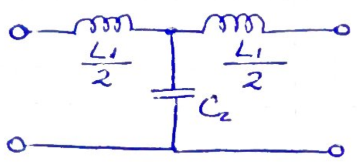
$$Z_1^2 + 2 \cdot 20 \cdot Z_1 - 50^2 = 0$$

$$Z_1^2 + 40 Z_1 - 2500 = 0 \quad \begin{cases} (Z_1)_1 = 33{,}851\ \Omega \\ (Z_1)_2 = -73{,}851\ \Omega \end{cases}$$

$$\boxed{Z_1 = Z_3 = 33{,}851\ \Omega}$$

107) Calcular los componentes de un filtro pasa-bajos Kcte considerando $R_0 = 600\ \Omega$ y $f_c = 3\,kHz$.

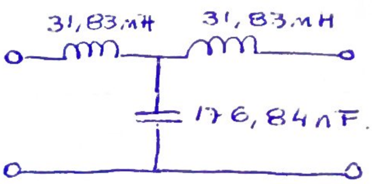


$$L_1 = \frac{2 R_0}{\omega_c} \Rightarrow \frac{L_1}{2} = \frac{R_0}{\omega_c}.$$

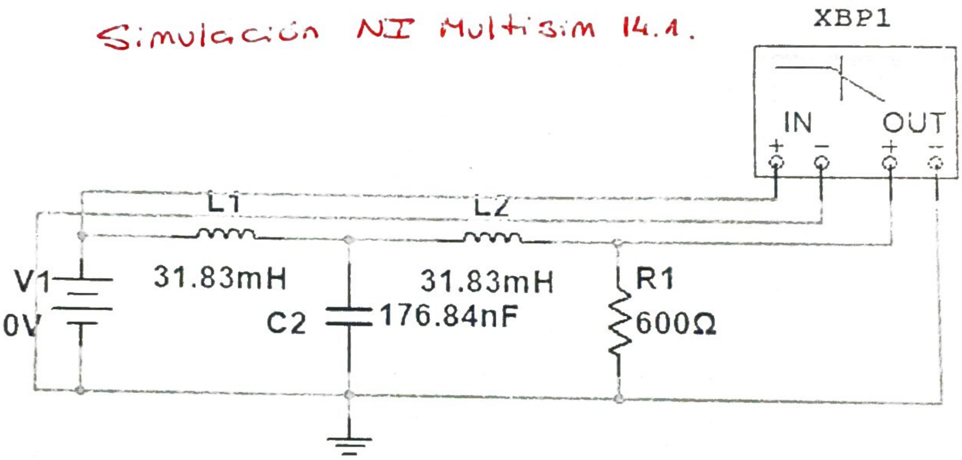
$$C_2 = \frac{2}{R_0\, \omega_c}$$

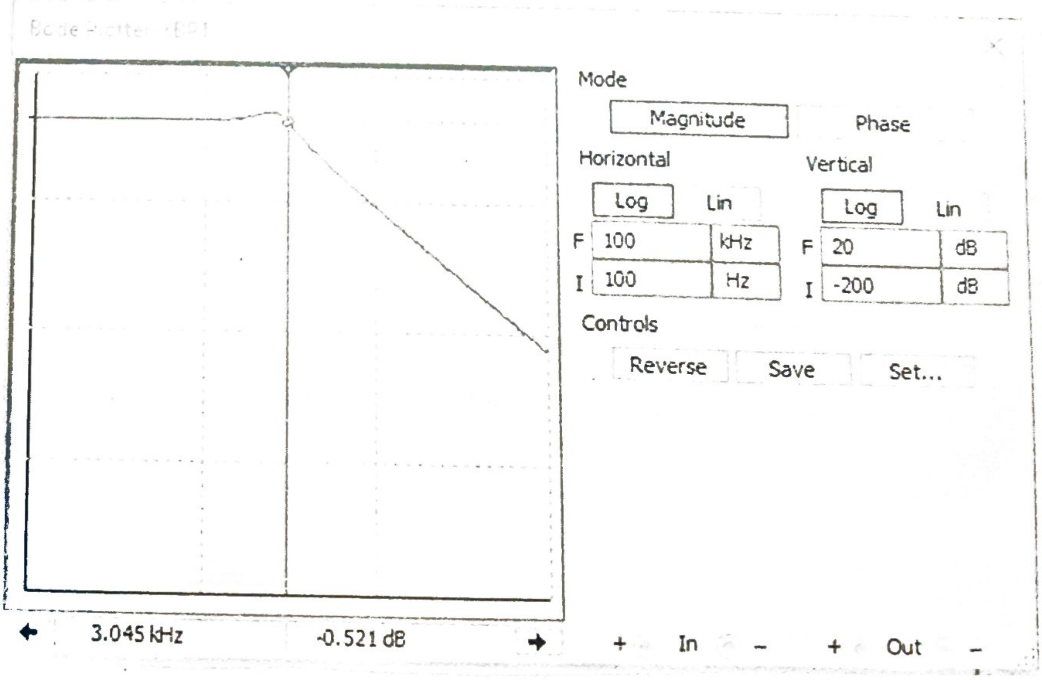
$$\frac{L_1}{2} = \frac{600}{2\pi \cdot 3 \times 10^3}\ Hy = \boxed{31{,}83\ mH = \frac{L_1}{2}}$$

$$C_2 = \frac{2}{600 \times 2\pi \cdot 3 \times 10^3} = \boxed{176{,}84\ nF = C_2}$$

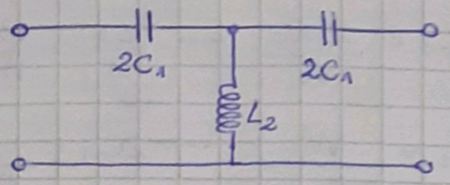


Simulación NI Multisim 14.1.





108) Calcular los componentes de un filtro pasa-altos Kcte considerando $R_0 = 600\,\Omega$ y $f_c = 3\,kHz$.

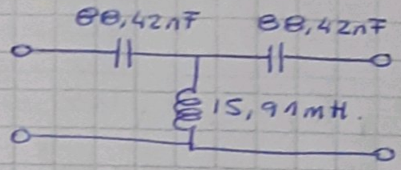


$$C_1 = \frac{1}{2R_0\omega_c} \rightarrow 2C_1 = \frac{1}{R_0\omega_c}$$

$$L_2 = \frac{R_0}{2\omega_c}$$

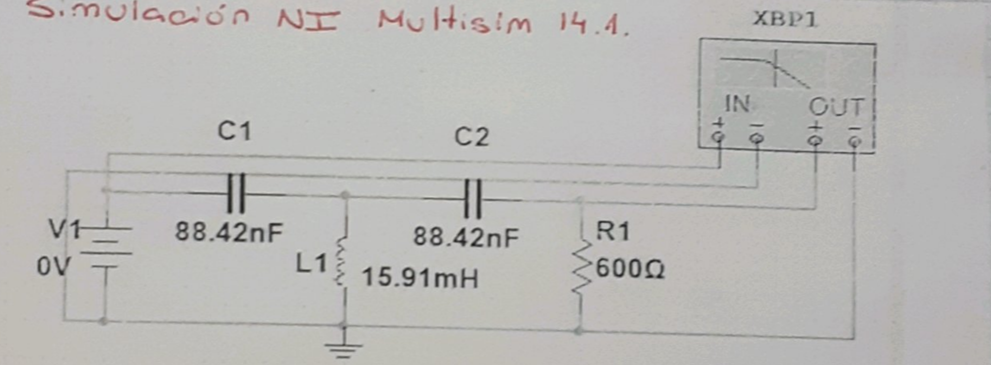
$$2C_1 = \frac{1}{600 \times 2\pi \times 3\times10^3}\ F = 88,42\ nF$$

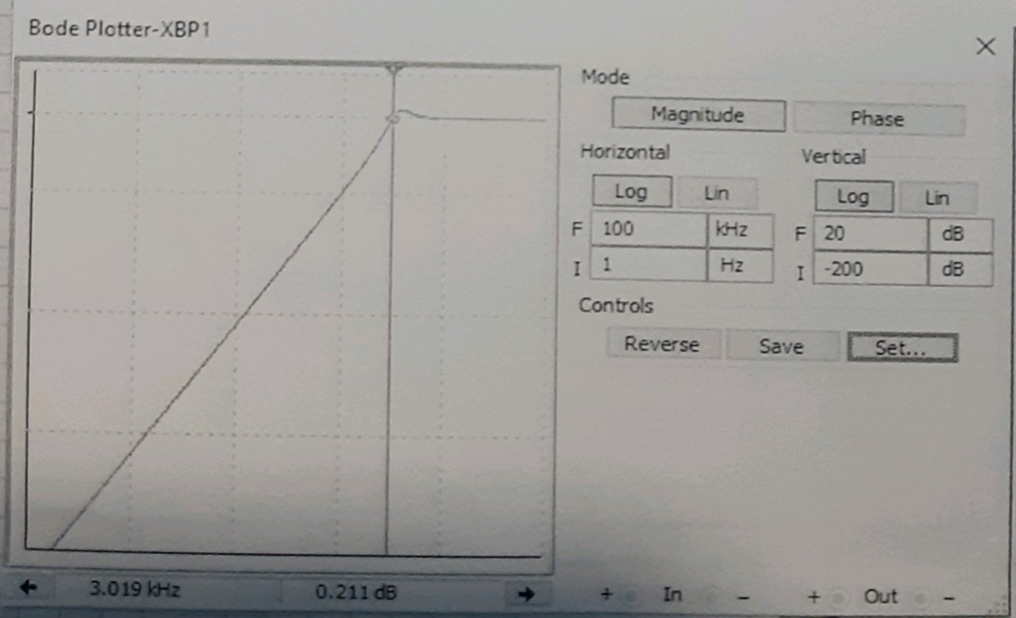
$$L_2 = \frac{600}{2\times 2\pi \times 3\times10^3}\ H = 15,91\ mH$$



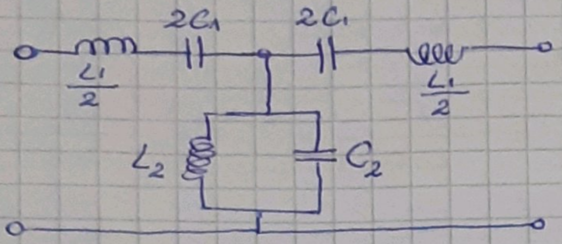
$\boxed{2C_1 = 88,42nF}$ $\boxed{L_2 = 15,91mH}$

Simulación NI Multisim 14.1.





109) Calcular los componentes de un filtro pasa-banda k-cte considerando $R_0 = 600\Omega$, con f_{c1} (inferior) $= 1kHz$ y f_{c2} (superior) $= 4kHz$



$\omega_0 \to$ media geométrica entre ω_{c1} y ω_{c2}

$$f_0 = \sqrt{f_{c1} \times f_{c2}} = \sqrt{1kHz \cdot 4kHz} = 2kHz$$

$$\omega_0 = 2\pi \cdot 2 \times 10^3 \text{ rps}$$

$$F\left(\begin{smallmatrix}\text{Ancho de} \\ \text{Banda}\end{smallmatrix}\right) = f_{c2} - f_{c1} = 3kHz$$

$$W = 2\pi \cdot F = 2\pi \cdot 3 \times 10^3 \text{ rps}$$

$$L_1 = \frac{2R_0}{W} \to \frac{L_1}{2} = \frac{R_0}{W}$$

$$C_1 = \frac{W}{2R_0 \omega_0^2} \to 2C_1 = \frac{W}{R_0 \cdot \omega_0^2}$$

$$L_2 = \frac{R_0}{2W}$$

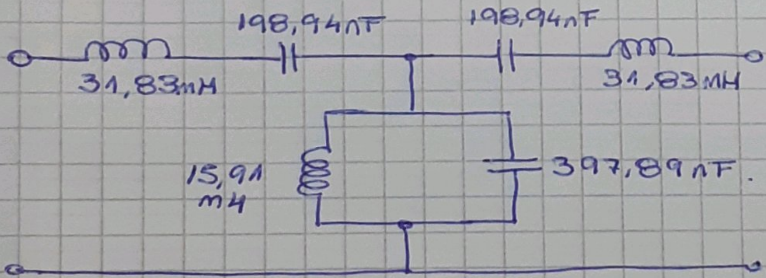
$$C_2 = \frac{2W}{R_0 \omega_0^2}$$

- $\frac{L_1}{2} = \frac{600}{2\pi 3 \times 10^3} H = \boxed{31,83 \, mH = \frac{L_1}{2}}$

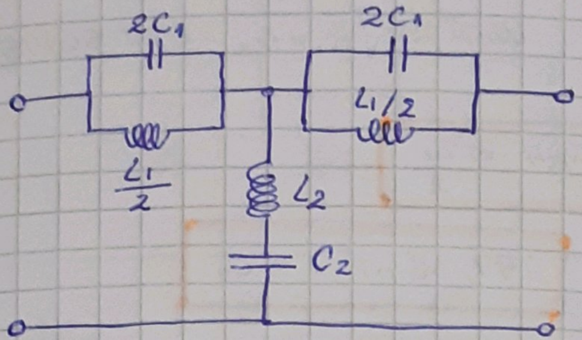
- $2C_1 = \frac{2\pi 3 \times 10^3}{600 \times (2\pi \times 2 \times 10^3)^2} F = \boxed{198,94 nF = 2C_1}$

- $L_2 = \frac{600}{2 \cdot 2\pi \cdot 3 \times 10^3} H = \boxed{15,91 mH = L_2}$

- $C_2 = \frac{2 \cdot 2\pi \cdot 3 \times 10^3}{600 \cdot (2\pi \cdot 2 \times 10^3)^2} F = \boxed{397,89 nF = C_2}$

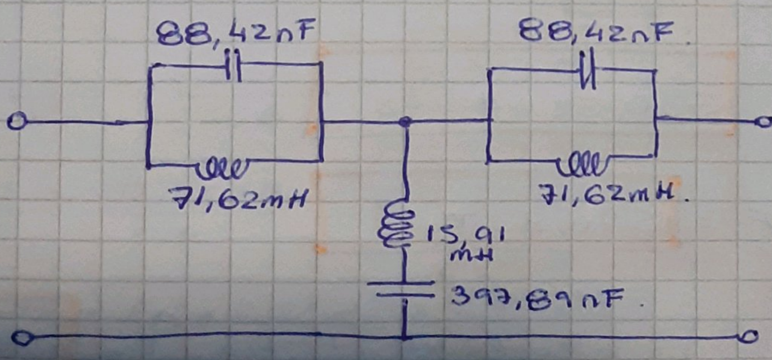


110) Calcular los componentes de un filtro elimina-banda kcte considerando $R_0 = 600\,\Omega$, con $f_{c1} = 1\,kHz$ y $f_{c2} = 4\,kHz$



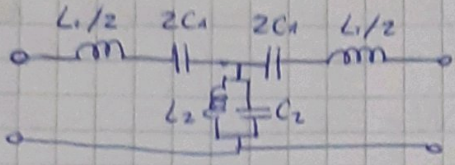
- $W = 2\pi\,(f_{c2} - f_{c1}) = 2\pi \cdot 3\times10^3\ rps$
- $W_0 = 2\pi \cdot \sqrt{f_{c1} \times f_{c2}} = 2\pi \cdot 2\times10^3\ rps$
- $L_1 = \frac{2 R_0 \cdot W}{W_0^2} \rightarrow \frac{L_1}{2} = \frac{R_0 W}{W_0^2}$
- $C_1 = \frac{1}{2 R_0 W} \rightarrow 2C_1 = \frac{1}{R_0 W}$
- $L_2 = \frac{R_0}{2W}$
- $C_2 = \frac{2W}{R_0 W_0^2}$

- $\frac{L_1}{2} = \frac{600 \cdot 2\pi \cdot 3\times10^3}{(2\pi \times 2\times10^3)^2}\,H = \boxed{71{,}62\,mH = \frac{L_1}{2}}$
- $2C_1 = \frac{1}{600 \cdot 2\pi \cdot 3\times10^3}\,F = \boxed{88{,}42\,nF = 2C_1}$
- $L_2 = \frac{600}{2 \cdot 2\pi \cdot 3\times10^3}\,H = \boxed{15{,}91\,mH = L_2}$
- $C_2 = \frac{2W}{R_0 W_0^2} = \frac{2 \cdot 2\pi \cdot 3\times10^3}{600 \cdot (2\pi \cdot 2\times10^3)^2} = \boxed{397{,}89\,nF = C_2}$



111) Calcular los componentes de un filtro pasa banda Kcte y su m-derivado, con $R_0 = 8\,\Omega$ y $m = 0,6$, con $F_{c1} = 8\,KHz$ y $F_{c2} = 10\,KHz$.

K-cte:



$W = 2\pi\,(f_{c2} - f_{c1}) = 2\pi \cdot 2 \times 10^3$ rps

$W_0 = 2\pi \sqrt{f_{c1} \times f_{c2}} = 56198,518$ rps

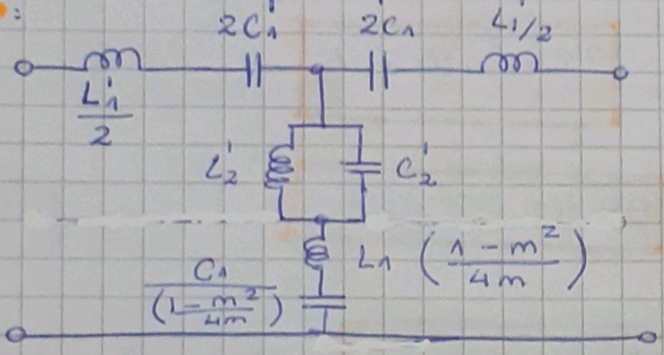
$$\frac{L_1}{2} = \frac{R_0}{W} = \frac{8}{2\pi\, 2 \times 10^3}\,H = \boxed{636,62\,\mu H = \frac{L_1}{2}}$$

$$2C_1 = \frac{W}{R_0\, W_0^2} = \frac{2\pi 2 \times 10^3}{8 \cdot (56198,518)^2}\,F = \boxed{497,36\,nF = 2\,C_1}$$

$$L_2 = \frac{R_0}{2W} = \frac{8}{2 \cdot 2\pi \cdot 2 \cdot 10^3}\,H = \boxed{318,31\,\mu H = L_2}$$

$$C_2 = \frac{2W}{R_0\, W_0^2} = \frac{2 \cdot 2\pi\, 2 \times 10^3}{8 \cdot (56198,518)^2} = \boxed{994,72\,nF = C_2}$$

m-deriv:



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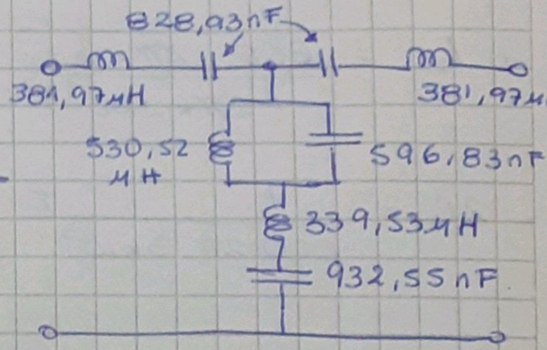
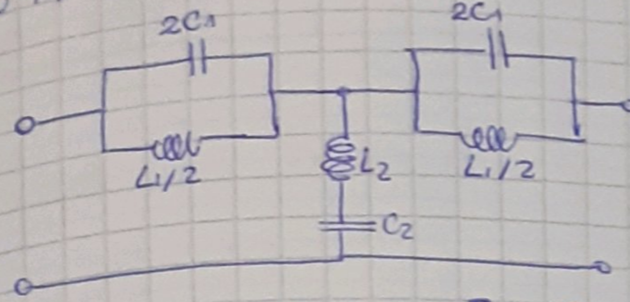


- $$\frac{L_1'}{2} = \frac{L_1}{2} \cdot m = 0,6 \times 636,62\,\mu H = \boxed{381,97\,\mu H = L_1'/2}$$
- $$2C_1' = \frac{2C_1}{m} = \frac{497,36\,nF}{0,6} = \boxed{828,93\,nF = 2\,C_1'}$$
- $$L_2' = \frac{L_2}{m} = \frac{318,31\,\mu H}{0,6} = \boxed{530,52\,\mu H = L_2'}$$
- $$C_2' = m \cdot C_2 = 0,6 \times 994,72\,nF = \boxed{596,83\,nF = C_2'}$$
- $$L_1\left(\frac{1 - m^2}{4m}\right) = \frac{L_1}{2}\left(\frac{1 - m^2}{2m}\right) = 636,62\,\mu H \left(\frac{1 - 0,6^2}{2 \cdot 0,6}\right) = \boxed{339,53\,\mu H}$$
- $$\frac{C_1}{\left(\frac{1 - m^2}{4m}\right)} = \frac{2C_1}{\left(\frac{1 - m^2}{2m}\right)} = \frac{497,36\,nF}{\left(\frac{1 - 0,6^2}{2 \times 0,6}\right)} = \boxed{932,55\,nF}$$

112) Calcular los componentes de un filtro elimina-banda Kcte y su m-derivado. con $R_o = 8\,\Omega$ y $m = 0{,}6$. $f_{c1} = 6\,kHz$ y $f_{c2} = 9\,kHz$.

K-cte:



- $W = 2\pi\,(f_{c2} - f_{c1}) = 2\pi \cdot 3\times10^3\ rps$
- $W_0 = 2\pi\sqrt{f_{c1} \times f_{c2}} = 46171{,}79\ rps$

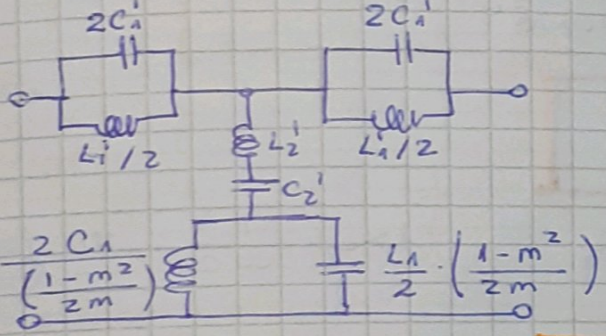
- $\dfrac{L_1}{2} = \dfrac{R_o W}{W_o^2} = \dfrac{8 \cdot 2\pi \cdot 3\times10^3}{(46171{,}79)^2} = \boxed{70{,}73\,\mu H = \dfrac{L_1}{2}}$

- $2C_1 = \dfrac{1}{R_o W} = \dfrac{1}{8 \cdot 2\pi\, 3\times10^3} = \boxed{6{,}63\,\mu F = 2C_1}$

- $L_2 = \dfrac{R_o}{2W} = \dfrac{8}{2 \cdot 2\pi \cdot 3\times10^3} = \boxed{212{,}21\,\mu H = L_2}$

- $C_2 = \dfrac{2W}{R_o W_o^2} = \dfrac{2 \cdot 2\pi \cdot 3\times10^3}{8 \cdot (46171{,}79)^2} = \boxed{2{,}21\,\mu F = C_2}$

m-deriv:



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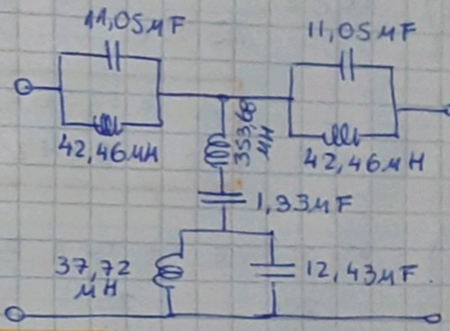


- $\dfrac{L_1'}{2} = \dfrac{L_1}{2} \cdot m = 0{,}6 \times 70{,}73\,\mu H = \boxed{42{,}46\,\mu H = \dfrac{L_1'}{2}}$

- $2C_1' = \dfrac{2C_1}{m} = \dfrac{6{,}63\,\mu F}{0{,}6} = \boxed{11{,}05\,\mu F = 2C_1'}$

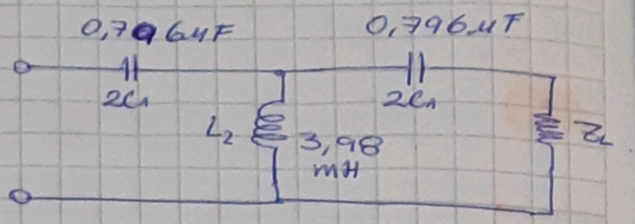
- $L_2' = \dfrac{L_2}{m} = \dfrac{212{,}21\,\mu H}{0{,}6} = \boxed{353{,}68\,\mu H = L_2'}$

- $C_2' = m\,C_2 = 0{,}6 \times 2{,}21\,\mu F = \boxed{1{,}33\,\mu F = C_2'}$

- $\dfrac{L_1}{2}\left(\dfrac{1-m^2}{2m}\right) = 70{,}73\,\mu H \left(\dfrac{1-0{,}6^2}{2 \cdot 0{,}6}\right) = \boxed{37{,}72\,\mu H =}$

- $\dfrac{2C_1}{\left(\dfrac{1-m^2}{2m}\right)} = \dfrac{6{,}63\,\mu F}{\left(\dfrac{1-0{,}6^2}{2 \cdot 0{,}6}\right)} = \boxed{12{,}43\,\mu F}$

113) Dado el cuadripolo. Determinar.



a) Tipo de filtro
b) Valor de Zo (imp. carac.)
c) Valor de Z_L
d) W_c (frec de corte)
e) Atenuación para $f = 500Hz$.

a) Filtro pasa alto.

b) c) $\boxed{Z_o = Z_L = R_o}$

$$2C_1 = \frac{1}{R_o W_c} \Rightarrow W_c = \frac{1}{R_o \, 2C_1}$$

$$L_2 = \frac{R_o}{2W_c} = \frac{R_o}{2\left(\frac{1}{R_o 2C_1}\right)} = \frac{R_o^2 \cdot 2C_1}{2}$$

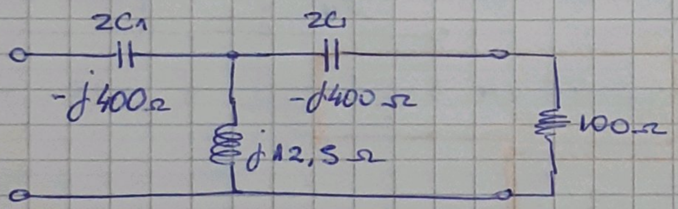
$$R_o = \sqrt{\frac{2L_2}{2C_1}} = \sqrt{\frac{2\times 3{,}98\times 10^{-3}}{0{,}796\times 10^{-6}}}\ \Omega = 100\,\Omega$$

$$\boxed{R_o = 100\,\Omega = Z_L}$$

d) $$W_c = \frac{1}{R_o \, 2C_1} = \frac{1}{100 \cdot 0{,}796\times 10^{-6}}$$

$$\boxed{\begin{array}{l} W_c = 12562{,}81 \text{ rps} \\ f_c = 2\,kHz \end{array}}$$

e) $f = 500Hz \rightarrow \omega = 2\pi \cdot 500Hz$; $-jX_C = -j\frac{1}{\omega C}$; $jX_L = j\omega L$



* $$\frac{E_{in}}{E_{out}} = A + \frac{B}{Z_{out}}$$

- $$A = \frac{Z_{11}}{Z_{21}} = \frac{j12{,}5 - j400}{j12{,}5} = -31$$

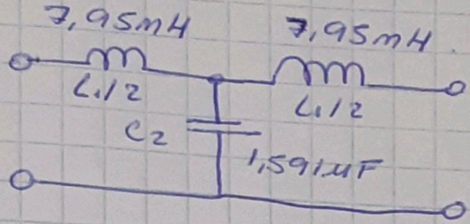
- $$B = \frac{\Delta Z}{Z_{21}} = \frac{(-j400 + 12{,}5j)^2 - (12{,}5j)^2}{j12{,}5} = 12000j$$

* $$\frac{E_{in}}{E_{out}} = -31 + \frac{12000j}{100} = 123{,}94 \angle 104{,}48^\circ \longrightarrow$$

$$\boxed{\begin{array}{l} e^{\alpha} = 123{,}94 \quad \begin{pmatrix} 4{,}82\,Np \\ 41{,}86\,dB \end{pmatrix} \\ \beta = 104{,}48^\circ \end{array}}$$

114) Dado el sig. cuad. determinar:

a) Tipo de filtro
b) Z_0
c) Z_L
d) ω_c
e) Atenuación para $f = 3000Hz$



a) Filtro pasa bajo

b), c) $Z_0 = Z_L = R_0$.

$$\frac{L_1}{2} = \frac{R_0}{\omega_c} \quad ; \quad C_2 = \frac{2}{R_0 \omega_c} \rightarrow \omega_c = \frac{2}{C_2 R_0}$$

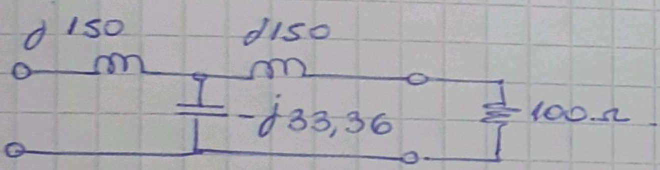
$$\frac{L_1}{2} = R_0 \cdot \frac{C_2 R_0}{2} \rightarrow R_0 = \sqrt{\frac{L_1/2}{C_2/2}} = \sqrt{\frac{7{,}95 \times 10^{-3}}{\frac{1{,}591 \times 10^{-6}}{2}}} = 100\,\Omega.$$

$$\boxed{Z_0 = 100\,\Omega}$$

d) $$\omega_c = \frac{2}{C_2 R_0} = \frac{2}{1{,}591 \times 10^{-6} \times 100} = 12570{,}71 \text{ cps}$$

$$\boxed{\begin{array}{l} \omega_c = 12570{,}71 \text{ cps} \\ f_c = 2kHz \end{array}}$$

e) P/3KHz:



$$\frac{E_{in}}{E_{out}} = A + \frac{B}{Z_{out}}$$

· $$A = \frac{j150 - j33{,}36}{j33{,}36} = 3{,}5$$

· $$B = \frac{(j150 - j33{,}36)^2 - (-j33{,}36)^2}{-j33{,}36} = -j\,374{,}46$$

$$\frac{E_{in}}{E_{out}} = 3{,}5 - j\frac{374{,}46}{100} = 5{,}12 \,\lfloor\!\underline{-46{,}93^\circ} \rightarrow \boxed{\begin{array}{l} e^{\alpha} = 5{,}12 \quad \begin{pmatrix} 1{,}63 Np \\ 14{,}18 dB \end{pmatrix} \\ \beta = -46{,}93^\circ \end{array}}$$