1) Ej. 6 TP Síntesis de Cuadripolos)

Sintetizar un cuadripolo que cumpla con los siguientes parámetros:

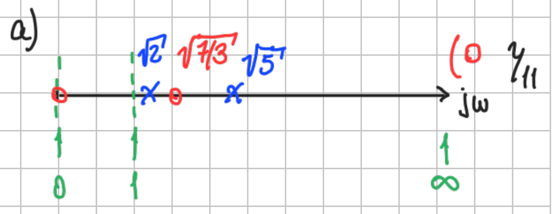
$$Y_{11} = \frac{I1}{V1}\Big|_{V_2=0} = \underbrace{\frac{3s.\,(s^2+7/3)}{(s^2+2)(s^2+5)}}_{A}$$

$$Y_{21} = \frac{I2}{V1}\Big|_{V_2=0} = \underbrace{\frac{s.\,(s^2+1)}{(s^2+2)(s^2+5)}}_{A}$$

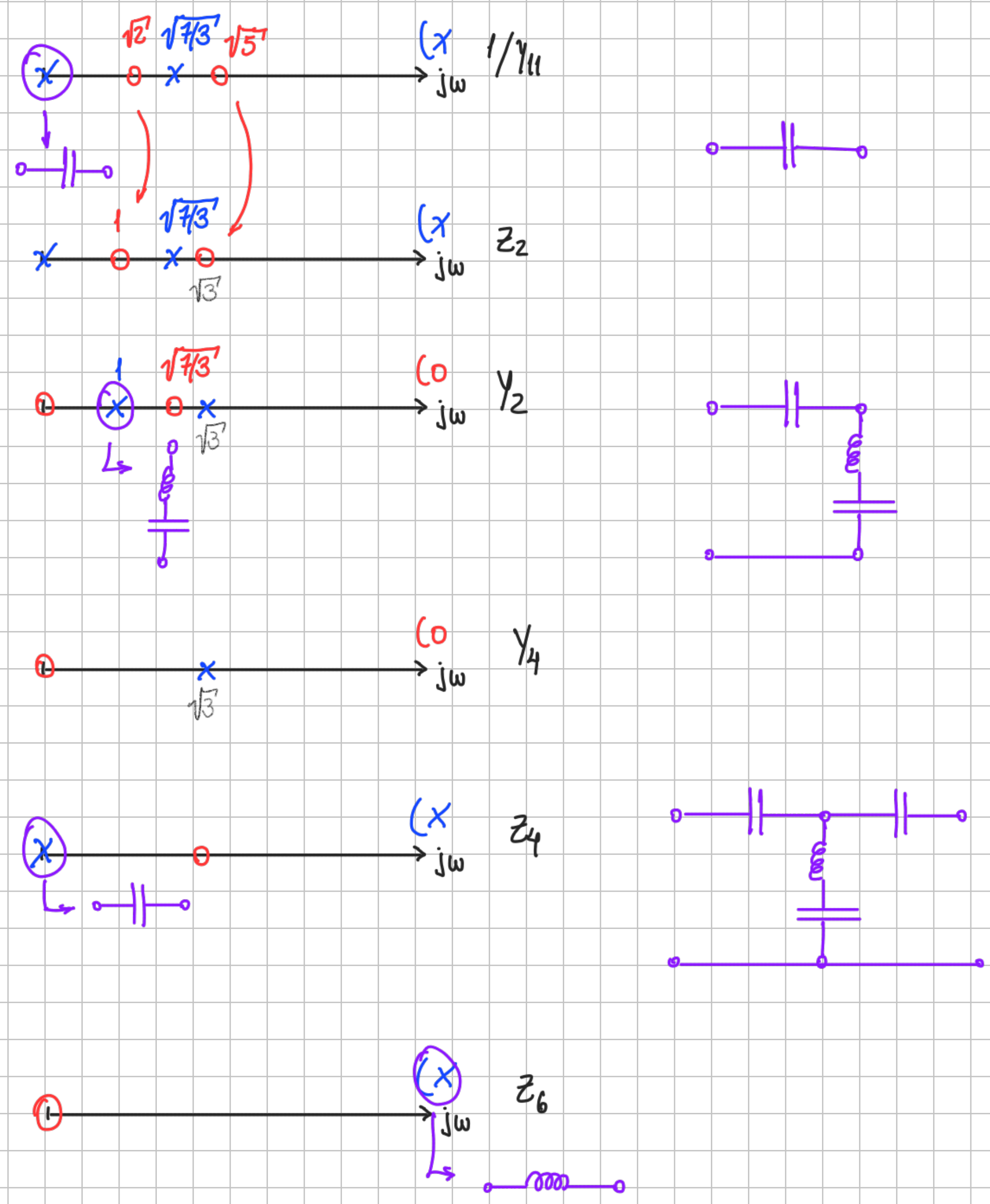
a) Obtener la topología mediante la **síntesis gráfica**, es decir la red sin valores.

b) Calcular el valor de los componentes, es decir la **síntesis analítica.**

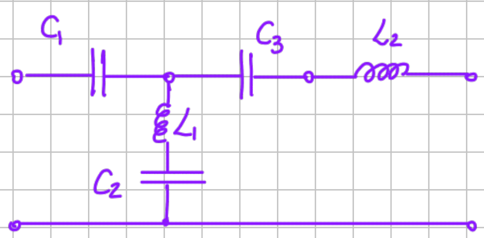
a)



remociones para cumplir con Y_{21}



Finalmente:



b) $1/Y_{11} = \dfrac{(s^2+2)(s^2+5)}{3s\,(s^2+7/3)}$

$Z_2 = 1/Y_{11} - K_0'/s$; $Z_2(j1) = 0 \rightarrow K_0' = s/Y_{11}\Big]_{s=j1} = 1$

↳ $1/K_0' = C_1 = 1$

$Z_2 = \dfrac{(s^2+2)(s^2+5)}{3s\,(s^2+7/3)} - 1/s = \dfrac{(s^2+1)(s^2+3)}{3s\,(s^2+7/3)}$

$Y_2 = 1/Z_2 = \dfrac{3s\,(s^2+7/3)}{(s^2+1)(s^2+3)} \rightarrow Y_4 = Y_2 - \dfrac{2K_i s}{s^2+1}$

$2K_i = \lim_{s^2 \to -1} \dfrac{(s^2+1)}{s} Y_2 = 2$

↳ $L_1 = 1/2K_i$ y $C_2 = 2K_i$

$\begin{cases} L_1 = 1/2 \\ C_2 = 2 \end{cases}$

$Y_4 = \dfrac{3s\,(s^2+7/3)}{(s^2+1)(s^2+3)} - \dfrac{2s}{s^2+1} = \dfrac{s}{(s^2+3)}$

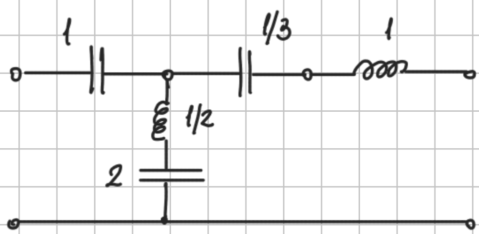
$Z_4 = 1/Y_4 = \dfrac{(s^2+3)}{s} \rightarrow Z_6 = Z_4 - K_0/s \rightarrow K_0 = \lim_{s \to 0} s\,Z_4 = 3$

$1/K_0 = C_3 = 1/3$

$Z_6 = \dfrac{2\,(s^2+3)}{s} - 3/s = s$

$Z_8 = Z_6 - sK_\infty \rightarrow K_\infty = \lim_{s \to \infty} \dfrac{1}{s} Z_6 = 1$

$K_\infty = L_2 = 1$



2) Dada la siguiente transferencia:

$$T(s) = \left.\frac{V2}{V1}\right|_{I_2=0} = \frac{k.(s+1)}{(s+2)(s+4)}$$

a) Obtener la topología circuital que respeta la transferencia solicitada, utilizando parámetros Z e Y.
b) Calcular el valor de los componentes y el parámetro k.

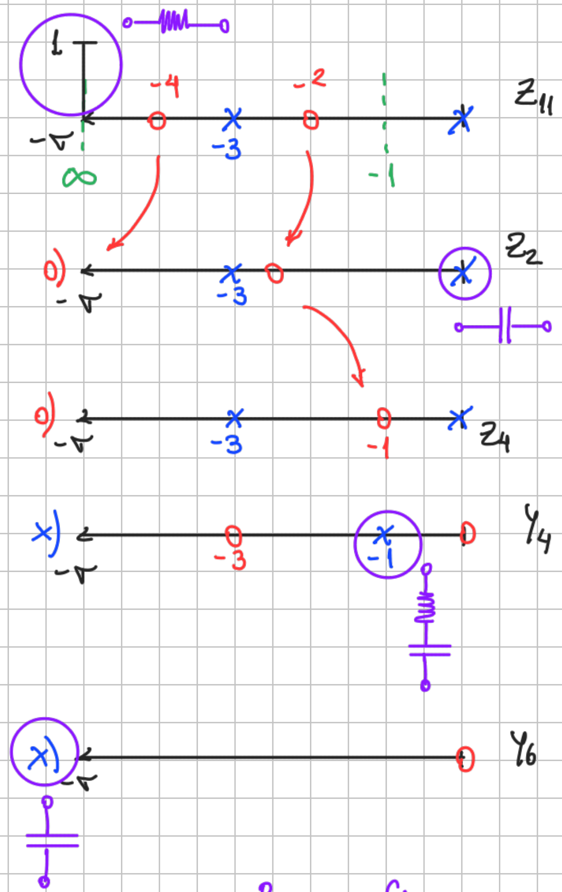
$$T = \frac{Z_{21}}{Z_{11}} = -\frac{Y_{21}}{Y_{22}}$$

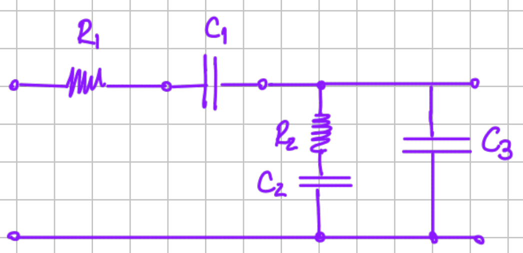
Con parámetros Z:

a) $Z_{11} = \dfrac{(s+2)(s+4)}{A}$; elijo $A = s(s+3)$

$$Z_{11} = \frac{(s+2)(s+4)}{\underbrace{s(s+3)}_{A}}$$

$$Z_{21} = \frac{s+1}{\underbrace{s(s+3)}_{A}}$$





b) $Z_2 = Z_{11} - 1 = \dfrac{(s+2)(s+4)}{s(s+3)} - 1 = \dfrac{3\,(s+8/3)}{s(s+3)}$

$\downarrow$

$\boxed{R_1 = 1}$

$Z_4 = Z_2 - K_0'/s$; $Z_4(-1) = 0 \rightarrow K_0' = s\,Z_2\big|_{s=-1} = 5/2$

$1/K_0' = \boxed{C_1 = 2/5}$

$$Z_4 = \frac{3\,(s+8/3)}{s\,(s+3)} - \frac{5/2}{s} = \frac{s+1}{2s\,(s+3)}$$

$$Y_4 = 1/Z_4 = \frac{2s\,(s+3)}{(s+1)}$$

$$Y_6 = Y_4 - \frac{K_i\, s}{s+1} \rightarrow K_i = \lim_{s\to -1} \frac{(s+1)}{s}\, Y_4 = 4$$

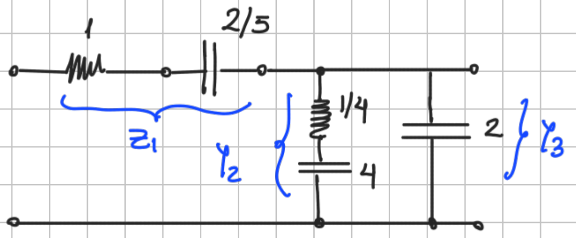
$$R_2 = 1/K_i \quad y \quad C_2 = K_i$$

$$\begin{cases} \boxed{R_2 = 1/4} \\ \boxed{C_2 = 4} \end{cases}$$

$$Y_6 = \frac{2s\,(s+3)}{(s+1)} - \frac{4s}{(s+1)} = 2s$$

$$\downarrow$$

$$\boxed{C_3 = 2}$$



$$Z_1 = 1 + \frac{1}{s\, 2/5} = \frac{(s+5/2)}{s}$$

$$Y_2 = \left(1/4 + \frac{1}{s\,4}\right)^{-1} = \frac{4s}{s+1}$$

$$Y_3 = s\,2$$

$$\begin{pmatrix} 1 & Z_1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ Y_2 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ Y_3 & 1 \end{pmatrix} = \begin{pmatrix} \frac{2(s+2)(s+4)}{(s+1)} & \cdots \\ \cdots & \cdots \end{pmatrix}$$

$$\downarrow$$

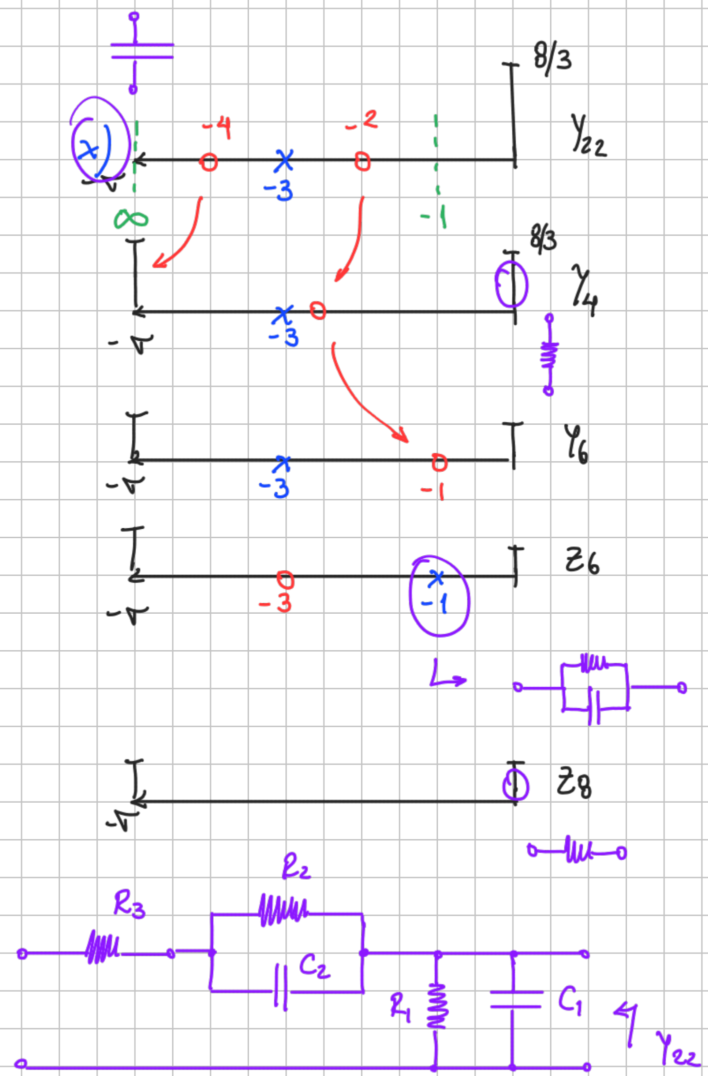
$$A = \left.\frac{V_1}{V_2}\right|_{I_2=0}$$

$$T(s) = \left.\frac{V_2}{V_1}\right|_{I_2=0} = \frac{1}{A} = \frac{(s+1)}{2\,(s+2)\,(s+4)} \Rightarrow \boxed{K = 1/2}$$

Con parámetros Y:

$$Y_{22} = \frac{(s+2)(s+4)}{\underbrace{(s+3)}_{A}}$$

$$Y_{21} = \frac{\overbrace{(s+1)}}{\underbrace{(s+3)}_{A}}$$



b) $Y_4 = Y_{22} - sK_\infty \rightarrow K_\infty = \lim\limits_{s\to\infty} \frac{1}{s} Y_{22} = 1 \rightarrow \boxed{C_1 = 1}$

$$Y_4 = \frac{(s+2)(s+4)}{(s+3)} - s = \frac{3\,(s+8/3)}{s+3}$$

$Y_6 = Y_4 - G_1$; $Y_6(-1) = 0 \rightarrow G_1 = Y_4\big]_{s=-1} = 5/2$

$\hookrightarrow \boxed{R_1 = 2/5}$

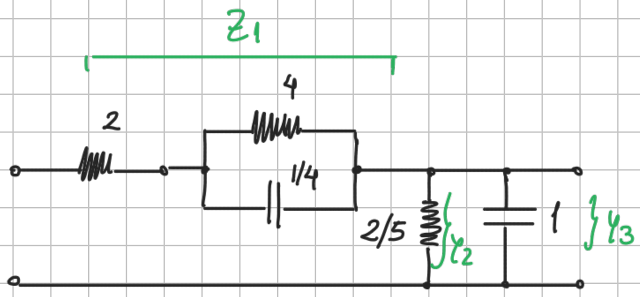
$$Y_6 = \frac{3\,(s+8/3)}{s+3} - 5/2 = \frac{(s+1)}{2\,(s+3)}$$

$$Z_6 = 1/Y_6 = \frac{2(s+3)}{(s+1)}$$

$$Z_8 = Z_6 - \frac{K_i}{s+1} \rightarrow K_i = \lim_{s\to -1} (s+1)\, Z_6 = 4 \rightarrow \frac{1}{\underbrace{\frac{s}{K_i}}_{Y_C} + \underbrace{\frac{1}{K_i}}_{Y_R}} \quad \begin{cases} R = K_i \\ C = 1/K_i \end{cases}$$

$$\begin{cases} R_2 = 4 \\ C_2 = 1/4 \end{cases}$$

$$Z_8 = \frac{2(s+3)}{(s+1)} - \frac{4}{(s+1)} = 2 \rightarrow R_3 = 2$$



$$Z_1 = 2 + \frac{1}{\frac{1}{4} + \frac{s}{4}} = \frac{2(s+3)}{(s+1)}$$

$Y_2 = 5/2$

$Y_3 = s$

$$\begin{pmatrix} 1 & Z_1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ Y_2 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ Y_3 & 1 \end{pmatrix} = \begin{pmatrix} \frac{2(s+2)(s+4)}{s+1} & \dots \\ \dots & \dots \end{pmatrix}$$

$$\downarrow$$

$$A = \left.\frac{V_1}{V_2}\right|_{I_2 = 0}$$

$$T = \frac{1}{A} = \frac{s+1}{2(s+2)(s+4)} \rightarrow K = -1/2$$