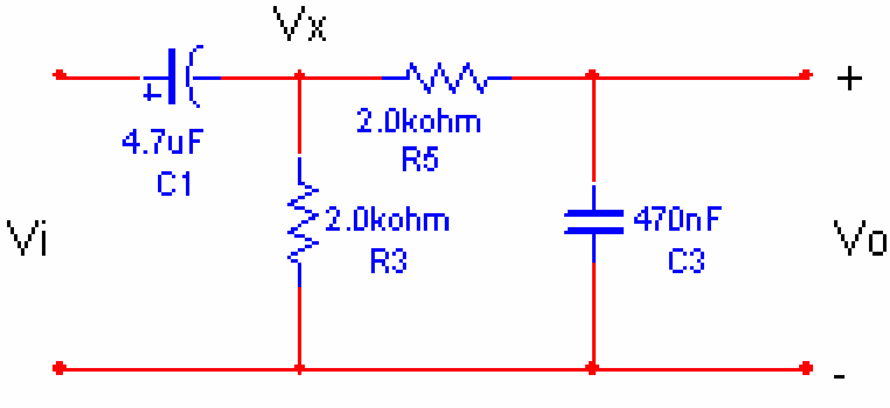
FILTRO PASABANDA: BANDA ANCHA



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

$$V_x = \frac{R_3}{R_3 + ZC_1} V_i \quad \rightarrow \quad V_x = \frac{R_3}{R_3 + \frac{1}{jwC_1}} V_i \quad \rightarrow \quad \boxed{V_x = \frac{jwR_3C_1}{1 + jwR_3C_1} V_i} \ (1)$$

$$V_o = \frac{ZC_3}{ZC_3 + R_5} V_x \quad \rightarrow \quad V_o = \frac{\frac{1}{jwC_3}}{\frac{1}{jwC_3} + R_5} V_x \quad \rightarrow \quad \boxed{V_o = \frac{1}{1 + jwR_5C_3} V_x} \ (2)$$

Reemplazando 1 en 2

$$V_o = \frac{1}{1 + jwR_5C_3} * \frac{jwR_3C_1}{1 + jwR_3C_1} V_i \qquad V_o = \frac{jwR_3C_1}{(1 + jwR_5C_3)(1 + jwR_3C_1)} V_i$$

$$\frac{V_o}{V_i} = \frac{jwR_3C_1}{-\mathbf{w^2}R_5R_3C_3C_1 + jwR_3C_1 + jwR_5C_3 + 1}$$

Dado que $\frac{V_o}{V_i}$ forma la ganancia del filtro en función de la frecuencia en forma fasorial su módulo se halla hallando la raíz cuadrada de la suma de su parte real e imaginaria al cuadrado:

$$\boxed{|Av(w)| = \frac{wR_3C_1}{\sqrt{(\mathbf{1 - w^2}R_5R_3C_3C_1)^2 + (wR_3C_1 + wR_5C_3)^2}}}$$

b. Hallar w_c y f_c

$$\frac{1}{\sqrt{2}} = \frac{wR_3C_1}{\sqrt{(\mathbf{1 - w^2}R_5R_3C_3C_1)^2 + (wR_3C_1 + wR_5C_3)^2}}$$

$$\sqrt{(\mathbf{1-w^2}R_5R_3C_3C_1)^2+(wR_3C_1+wR_5C_3)^2}=\sqrt{2}wR_3C_1$$
$$\left(\sqrt{(\mathbf{1-w^2}R_5R_3C_3C_1)^2+(wR_3C_1+wR_5C_3)^2}\right)^2=\left(\sqrt{2}wR_3C_1\right)^2$$
$$(\mathbf{1-w^2}R_5R_3C_3C_1)^2+(wR_3C_1+wR_5C_3)^2=2w^2R_3{}^2C_1{}^2$$
$$1-2\mathbf{w^2}R_5R_3C_3C_1+\mathbf{w^4}R_5{}^2R_3{}^2C_3{}^2C_1{}^2+w^2R_3{}^2C_1{}^2+2w^2R_3R_5C_1C_3+w^2R_5{}^2C_3{}^2=2w^2R_3{}^2C_1{}^2$$
$$1+\mathbf{w^4}R_5{}^2R_3{}^2C_3{}^2C_1{}^2-w^2R_3{}^2C_1{}^2+w^2R_5{}^2C_3{}^2=0$$

Como: $f_H = 10 f_L$ (5) , entonces:

$$f_L=\frac{1}{2\pi R_3C_1}\rightarrow \qquad f_H=\frac{10}{2\pi R_3C_1}\rightarrow \qquad \frac{1}{2\pi R_5C_3}=\frac{10}{2\pi R_3C_1}\qquad\rightarrow$$
$$R_3C_1=10R_5C_3 \quad (6)$$

Reemplazando (6) en la ecuación (4), se obtiene:

$$1+\mathbf{w^4}(10R_5C_3)^2R_5{}^2C_3{}^2-w^2(10R_5C_3)^2+w^2R_5{}^2C_3{}^2=0$$
$$1+100\mathbf{w^4}R_5{}^4C_3{}^4-\mathbf{100}\,w^2R_5{}^2C_3{}^2+w^2R_5{}^2C_3{}^2=0$$
$$1+100\mathbf{w^4}R_5{}^4C_3{}^4-\mathbf{99}\,w^2R_5{}^2C_3{}^2=0$$
$$1+w^2\left(100\mathbf{w^2}R_5{}^4C_3{}^4-\mathbf{99}\,R_5{}^2C_3{}^2\right)=0$$
$$1+w^2=0$$
$$100\mathbf{w^2}R_5{}^4C_3{}^4-\mathbf{99}\,R_5{}^2C_3{}^2=0$$
$$w=\sqrt{-1}$$
$$\mathbf{w^2}=\frac{\mathbf{99}\,R_5{}^2C_3{}^2}{100R_5{}^4C_3{}^4}\qquad \mathbf{w}=\sqrt{\frac{\mathbf{99}}{100R_5{}^2C_3{}^2}}\qquad \boxed{\mathbf{w}=\frac{\sqrt{\mathbf{99}}}{10R_5C_3}}\ (6)$$

$$2\pi f_H=\frac{\sqrt{\mathbf{99}}}{10R_5C_3}\qquad f_H=\frac{\sqrt{\mathbf{99}}}{20\pi R_5C_3}\qquad \boxed{f_H=\frac{0.1584}{R_5C_3}}\ (7)$$

Reemplazando (7) en la ecuación (5), se obtiene:

$$f_L=\frac{f_H}{10}\qquad f_L=\frac{\frac{0.1584}{R_5C_3}}{10}\qquad f_L=\frac{0.1584}{10R_5C_3}\qquad \boxed{f_L=\frac{0.01584}{R_5C_3}}\ (8)$$

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

$$f_r=\sqrt{f_Hf_L}\qquad f=\sqrt{\frac{0.1584}{R_5C_3}*\frac{0.01584}{R_5C_3}}\qquad f_r=\frac{0.05}{R_5C_3}\,(\mathbf{-10})$$

$$f_r = \sqrt{\left(\frac{0.1583}{R_1C_1}\right)\left(\frac{0.01583}{R_1C_1}\right)} = \frac{0.05}{R_1C_1} \quad \rightarrow \quad \boxed{R_1C_1 == \frac{0.05}{f_r}}$$

$$|A_v(w)| = \frac{10w\left(\frac{0.05}{f_r}\right)}{\sqrt{\left(1-10w^2\left(\frac{0.05}{f_r}\right)^2\right)^2 + \left(11w\left(\frac{0.05}{f_r}\right)\right)^2}}$$

$$\boxed{|A_v(w)| = \frac{3.1415\left(\frac{f}{f_r}\right)}{\sqrt{\left(1-0.986\left(\frac{f}{f_r}\right)^2\right)^2 + \left(3.4557\left(\frac{f}{f_r}\right)\right)^2}}}$$

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

$$\boxed{|A_v(w)| = \frac{3.1415\left(\frac{f}{f_r}\right)}{\sqrt{\left(1-0.986\left(\frac{f}{f_r}\right)^2\right)^2 + \left(3.4557\left(\frac{f}{f_r}\right)\right)^2}}} \qquad \boxed{A_v = 20\log\left(\frac{V_0}{V_i}\right)}$$

f	$\|A_v(f)\|$	$\|A_v(f)\|\ db$
0	0	0
0.1fc	0.3	-10
0.5fc	0.8	-2
0.8 fc	0.9	-1
fc	0.9	-1
2 fc	0.8	-2
4 fc	0.6	-4
6 fc	0.5	-7
8 fc	0.4	-9
10 fc	0.3	-10