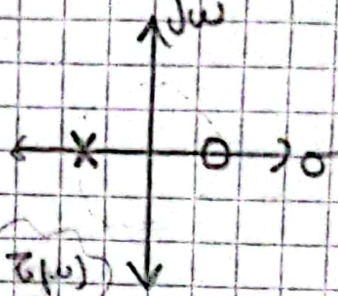
# TS5

1) a) Implemento Pasa Todos de primer orden Normalizado

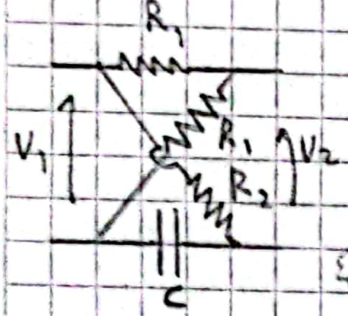
$$T(s) = \frac{s-\omega_0}{s+\omega_0} \rightarrow T(s) = \frac{s-1}{s+1} \rightarrow T(j\omega) = \frac{j\omega - 1}{j\omega + 1}$$




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

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

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




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

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

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

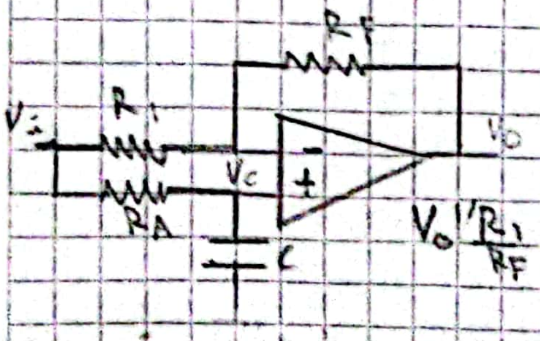
Calculo $R_2$ y $C$: $\varphi = \operatorname{arctg}(-CR_2) - \operatorname{arctg}(CR_2)$ $\quad \omega = 1$

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

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

Circuito Activo

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




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

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

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

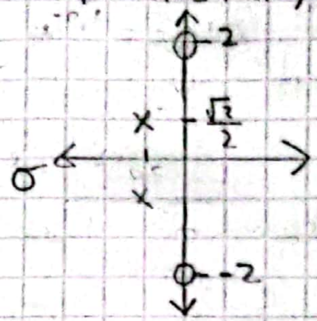
No especifica K, aplico todos los R = 1 y siguiendo el mismo procedimiento: $C = 0{,}131$

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 Paso altos de $2^{do}$ orden: $(s^2+\sqrt{2}\,s+\underbrace{\omega_p^2}_{1})$ $\qquad \frac{\omega_p}{Q_p} = \sqrt{2}$

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




a) Filtro elimina Banda $Q_m >> Q_p$

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

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

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

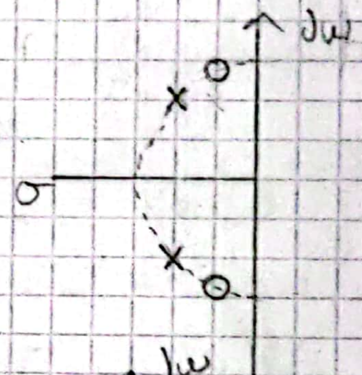
La asíntota cae en $\omega = 2 \to \omega_m = 2$

b) Elimina Banda con $Q_m$ finito. Ganancia $\boxed{K=1}$

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

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

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

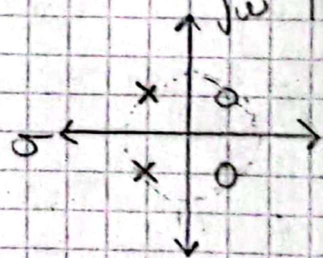



c) Filtro Pasa todo $\quad$ K no especifica, puede tomar cualquier valor

$\omega_p = \omega_m = 1$

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

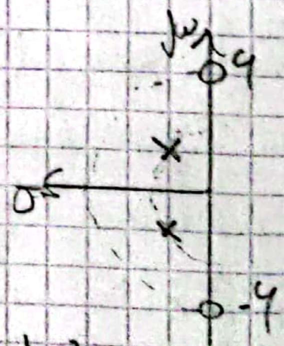
$O_{1,2} = \frac{\sqrt{2}}{2} \pm j\frac{\sqrt{2}}{2}$



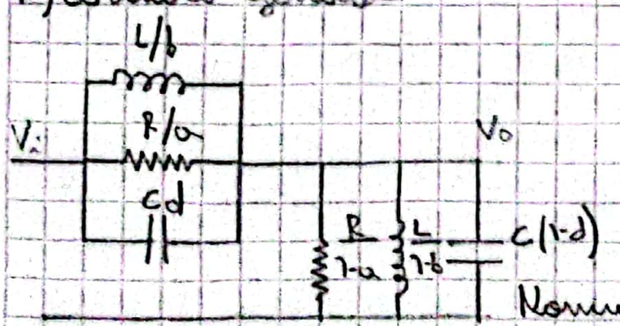

d) Elimina Banda parecido a a) $\quad$ K no especifica

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

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




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

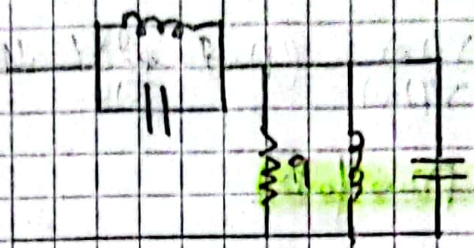
$L = Q$ $\qquad C = \frac{1}{Q}$

Escaneado con CamScanner

HOJA N°
FECHA

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

$\omega_m = 2 = \dfrac{b}{d}$   $\dfrac{1}{LC}$   $\to b = 2d = 0{,}502$



Caso b) $\omega_m = 1$   $K = 1 = d \to$

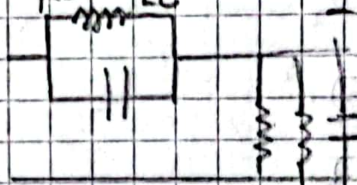
$\dfrac{b}{d} = 1 \to b = 1$   $\dfrac{1}{\sqrt{2}} = \dfrac{1}{\sqrt{2}}\dfrac{a}{d} \to a = 1$

Caso c) $C = \dfrac{1}{\sqrt{2}}$   $L = \sqrt{2}$

$$T(s) = K\,\frac{s^2 - s\frac{\omega_m}{Q_m} + \omega_m^2}{s^2 + s\frac{\omega_p}{Q_p} + \omega_p^2} = \frac{s^2 - s\frac{1}{RC} + \frac{1}{LC}}{s^2 + s\frac{1}{RC} + \frac{1}{LC}}$$


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

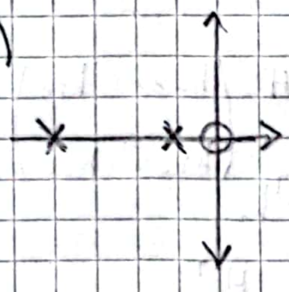
$4 = \dfrac{b}{d} \to b = 4$   $a = 0$



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

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

b)

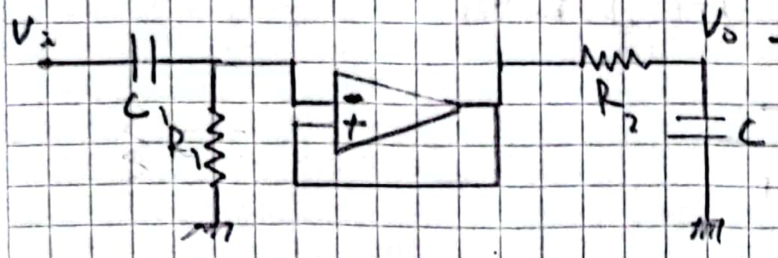


$\omega \to 0 \Rightarrow \varphi = \dfrac{\pi}{2}$

$\omega \to \infty \quad \varphi = -\dfrac{\pi}{2}$

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

Circuito Pasivo:




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

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

Escaneado con CamScanner