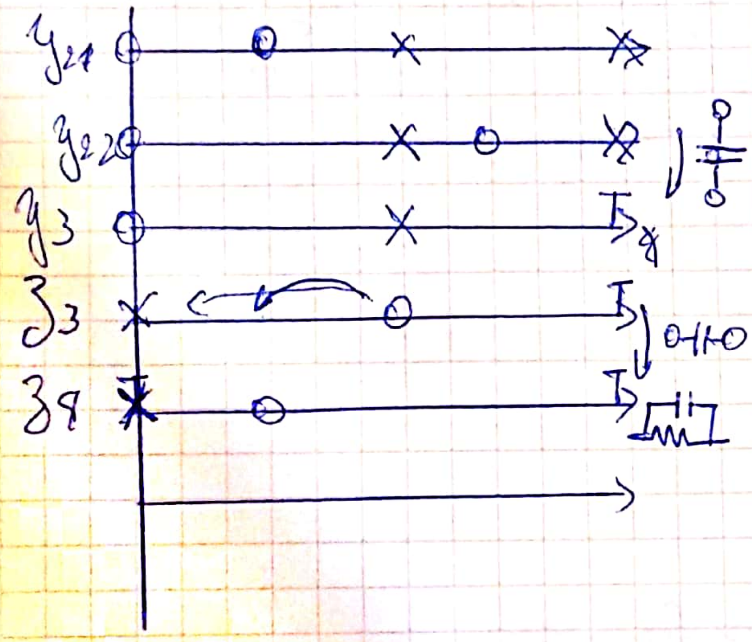
1) a) $-y_{21} = \frac{s(s+1)}{s+2}$ $\qquad y_{22} = \frac{s(s+2,25)}{s+2}$

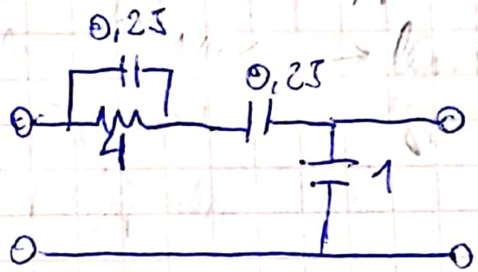


$\lim_{s\to\infty} \frac{1}{s} y_{22} = 1$

$y_3 = y_{22} - s = \frac{1/4\, s}{s+2}$

$z_3 = \frac{s+2}{1/4\, s} \rightarrow \frac{1}{C_2} = s\, z_3 \Big|_{s=-1} = 4$

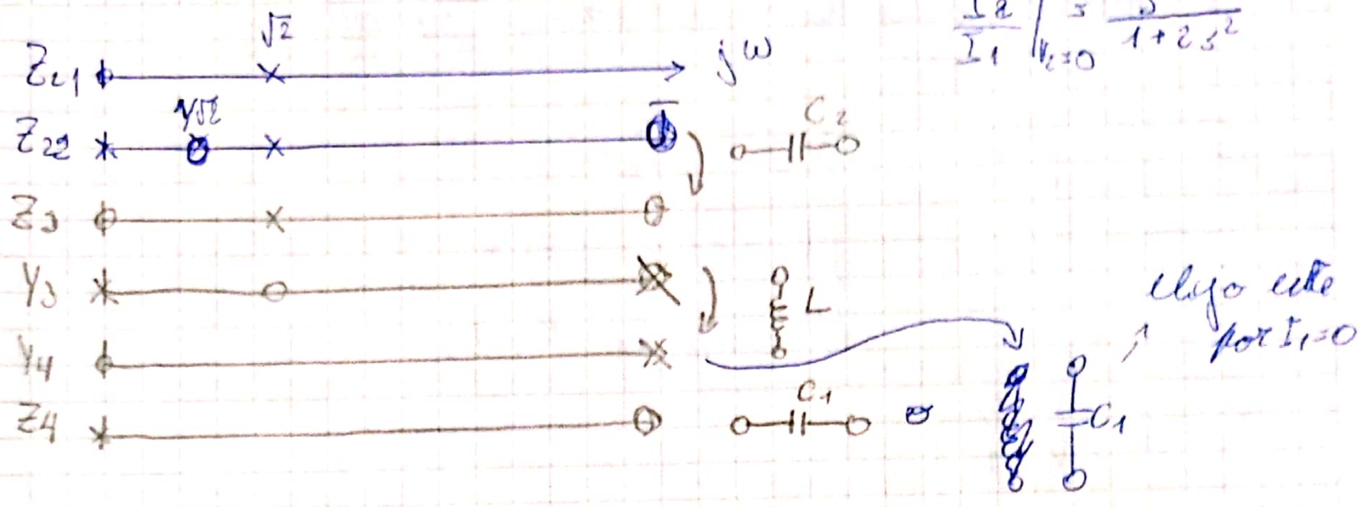
$z_4 = z_3 - \frac{4}{s} = \frac{s+1}{1/4\, s} \rightarrow R = 4$, $C = 0,25$



$\frac{1/4 + 0,125 s}{1/4 + 1,125 s}$

b) $Z_{21} = \dfrac{s}{s^2+2}$ $\qquad Z_{22} = \dfrac{1+2s^2}{s(s^2+2)}$

$\dfrac{I_2}{I_1}\Big|_{V_2=0} = \dfrac{s^2}{1+2s^2}$



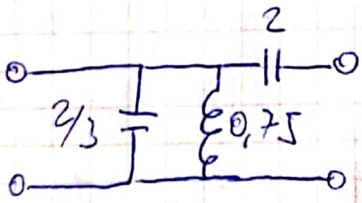
$C_2^{-1} = \lim_{s\to 0} s\, Z_{22}(s) = 1/2 \rightarrow C_2 = 2$

$Z_3 = Z_{22} - \dfrac{1}{2s} = \dfrac{1+2s^2-0{,}5s^2-1}{s(s^2+2)} = \dfrac{1{,}5s^{\cancel{2}}}{\cancel{s}(s^2+2)}$

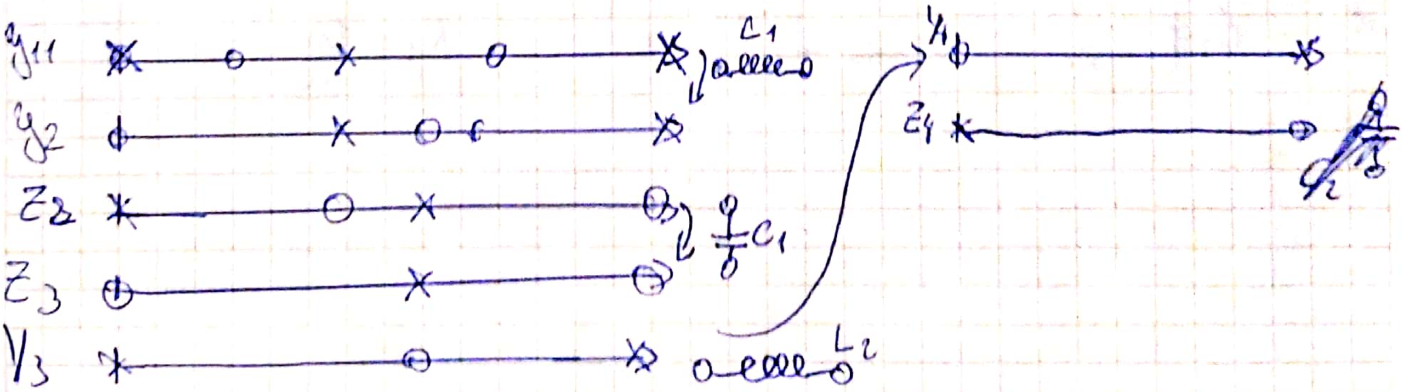
$Y_3 = \dfrac{s^2+2}{1{,}5s} \rightarrow \lim_{s\to 0} s\, Y_3(s) = \dfrac{4}{3} = \dfrac{1}{L}$

$Y_4 = \dfrac{s^2+2-2}{1{,}5s} = \dfrac{s^{\cancel{2}}}{1{,}5\cancel{s}} \rightarrow C_1 = 2/3$

~~$Z_4 = \dfrac{1{,}5}{s} \rightarrow C_1 = 2/3$~~



c) $-y_{21} = \dfrac{1}{s(s^2+4)}$ $\qquad y_{11} = \dfrac{(s^2+1)(s^2+9)}{s(s^2+4)}$



Escaneado con CamScanner

$$\lim_{s\to 0} s\, y_{11} = 9/4 = \frac{1}{L_1}$$

$$y_2 = \frac{s^4 + 10s^2 + 9}{s(s^2+4)} - \frac{9/4}{s} = \frac{s^{\cancel{4}3} + 7{,}75 s^{\cancel{2}}}{\cancel{s}(s^2+4)} = \frac{s(s^2+7{,}75)}{s^2+4} = \frac{1}{Z_2}$$

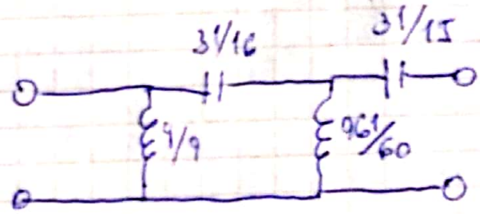
$$\lim_{s\to 0} s\, Z_2 = \frac{16}{31} = \frac{1}{C_1}$$

$$Z_3 = Z_2 - \frac{16/31}{s}$$

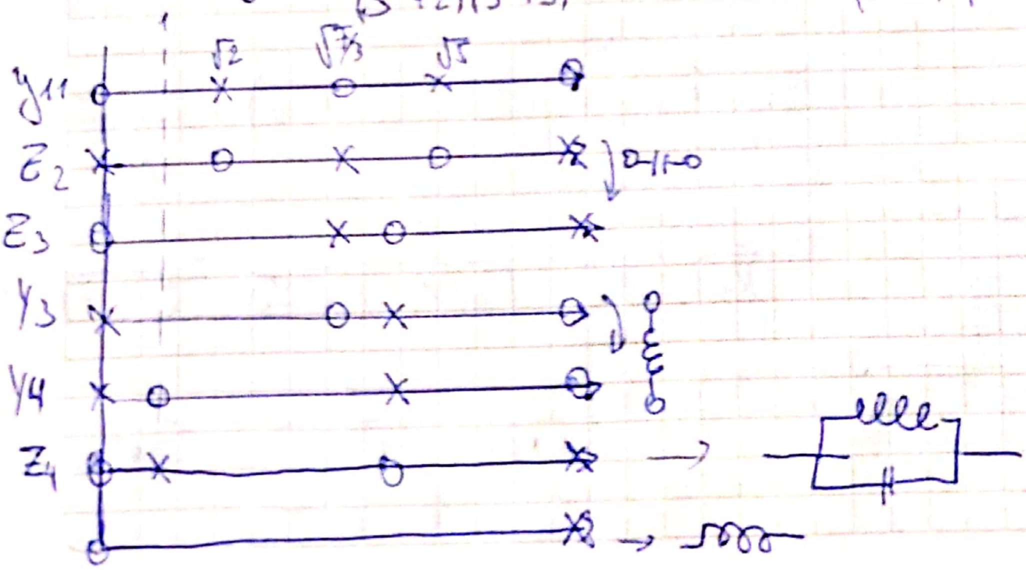
$$Z_3 = \frac{s^2+4}{s(s^2+7{,}75)} - \frac{16/31}{s} = \frac{15/31\, s^{\cancel{2}}}{\cancel{s}(s^2+7{,}75)}$$

$$\lim_{s\to 0} s\, Y_3 = \frac{961}{60} = 1/L_1$$

$$Y_4 = \frac{s^2+7{,}75}{15/31\, s} - \frac{961/60}{s} = \frac{s^{\cancel{2}}}{15/31\, \cancel{s}} \to Z_4 = \frac{1}{\boxed{\frac{31}{15}}\, s} \quad C_2$$



d) $-y_{21} = \frac{s(s^2+1)}{(s^2+2)(s^2+5)}$ $\qquad y_{11} = \frac{3s(s^2+7/3)}{(s^2+2)(s^2+5)}$



$$\lim_{s\to 0} s\, y_{11}^{-1} = \lim_{s\to 0} \frac{(s^2+2)(s^2+5)}{(s^2+7/3)\,3} = 10/7 = 1/C_1$$

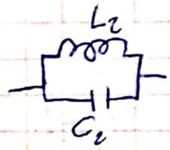
$$Z_2 = \frac{s^4+7s^2+10}{3s(s^2+7/3)} - \frac{10/7}{s} = \frac{s^3+19/7\, s}{3(s^2+7/3)}$$

$$Y_2 = \frac{3(s^2+7/3)}{s(s^2+19/7)} \quad \cancel{\lim_{s\to 0} s Y_2 = \frac{49}{19}}$$

$$1/L_1 = k_0 = \left.\frac{3(s^2+7/3)}{s^2+19/7}\right|_{s^2=-1} = 7/3$$

$$Y_3 = \frac{3(s^2+7/3)}{s(s^2+19/7)} - \frac{7/3}{s} = \frac{2/3\, s^2 + 2/3}{s(s^2+19/7)}$$

$$Z_3 = \frac{s(s^2+19/7)}{2/3\,(s^2+1)}$$



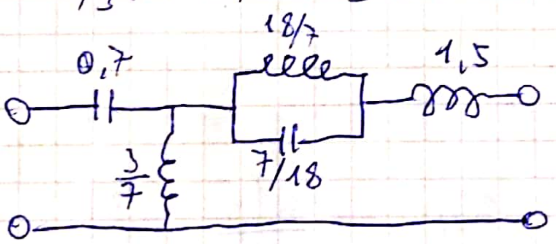
$$\left(sC_2 + \frac{1}{sL_2}\right)^{-1}$$

$$\frac{sL_2}{s^2C_2L_2+1} = \frac{s\,1/C_2}{s^2+\frac{1}{C_2L_2}}$$

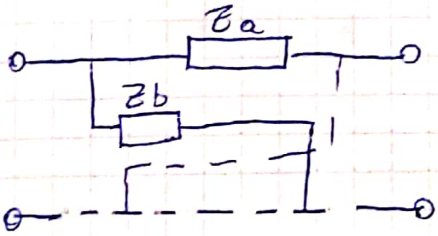
$$\lim_{s^2\to -1} \frac{s^2+1}{s} Z_3 = \frac{18}{7} = 1/C_2 \to L_2 = \frac{18}{7}$$

$$Z_4 = \frac{s(s^2+19/7)}{2/3\,(s^2+1)} - \frac{s\,18/7}{s^2+1} = \frac{s^3+s}{2/3\,(s^2+1)} = \frac{s}{2/3}$$

$L_3 = 1{,}5$



2) $\frac{Z_b - Z_a}{Z_b + Z_a}$



$$\left.\frac{V_1}{I_1}\right|_{I_2=0} = Z_{11} = (Z_a+Z_b)//(Z_a+Z_b) = \frac{Z_a+Z_b}{2}$$

$$\left.\frac{I_1}{V_1}\right|_{V_2=0} = Y_{11} = \frac{1}{(Z_a//Z_b)+(Z_a//Z_b)} = \frac{1}{2(Y_a+Y_b)^{-1}}$$

$$Z_{11} = \frac{s^2+1}{s} K$$

$$Y_{11} = \frac{s^2+1}{s(s^2+2)} K$$

$$Y_{11} = \frac{Z_{11}}{Z_a Z_b} \to \frac{1}{s^2+2} = \frac{1}{Z_a Z_b}$$

$$Z_a = (s^2+2)/Z_b$$

Escaneado con CamScanner

$$2Z_{11} = Z_a + Z_b$$

$$\cancel{2\frac{s^2+2}{s} = Z_A Z_B + Z_b}$$

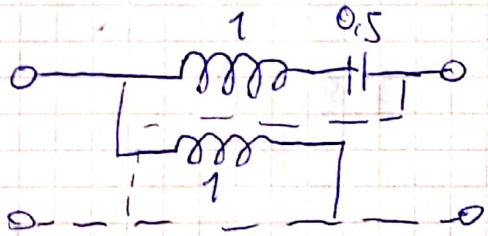
$$2\frac{(s^2+2)}{s} - Z_b = Z_A \qquad s^2+2 = Z_A Z_B$$

$$\cancel{Z_{11}}\ Y_{11} = \frac{s(s^2+2)}{s^2+1}, \quad \cancel{= Z_A Z_B = \left(\frac{2(s^2+2)}{s}\right) Z_B - Z_B^2}$$

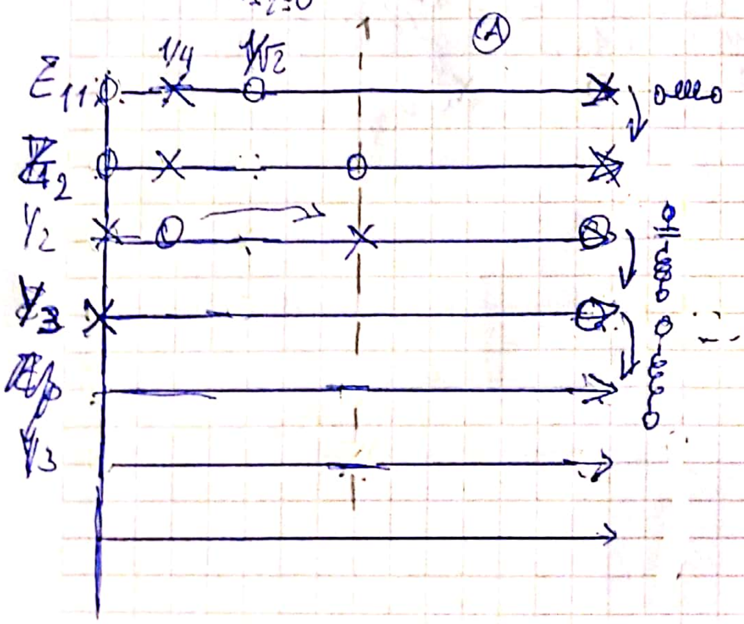
$$s^2+2 = 2\frac{(s^2+2)}{s} Z_B - Z_B^2$$

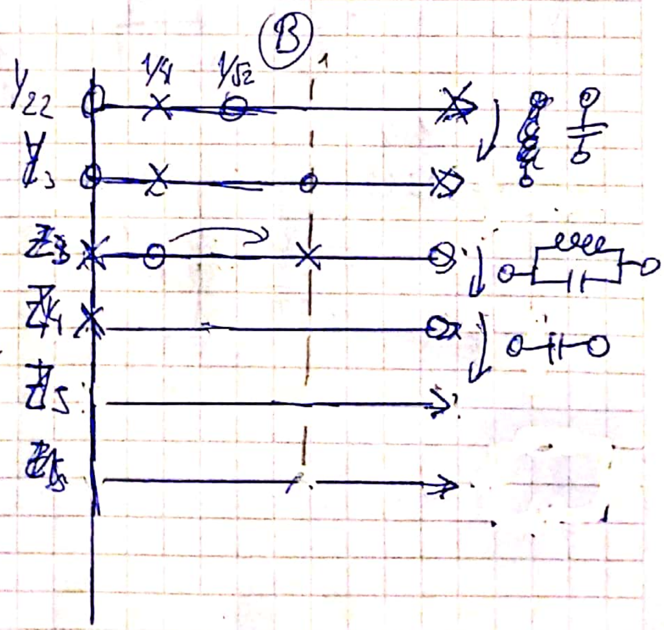
$$L=1 \quad C=0{,}5$$

$$\text{si } Z_b = s \quad \checkmark \quad \rightarrow \quad Z_A = \frac{s^2+2}{s} = \boxed{s} + \boxed{\frac{2}{s}}$$



$$3)\quad \left.\frac{V_2}{V_1}\right|_{I_2=0} = \frac{s^2+1}{2s^2+1} = \frac{Z_{21}}{Z_{11}} = \frac{-Y_{21}}{Y_{22}} \qquad D = \frac{s^2+1/2}{s}$$





3) $T(s) = \left.\frac{V_2}{V_1}\right|_{I_2=0} = \frac{s^2+1}{2s^2+1}$

$Z_{11} = \frac{s(2s^2+1)}{s^2+1/16}$ $\qquad$ $Z_{21} = \frac{s(s^2+1)}{s^2+1/16}$

lim $\left. s\,k'_\infty \right|_{s=j} = \frac{s(2s^2+1)}{s^2+1/16} \Rightarrow k'_\infty = \frac{16}{15} \rightarrow L_1$

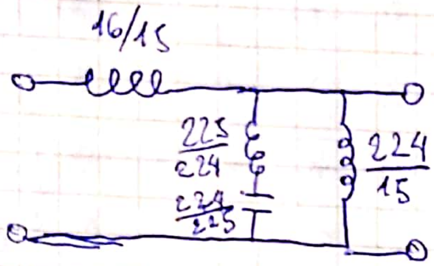
$Z_2 = \frac{2s^3+s-\frac{16}{15}s^3-\frac{1}{15}s}{s^2+1/16} = \frac{\frac{14}{15}s(s^2+1)}{s^2+1/16}$

$Y_2 = \frac{s^2+1/16}{\frac{14}{15}(s^2+1)s} \rightarrow \lim_{s^2\to -1} \frac{s^2+1}{s} Y_2(s) = \frac{225}{224} = 1/C \rightarrow \frac{1}{L} = \frac{228}{225}$

$Y_3 = Y_2 - \frac{\frac{225}{224}s}{s^2+1} = \frac{1/16\,s^2+1/16}{\frac{14}{15}(s^2+1)s} = \frac{1\cancel{7}}{\cancel{2}24}\frac{1}{s}$

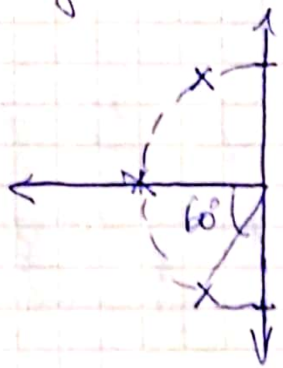
$\Downarrow$

$C = \frac{224}{15}$



4) $\left|\frac{V_2}{V_1}\right| = \sqrt{\frac{k^2}{1+\omega^6}} = |T(j\omega)|$ $\quad Z_L = 50\,\Omega$ → normalizo a $50\,\Omega$

$0 = 1+\omega^6 \xrightarrow[\omega = s/j]{} 0 = 1 - s^6 \to s^6 = 1 = e^{jk\,360^\circ}$



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

$$\begin{cases} V_1 = z_{11} I_1 + z_{12} I_2 \\ V_2 = z_{21} I_1 + z_{22} I_2 \\ V_2 = -\underbrace{Z_L}_{=1} I_2 = -I_2 \end{cases}$$

$$\begin{cases} I_1 = y_{11} V_1 + y_{21} V_2 \\ I_2 = y_{21} V_1 + y_{22} V_2 \\ V_2 = -Z_L I_2 \end{cases}$$

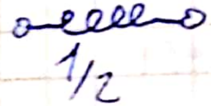
$$\frac{V_2}{V_1} = \frac{-y_{21}}{\frac{1}{Z_L} + y_{22}}$$

$$T(s) = \frac{P}{Q} = \frac{P}{M+N} = \frac{P/\overset{\text{impar}}{M}}{1+N/M} = \frac{K}{1+s^3+2s^2+2s}$$

$$\frac{V_2}{V_1} = \frac{K/(s^3+2s)}{1+\frac{2s^2+1}{s^3+2s}} \rightarrow Y_{22} = \frac{2(s^2+1/2)}{s(s^2+2)} \qquad \frac{1}{Y_{22}} = \frac{\frac{1}{2}s^3+s}{s^2+1/2}$$

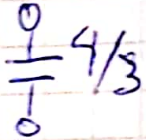
$$\frac{1}{2}s^3 + s \;\Big|\; s^2 + 1/2$$

$$-\;0{,}5s^3 + 0{,}25s \qquad \frac{1}{2}s$$



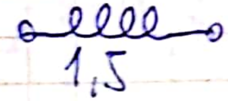
$$s^2 + 1/2 \;\Big|\; \frac{3}{4}s$$

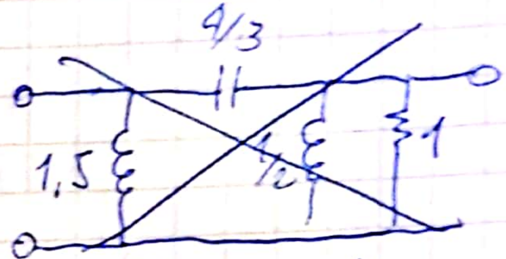
$$-\;s^2 \qquad \frac{4}{3}s$$

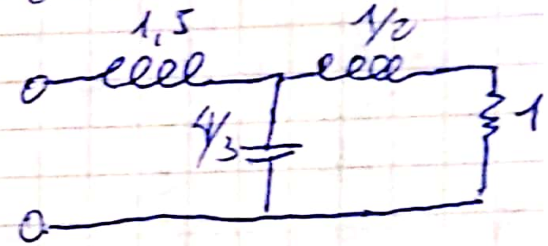


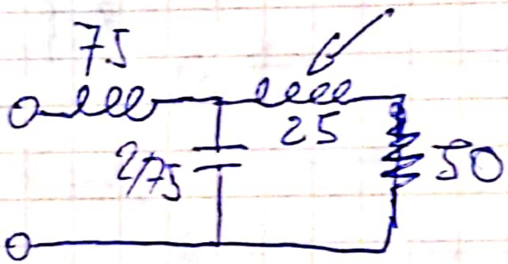
$$\frac{3}{4}s \;\Big|\; 1/2$$

$$0 \qquad \frac{3}{2}s$$



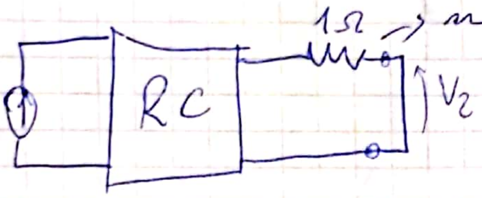






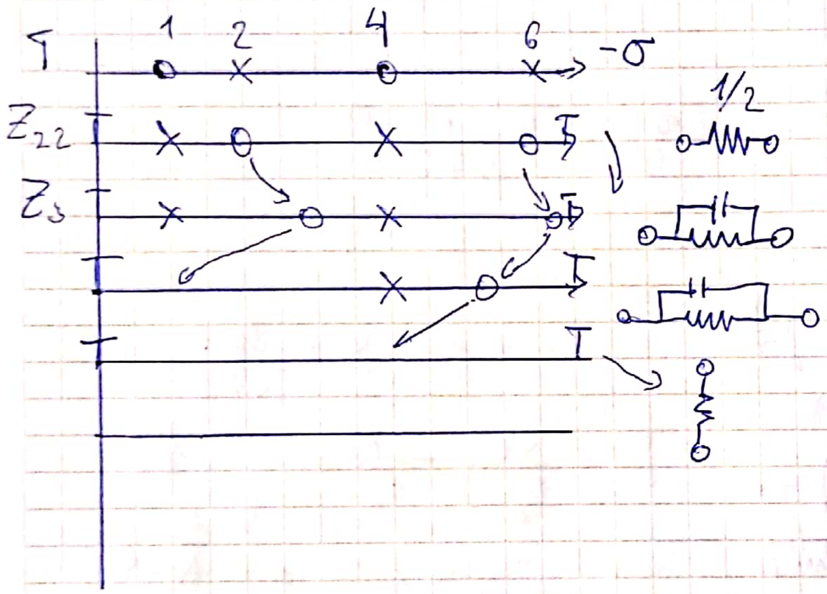
5) $\frac{-I_2}{I_1} = H \frac{s^2+5s+4}{s^2+8s+12}$ $\quad Z_{21} = 6H$

1Ω → no altera Z_{21}



$$\frac{-I_2}{I_1} = \frac{Z_{21}}{Z_{22}} = \frac{6H}{Z_{22}} = H\frac{s^2+5s+4}{s^2+8s+12}$$

$$Z_{22} = 6\frac{(s+2)(s+6)}{(s+1)(s+4)} = \frac{6(s^2+8s+12)}{s^2+5s+4}$$



$$\frac{1}{G+sC} = \frac{1/C}{s+1/RC}$$

$$Z_3 = Z_{22} - 1/2 = \frac{5{,}5s^2+45{,}5s+70}{s^2+5s+4}$$

~~C = 3/10 R1 = 10/3~~

$$\lim_{s\to -1} Z_3\,(s+1) = 10 \rightarrow C = 0{,}1 \rightarrow R = 10$$

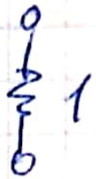
$$\cancel{Z_4 = Z_3 - \frac{10/3}{s+1} = \frac{5{,}5s^2+13/6\,s-10/3}{(s+1)(s+4)} = s - 20/33}$$

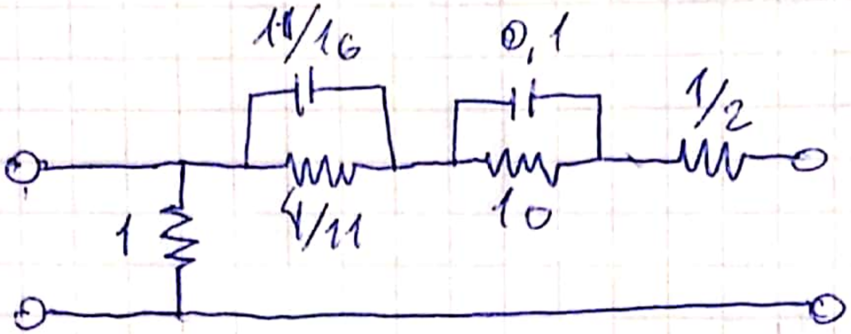
$$Z_4 = Z_3 - \frac{10}{s+1} = \frac{5{,}5s^2+35{,}5s+30}{(s+1)(s+4)} = \frac{s+\frac{60}{11}}{s+4}$$

Escaneado con CamScanner

$$\lim_{s \to -4} (s+4)\, Z_4 = 16/11 \to C_2 = \frac{11}{16} \quad R_2 = \frac{4}{11}$$

$$Z_5 = Z_4 - \frac{16/11}{s+4} = \frac{s+4}{s+4} = 1 \; \to$$





desnormalizo a 2Ω