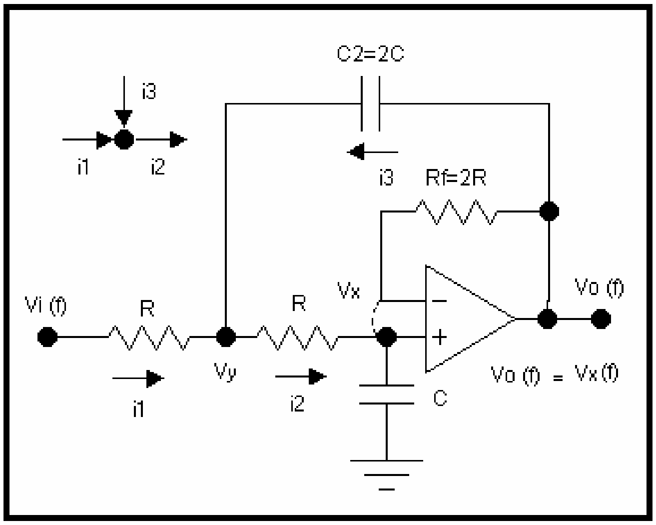
FILTRO PASABAJAS DE –40 db / dec



a. Hallar $A_v(w) = f(R, C, w)$

$$V_x(w) = \frac{Zc}{R + Zc} V_y(w) \quad \rightarrow \quad V_x(w) = \frac{\frac{1}{jwC}}{R + \frac{1}{jwC}} V_y(w) \quad \rightarrow$$

$$V_x(w) = \frac{\frac{1}{jwC}}{\frac{jwRC + 1}{jwC}} V_y(w)$$

$$\boxed{V_x(w) = \frac{1}{jwRC + 1} V_y(w) \quad (1)}$$

$$i2 = i1 + i3$$

$$\frac{V_y}{R} - \frac{V_x}{R} = \frac{V_i}{R} - \frac{V_y}{R} + \frac{V_x}{\frac{1}{2jwC}} - \frac{V_y}{\frac{1}{2jwC}} \quad \rightarrow \quad \frac{V_y}{R} - \frac{V_x}{R} = \frac{V_i}{R} - \frac{V_y}{R} + 2jwCV_x - 2jwCV_y$$

$$\frac{V_y}{R} + \frac{V_y}{R} + 2jwCV_y = \frac{V_i}{R} + \frac{V_x}{R} + 2jwCV_x \quad \rightarrow \quad V_y\left(\frac{2}{R} + 2jwC\right) = \frac{V_i + V_x + 2jwCRV_x}{R}$$

$$V_y(w) = \frac{\frac{V_i + V_x + 2jwCRV_x}{R}}{\frac{2 + 2jwRC}{R}} \quad \rightarrow \quad V_y(w) = \frac{V_i + V_x(1 + 2jwCR)}{2 + 2jwRC} \quad \rightarrow \quad V_x(w) = V_o(w)$$

$$V_y(w)=\frac{V_i(w)+V_o(w)(1+2jwCR)}{2+2jwRC} \quad (2)$$

Reemplazo 2 en 1

$$V_x(w)=\frac{1}{jwRC+1}\left[\frac{V_i(w)+V_o(w)(1+2jwCR)}{2+2jwRC}\right]\rightarrow \qquad V_x(w)=V_o(w)$$

$$V_o(w)=\frac{1}{jwRC+1}\left[\frac{V_i+V_o(1+2jwCR)}{2+2jwRC}\right]$$

$$(jwRC+1)(2+2jwRC)V_o(w)=V_i+V_o(1+2jwCR)$$

$$(jwRC+1)(2+2jwRC)V_o(w)-V_o(1+2jwCR)=V_i(w)$$

$$V_o(w)\left[(jwRC+1)(2+2jwRC)-(1+2jwCR)\right]=V_i(w)$$

$$V_o(w)=\frac{1}{2(jwRC+1)^2-(1+2jwCR)}V_i(w) \quad \rightarrow$$

$$\frac{V_o(w)}{V_i(w)}=\frac{1}{2(jwRC+1)^2-(1+2jwCR)}$$

$$A_v(w)=\frac{1}{2(jwRC+1)^2-(1+2jwCR)} \quad \rightarrow \quad A_v(w)=\frac{1}{-2w^2R^2C^2+4jwRC+2-1-2jwCR}$$

$$A_v(w)=\frac{1}{-2w^2R^2C^2+2jwRC+1}$$

$$\left|A_v(w)\right|=\frac{1}{\sqrt{(1-2w^2R^2C^2)^2+(2wRC)^2}}$$

$$\lim_{w\to\infty}\left|A_v(w)\right|=\frac{1}{\sqrt{(1-\infty)^2+(\infty)^2}}=\frac{1}{\infty}=0$$ (Las frecuencias altas no pasan)

$$\lim_{w\to o}\left|A_v(w)\right|=\frac{1}{\sqrt{(1-0)^2+(0)^2}}=\frac{1}{1}=1$$ (Las frecuencias bajas pasan)

b. Hallar $w_c \;\; y \;\; f_c$

$$\frac{1}{\sqrt{2}} = \frac{1}{\sqrt{(1-2w_c{}^2R^2C^2)^2 + (2w_cRC)^2}} \quad \rightarrow \quad \left(\sqrt{(1-2w_c{}^2R^2C^2)^2 + (2w_cRC)^2} = \sqrt{2}\right)^2$$

$$(1-2w_c{}^2R^2C^2)^2 + (2w_cRC)^2 = 2 \quad \rightarrow$$

$$1-4w_c{}^2R^2C^2 + 4w_c{}^4R^4C^4 + 4w_c{}^2R^2C^2 = 2$$

$$1+4w_c{}^4R^4C^4 = 2 \quad \rightarrow \quad w_c{}^4 = \frac{1}{4R^4C^4} \quad \rightarrow \quad \sqrt[4]{w_c{}^4} = \sqrt[4]{\frac{1}{4R^4C^4}}$$

$$w_c = \frac{1}{\sqrt[4]{4}RC} \quad \rightarrow \quad \sqrt[4]{4} = \sqrt{2} \quad \rightarrow \quad \boxed{w_c = \frac{1}{\sqrt{2}RC}}$$

$$2\pi f_c = \frac{1}{\sqrt{2}RC} \quad \rightarrow \quad \boxed{f_c = \frac{1}{2\sqrt{2}\pi RC}}$$

c. Hallar $|A_v(f)| = f(f, f_c)$

$$|A_v(w)| = \frac{1}{\sqrt{(1-2w^2R^2C^2)^2 + (2wRC)^2}}$$

$$|A_v(w)| = \frac{1}{\sqrt{\left(1-2w^2\left(\frac{1}{w_c\sqrt{2}}\right)^2\right)^2 + \left(2w\left(\frac{1}{w_c\sqrt{2}}\right)\right)^2}} \quad \rightarrow \quad |A_v(w)| = \frac{1}{\sqrt{\left(1-\frac{2w^2}{2w_c{}^2}\right)^2 + \left(\frac{2w}{\sqrt{2}w_c}\right)^2}}$$

$$|A_v(w)| = \frac{1}{\sqrt{\left(1-\frac{w^2}{w_c{}^2}\right)^2 + \frac{4w^2}{2w_c{}^2}}} \quad \rightarrow \quad |A_v(w)| = \frac{1}{\sqrt{\left(1-\frac{w^2}{w_c{}^2}\right)^2 + \frac{2w^2}{w_c{}^2}}}$$

$$|A_v(f)| = \frac{1}{\sqrt{\left(1-\frac{(2\pi f)^2}{(2\pi f_c)^2}\right)^2 + \frac{2(2\pi f)^2}{(2\pi f_c)^2}}} \quad \rightarrow \quad \boxed{|A_v(f)| = \frac{1}{\sqrt{\left(1-\left(\frac{f}{f_c}\right)^2\right)^2 + 2\left(\frac{f}{f_c}\right)^2}}}$$

d. Dibujar $|A_v(f)|\ \ Vs\ \ f$

$$|A_v(f)| = \frac{1}{\sqrt{\left(1-\left(\frac{f}{f_c}\right)^2\right)^2 + 2\left(\frac{f}{f_c}\right)^2}}$$

$$A_v = 20\log\left(\frac{V_0}{V_i}\right)$$

f	$\lvert A_v(f)\rvert$	$\lvert A_v(f)\rvert\ db$
0	1	0
0.1fc	0.999	0
0.5fc	0.970	0
0.8 fc	0.842	-1
fc	0.707	-3
2 fc	0.242	-12
4 fc	0.062	-24
6 fc	0.027	-31
8 fc	0.015	-36
10 fc	0.009	-40