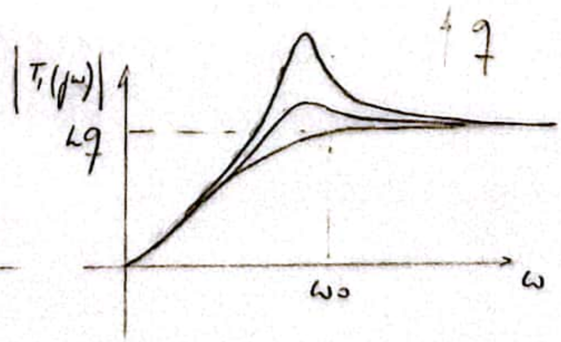
$$= k \frac{\sqrt{(-\omega^2)^2}}{\sqrt{(\omega_0^2 - \omega^2)^2 + \left(\omega \frac{\omega_0}{q}\right)^2}}$$

$$\left|T_1(j\omega)\right|_{\omega=0} = 0$$

$$\left|T_1(j\omega)\right|_{\omega=\omega_0} = k \frac{\sqrt{(-\omega_0^2)^2}}{\sqrt{\underbrace{(\omega_0^2 - \omega_0^2)^2}_{=0} + \left(\omega_0 \frac{\omega_0}{q}\right)^2}} = kq$$

$$\left|T_1(j\omega)\right|_{\omega\to\infty} = k \frac{\sqrt{\overbrace{(-\omega^2)^2}^{\to\infty}}}{\sqrt{\underbrace{(\omega_0^2 - \omega^2)^2}_{\to\infty} + \underbrace{\left(\omega \frac{\omega_0}{q}\right)^2}_{\to\infty}}} \to k$$





Filtro Pasa Altos