1) $$\frac{1}{s} + \cfrac{1}{\frac{3}{s} + \cfrac{1}{\frac{5}{s} + \cfrac{1}{\frac{7}{s} + \cdots}}} \rightarrow$$

2) • $N = 2$

b) • $N = 3$

c) • $N = 4$

a) $$\frac{1}{s} + \frac{s}{3} = \frac{3+s^2}{3s}$$

$$T_2(s) = \frac{3}{s^2+3s+3}$$

b) $$\frac{1}{s} + \frac{1}{\frac{3}{s} + \frac{s}{5}} = \frac{1}{s} + \frac{s \cdot 5}{15+s^2} = \frac{s^2 \cdot 5 + s^2 + 15}{s^3 + 15 \cdot s}$$

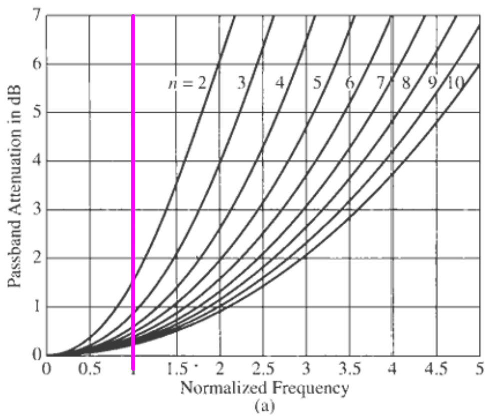
$$T_3(s) = \frac{15}{s^3+6s^2+15 \cdot s+15}$$

c) $$\frac{1}{s} + \cfrac{1}{\frac{3}{s} + \cfrac{1}{\frac{5}{s} + \frac{s}{7}}} = \frac{1}{s} + \cfrac{1}{\frac{3}{s} + \frac{7 \cdot s}{s^2+35}} = \frac{1}{s} + \frac{s^3 + 35 \cdot s}{10s^2 + 105}$$

$$= \frac{s^4 + 45 \cdot s^2 + 105}{10s^3 + 105 \cdot s}$$

$$T_4(s) = \frac{105}{s^4+10s^3+45 \cdot s^2+105 \cdot s+105}$$

2)



$n=3$ Cumple tambien la atenuación en la banda de STOP

$$T_3(s) = \frac{15}{s^3+6s^2+15.s+15}$$

Otra forma es evaluar $\frac{1}{|T(\omega)|}$ en $\omega=1$ para saber la atenuación de ese orden

$$T_3(\omega) = \frac{15}{(j\omega)^3+6(j\omega)^2+15\cdot j\omega+15}$$

$$|T3(\omega=1)| = 0{,}9$$

$$\alpha_{veces} = \frac{1}{|T_3(\omega=1)|} = \frac{10}{9} \rightarrow \text{en dB } 0{,}915\,dB \checkmark$$

$$< \alpha_{max}$$

3)

$$T_3(s) = \frac{15}{(s+2{,}32)(s-2{,}54\angle 136)(s-2{,}54\angle -136)}$$

$$T_3(s) = \frac{15}{(s+2{,}32)(s^2+3{,}65\cdot s + 2{,}54^2)}$$

$$T_3(s) = \frac{2{,}32}{\underset{\uparrow}{s+2{,}32}} \cdot \underbrace{\frac{2{,}54^2}{(s^2+3{,}65\cdot s+2{,}54^2)}}_{\downarrow}$$

$$e^{-j\,\mathrm{arctg}\left(\frac{\omega}{2{,}32}\right)} \qquad e^{-j\,\mathrm{arctg}\left(\frac{3{,}65\,\omega}{(2{,}54)^2-\omega^2}\right)}$$

$$e^{\underbrace{j(-1)\left(\mathrm{arctg}\left(\frac{\omega}{2{,}32}\right)+\mathrm{arctg}\left(\frac{3{,}65\cdot\omega}{(2{,}54)^2-\omega^2}\right)\right)}_{\phi(\omega)}}$$

$$D(\omega) = -\frac{d\phi}{d\omega}$$

$$D(\omega) = \frac{d\left(\operatorname{arctg}\left(\frac{\omega}{2,32}\right)\right)}{d\omega} + \frac{d\left(\operatorname{arctg}\left(\frac{3,65\cdot\omega}{(2,54)^2-\omega^2}\right)\right)}{d\omega}$$

Lindas derivadas

$$D(\omega) = \frac{2,32}{\left(\omega^2+(2,32)\right)^2} + \frac{\frac{3,65}{(2,54)^2-\omega^3} + \frac{2\cdot 3,65\cdot\omega^3}{(2,54)^2-\omega^2}}{\frac{3,65^2\cdot\omega^2}{\left((2,54)^2-\omega^2\right)^2}+1}$$

$$D(0) = 0,9967$$

$$D(2,5) = 0,7559$$

otra forma

Polos $z_1 = -2,32$

$z_2 = -1,839 + 1,754j$

$z_3 = -1,839 - 1,754j$

$$D_{(\omega)} = \frac{|\sigma_2|}{\sigma_2^{\,2} + (\omega+\omega_2)^2} + \frac{|\sigma_1|}{\sigma_1^{\,2} + (\omega+\omega_1)^2} + \frac{|\sigma_3|}{\sigma_3^{\,2} + (\omega+\omega_3)^2}$$

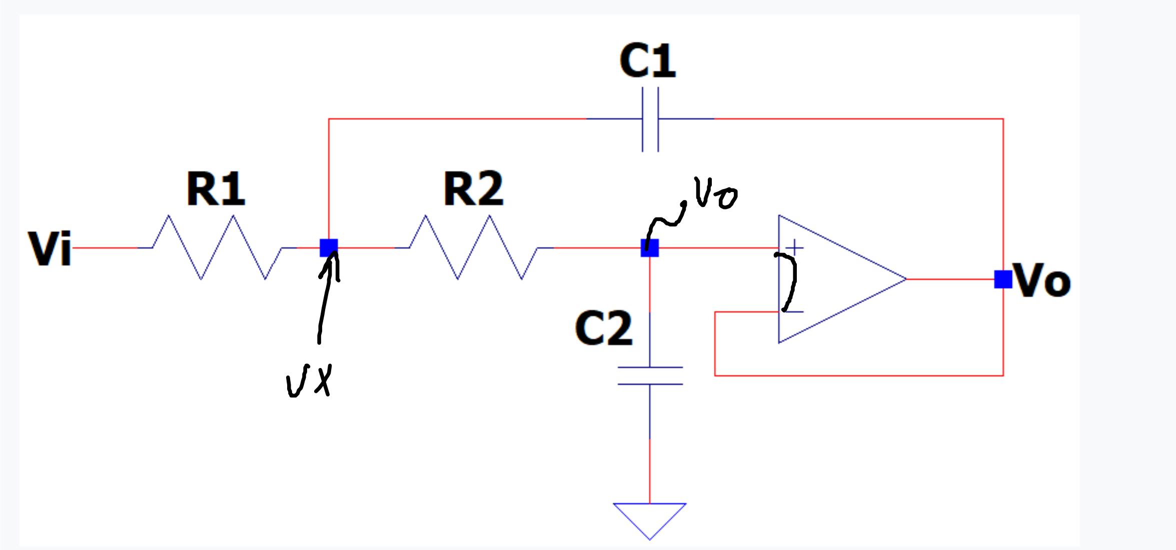
$$D(0) = 1$$

$$D(2,5) = 0,752$$

Desviamiento Porcentual:

$$\frac{D(0)-D(2,5)}{D(0)}\cdot 100 = 24,8\%$$

4)



$$V_o = V_x \cdot \frac{\frac{1}{R_2}}{sC_2+\frac{1}{R_2}} = V_x \cdot \frac{1}{sC_2R_2+1}$$

$$V_x\left(G_1+G_2+sC_1\right) = V_i G_1 + V_o\left(G_2+sC_1\right)$$

$$V_x = V_o\left(sC_2R_2+1\right)$$

$$V_o\left(s\frac{C_2}{G_2}+1\right)\left(G_1+G_2+sC_1\right) = V_i G_1 + V_o\left(G_2+sC_1\right)$$

$$V_o\left(\frac{sC_2G_1}{G_2}+sC_2+s^2\frac{C_1C_2}{G_2}+G_1+\cancel{G_2}+\cancel{sC_1}-\cancel{G_2}-\cancel{sC_1}\right)=V_iG_1$$

$$V_0\left[S^2\cdot\frac{C_1C_2}{G_1G_2}+S\left[\frac{C_2}{G_1}+\frac{C_2}{G_2}\right]+1\right]=V_1$$

$$\frac{V_0}{V_1}=\frac{\frac{G_1G_2}{C_1C_2}}{S^2+S\cdot\left[\frac{G_1}{C_1}+\frac{G_2}{C_1}\right]+\frac{G_1G_2}{C_1C_2}}$$

$$\frac{V_0}{V_1}=\frac{\frac{1}{R_1R_2C_1C_2}}{S^2+S\left[\frac{1}{R_1C_1}+\frac{1}{R_2C_1}\right]+\frac{1}{R_1R_2C_1C_2}}$$

Sallen-Key

$$T_3(s)=\underbrace{\frac{2{,}32}{s+2{,}32}}_{\text{Pasabajo}}\cdot\overbrace{\frac{2{,}54^2}{(s^2+3{,}65\cdot s+2{,}54^2)}}$$

Sallen-Key

$$H(s)=\frac{2{,}54^2}{s^2+3{,}65\cdot s+2{,}54^2}=\frac{\omega_0^2}{s+\frac{\omega_0}{Q}s+\omega_0^2}$$

$$\omega_0=\sqrt{\frac{1}{R_1R_2}}\cdot\sqrt{\frac{1}{C_1'C_2'}}$$

$$\frac{\omega_0}{Q}=\frac{1}{C_1'}\left[\frac{1}{R_1}+\frac{1}{R_2}\right]\longrightarrow R_1=\left(\frac{\omega_0\cdot C'}{Q}-\frac{1}{R_2}\right)^{-1}$$

$$C_1 = 10\,nF$$

$$C_1' = C_1 \cdot \Omega\omega = 5 \cdot 10^{-5}$$

$$\Omega\omega = \frac{1}{D(0)} = 5000$$

$$R_1 = 10k\Omega$$

$$\downarrow$$

$$R_2 = 12121\,\Omega$$

$$C_2' = 2{,}557 \cdot 10^{-5}$$

$$C_2 = 5{,}114\,nF$$

Relleno Matematico de despeje

$$\downarrow$$

$$Q = \frac{\sqrt{\frac{1}{R_1 R_2}} \cdot \frac{1}{C'}}{\frac{1}{C'}\left[\frac{1}{R_1} + \frac{1}{R_2}\right]} = \frac{\sqrt{\frac{1}{R_1 R_2}}}{\left[\frac{1}{R_1} + \frac{1}{R_2}\right]}$$

$$R_1 = \frac{1}{R_2 C'^2 \omega_0^2} \rightarrow R_2 = \frac{1}{R_1 C'^2 \omega_0^2} \quad \mathrm{I}$$

$$R_1 = \frac{1}{\frac{\omega_0 \cdot C'}{Q} - \frac{1}{R_2}} = \frac{R_2 \cdot Q}{\omega_0 C' R_2 - 1}$$

$$R_1 R_2 \omega_0 C' - R_1 = R_2 \cdot Q$$

$$R_2 (R_1 \omega_0 C' - Q) = R_1$$

$$R_2 = \frac{R_1}{R_1 \omega_0 C' - Q} \quad \mathrm{II}$$

$$\mathrm{I} = \mathrm{II}$$

$$\frac{R_1}{R_1 \omega_0 C' - Q} = \frac{1}{R_1 C'^2 \omega_0^2}$$

$$R_1^2 C'^2 \omega_0^2 = R_1 \omega_0 C' - Q$$

$$R_1^2 C'^2 \omega_0^2 - R_1 \omega_0 C' + Q = 0$$

$$R_1 = \frac{-b \pm \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a} = \frac{\omega_0 C' \pm \sqrt{(\omega_0 C')^2 - 4 \cdot Q \cdot (\omega_0^2 C'^2)}}{2 \cdot (C' \cdot \omega_0)^2}$$

Para bajo

$$\frac{2{,}32}{s + 2{,}32} \rightarrow \frac{1}{R_3 C_3'} = \omega_{o_2} \rightarrow R_3 = \frac{1}{C_3' \, \omega_{o_2}}$$

$$C_3 = 10nF \rightarrow C_3' = 5 \cdot 10^{-5}$$

$$\rightarrow R_3 = 8620{,}7 \, \Omega$$