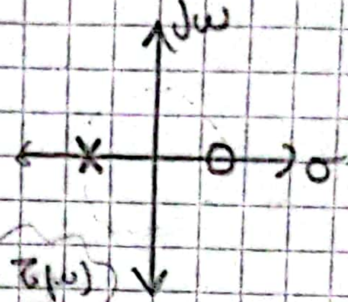
TS5

1) a) Implemento Paso Todo de primer orden Normalizado

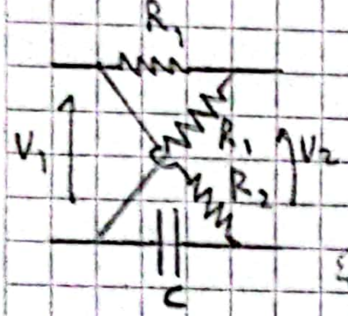
$$T(s)=\frac{s-\omega_0}{s+\omega_0} \to T(s)=\frac{s-1}{s+1} \to T(j\omega)=\frac{j\omega-1}{j\omega+1}$$



$$|T(j\omega)|=\frac{\sqrt{\omega^2+1}}{\sqrt{\omega^2+1}}=1 \qquad \varphi=\arctg(-\omega)-\arctg(\omega)$$

$$\tau=\frac{\sigma_z}{\sigma_z^2+\omega^2}-\frac{\sigma_p}{\sigma_p^2+\omega^2}=-\frac{1}{\omega^2+1}-\frac{1}{\omega^2+1}=-\frac{2}{\omega^2+1}=\tau(\omega)$$

b) Circuito Pasivo Lattice → R_1 y R_1 forman un divisor de tension $V_i \frac{R}{R+}$



$$T(s)=\frac{V_2}{V_1} \to V_2=\frac{V_i}{2}-\frac{G_2}{G_2+sC}V_i$$

$$T(s)=\frac{V_2}{V_1}=\left(\frac{1}{2}-\frac{G_2}{G_2+sC}\right)=\frac{G_2+sC-2G_2}{2(G_2+sC)}=\frac{sC-G_2}{2(sC+G_2)}$$

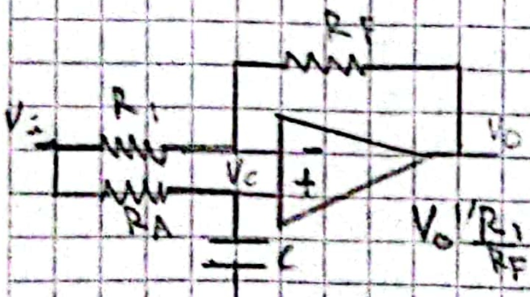
$$T(s)=\frac{1}{2}\,\frac{s-\frac{1}{R_2C}}{s+\frac{1}{R_2C}}$$

Calculo R_2 y C: $\varphi=\arctg(-CR_2)-\arctg(CR_2)$ $\quad \omega=1$

Normalizo impedancia $R_2=1$ $\quad 15°=\arctg(-c)-\arctg(c)$

$\to \arctg(-c)=\frac{15°}{2}=7,5° \to |C|=\tan(7,5)=0,131F=C$

Circuito Activo $\qquad V_c=V_i\frac{\frac{1}{sC}}{R_A+\frac{1}{sC}}=\frac{1}{sCR_A+1}$



$$\frac{V_i-V_c}{R_1}=\frac{V_c-V_0}{R_F} \to V_0\frac{R_1}{R_F}=V_c\left(\frac{R_1}{R_F}+1\right)-V_i$$

$$V_0\frac{R_1}{R_F}=V_i\left[\frac{1}{sCR_A+1}\,\frac{R_1+R_F}{R_F}-1\right]=V_i\frac{-(sCR_A+1)R_F+R_1+}{(sCR_A+1)R_F}$$

$$T(s)=\frac{R_F}{R_1}\,\frac{R_1-sCR_AR_F}{(sCR_A+1)R_F}=-\frac{R_F}{R_1}\,\frac{s-\frac{R_1}{CR_AR_F}}{s+\frac{1}{CR_A}}$$

No especifica K, aplico todas las R = 1 y siguiendo el mismo procedimiento: C = 0,131

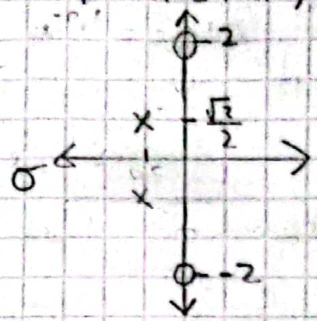
NOTA

2) $T(s) = K \dfrac{s^2 + s\frac{\omega_m}{Q} + \omega_m^2}{s^2 + s\frac{\omega_p}{Q_p} + \omega_p^2}$

Butter Pasa altos de 2^{do} orden: $\dfrac{}{(s^2 + \sqrt{2}\,s + \omega_p^2)}$ $\omega_p^2 \to 1$ $\qquad \dfrac{\omega_p}{Q_p} = \sqrt{2}$

Son todas respuestas de un filtro elimina Banda: $T(s) = \dfrac{s^2 + \omega_m^2}{(s^2 + \sqrt{2}s + 1)}$ $\qquad \dfrac{1}{Q} = \sqrt{2}$

a) Filtro elimina Banda $Q_m >> Q_p$



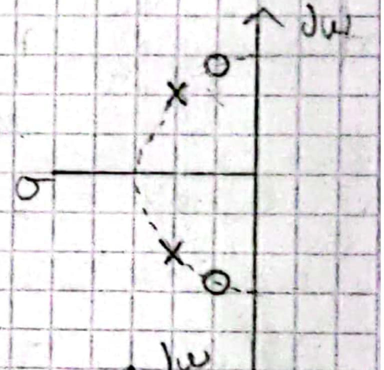
Arranca en 0 y termina en -12 dB $\to \omega_m > \omega_p$

$-12\,dB = 20 \log|K| \to -0{,}6 = \log K \to K = 0{,}251$

$Q_p = \dfrac{\sqrt{2}}{2}$ $\quad Q_m \to \infty$ $\quad \omega_p = 1$ $\quad P_{1,2} = -\dfrac{\sqrt{2}}{2} \pm j\dfrac{\sqrt{2}}{2}$

La asintota cae en $\omega = 2 \to \omega_m = 2$

b) Elimina Banda con Q_m finito. Ganancia $K = 1$

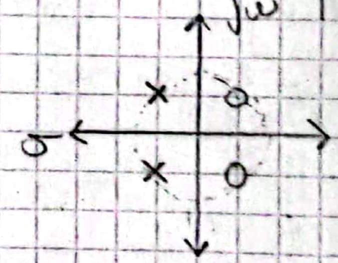


$-6 = +20 \log \dfrac{Q_p}{Q_m} \to 10^{\frac{+6}{20}} = \dfrac{Q_m}{Q_p} \to Q_m = 10^{\frac{+6}{20}} Q_p = \sqrt{2}$

$Q_m = \sqrt{2}$ $\quad Q_p = \dfrac{\sqrt{2}}{2}$ $\quad \omega_p = \omega_m = 1$

$P_{1,2} = -\dfrac{\sqrt{2}}{2} \pm j\dfrac{\sqrt{2}}{2}$ $\qquad O_{1,2} = -0{,}353 \pm j0{,}935$

c) Filtro Pasa todo K no especifica, puede tomar cualquier valor

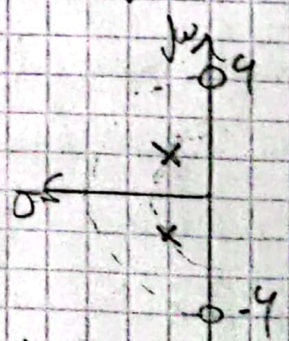


$\omega_p = \omega_m = 1$

$Q_p = \dfrac{\sqrt{2}}{2}$ $\quad Q_m = -\dfrac{\sqrt{2}}{2}$ $\quad P_{1,2} = -\dfrac{\sqrt{2}}{2} \pm j\dfrac{\sqrt{2}}{2}$

$O_{1,2} = \dfrac{\sqrt{2}}{2} \pm j\dfrac{\sqrt{2}}{2}$

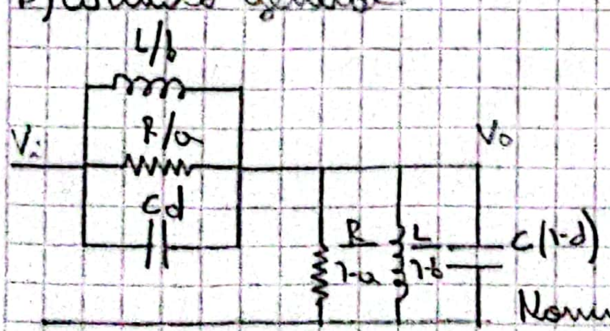
d) Elimina Banda parecido a a) $\quad K$ no especifica



Asintota en $\omega = 4 \to \omega_m = 4$ $\quad \omega_p = 1$

$Q_m \to \infty$ $\quad Q_p = \dfrac{\sqrt{2}}{2}$ $\quad O_{1,2} = \pm j4$ $\quad P = -\dfrac{\sqrt{2}}{2} \pm j\dfrac{\sqrt{2}}{2}$

B) Circuito general



$T(s) = d\,\dfrac{s^2 + s\frac{a}{d}\frac{1}{RC} + \frac{b}{d}\frac{1}{LC}}{s^2 + s\frac{1}{RC} + \frac{1}{LC}}$

$T(s) = d\,\dfrac{s^2 + s\frac{\omega_m}{Q}\frac{a}{d} + \frac{b}{d}\frac{1}{LC}}{s^2 + s\frac{\omega_p}{Q_p} + \omega_p^2}$

Normalizo $R = 1$ $\quad \dfrac{1}{LC} = 1 \Rightarrow L = \dfrac{1}{C}$

$L = Q$ $\qquad C = \dfrac{1}{Q}$

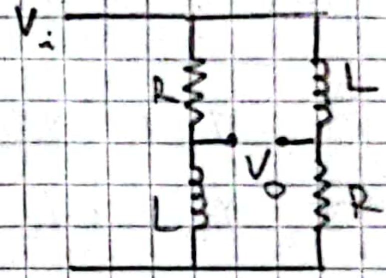
Caso a) $a = 0$ $d = 0{,}251 = K$

$\omega_n = 2 = \frac{b}{d}\ \left(\frac{1}{LC}\right) \Rightarrow b = 2d = 0{,}502$

Caso b) $\omega_n = 1$ $K = 1 = d$

$\frac{b}{d} = 1 \Rightarrow b = 1$ $\frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} \frac{a}{d} \Rightarrow a = 1$

Caso c) $R = 1$

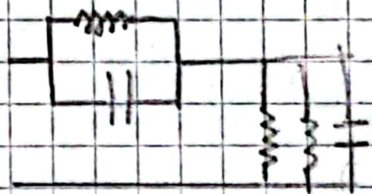


$$T(s) = K \frac{s^2 - s\frac{\omega_n}{Q_n} + \omega_n^2}{s^2 + s\frac{\omega_p}{Q_p} + \omega_p^2}$$

$R = 1$ $L = \frac{\sqrt{2}}{2} = Q_n$

Caso d) $K = 1 = d$ $\omega_n = 4$

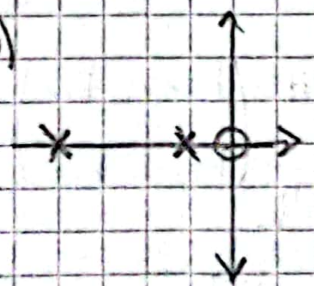
$4 = \frac{b}{d} \Rightarrow b = 4$ $a = 0$



3) $\varphi(\omega) = \frac{\pi}{2} - \operatorname{arctg}\left(\frac{6\omega}{4-\omega^2}\right)$ $\operatorname{Tg}(\varphi) = \frac{\operatorname{Im}(F(j\omega))}{\operatorname{Re}(F(j\omega))}$ con $K = 6 \Rightarrow 6 \cdot \frac{1}{6} = 1$

$$F(j\omega) = \frac{j\omega}{4-\omega^2 + j6\omega} = F(s)\Big|_{j\omega = \frac{s}{j}} = \frac{s\, K \cdot \frac{1}{6}}{4 + s^2 + 6s} \Rightarrow F(s) = \frac{s}{s^2 + 6s + 4}$$

b)

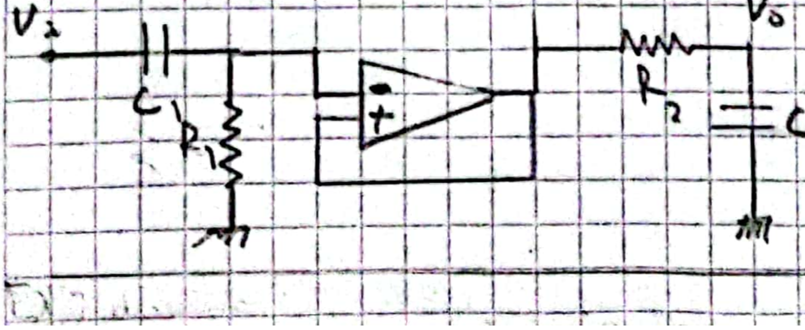


$\omega \to 0 \Rightarrow \varphi = \frac{\pi}{2}$

$\omega \to \infty \Rightarrow \varphi = -\frac{\pi}{2}$

$$T(s) = 6 \frac{s}{(s + 5{,}236)} \cdot \frac{1}{s + 0{,}764}$$

Circuito Pasivo:



$$T(s) = \frac{s}{s + \frac{1}{RC_1}} \cdot \frac{1}{s + \frac{1}{RC_2}}$$

$C_1 = \frac{1}{5{,}236} = 0{,}2\,F$ $C_2 = 1{,}3\,F$