1) Sea la función:

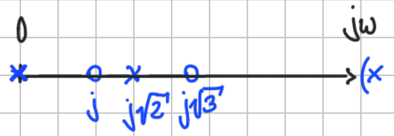
$$Z(s) = \frac{(s^2+3)(s^2+1)}{s(s^2+2)}$$

Se pide hallar la topología circuital y los valores de los componentes para:

a) Síntesis de $Z(s)$ mediante el método de Foster en su versión "paralelo" o "derivación".

b) Idem **a)** mediante Cauer 1 y 2.

a)



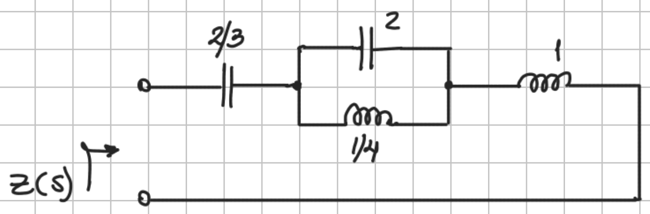
$$Z(s) = \frac{K_0}{s} + \frac{2K_1 \cdot s}{s^2+2} + K_\infty \cdot s$$

$$K_0 = \lim_{s\to 0} s \cdot Z(s) = \lim_{s\to 0} \cancel{s}\, \frac{(s^2+3)(s^2+1)}{\cancel{s}(s^2+2)} = 3/2$$

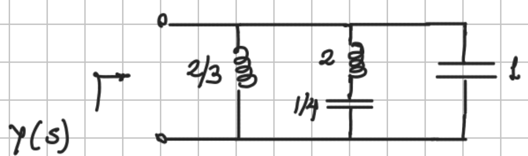
$$\frac{2K_1\, s}{s^2+2} = \cfrac{1}{\underbrace{\underbrace{\frac{s}{2K_1}}_{C} + \underbrace{\frac{1}{sK_1}}_{L}}_{Y_{tanque}}}$$

$$2K_1 = \lim_{s^2\to -2} \frac{s^2+2}{s} Z(s) = \lim_{s^2\to -2} \frac{\cancel{(s^2+2)}}{s} \frac{(s^2+3)(s^2+1)}{s\cancel{(s^2+2)}} = 1/2$$

$$K_\infty = \lim_{s\to\infty} \frac{Z(s)}{s} = \lim_{s\to\infty} \frac{(s^2+3)(s^2+1)}{s(s^2+2)} \frac{1}{s} = 1$$



En paralelo o derivación:



O también:

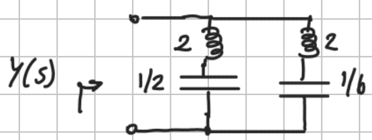
$$Y(s) = 1/Z(s) = \frac{s(s^2+2)}{(s^2+3)(s^2+1)} = \frac{2K_1 s}{s^2+1} + \frac{2K_2 s}{s^2+3}$$

$$2K_1 = \lim_{s^2\to -1} Y(s)\frac{(s^2+1)}{s} = 1/2$$

$$2K_2 = \lim_{s^2\to -3} Y(s)\frac{(s^2+3)}{s} = 1/2$$

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

$$Y(s) = \frac{1}{2s + \frac{2}{s}} + \frac{1}{2s + \frac{6}{s}}$$

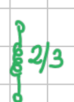


b)

- Cauer 1 (remoción en $s=0$):

$$Z(s) = \frac{s^4 + 4s^2 + 3}{s^3 + 2s}$$

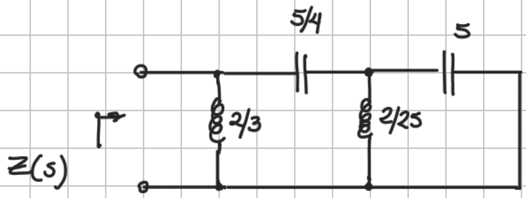
$$\begin{array}{r|l} 3 + 4s^2 + s^4 & 2s + s^3 \\ \hline -\;\; 3 + 3/2\, s^2 + 0 & 3/(2s) \\ \hline 5/2\, s^2 + s^4 & \end{array}$$



$$\begin{array}{r|l} 2s + s^3 & 5/2\, s^2 + s^4 \\ \hline -\;\; 2s + 4/5\, s^3 & 4/(5s) \\ \hline 1/5\, s^3 & \end{array}$$

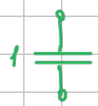
$$\begin{array}{r|l} 5/2\, s^2 + s^4 & 1/5\, s^3 \\ \hline -\;\; 5/2\, s^2 + 0 & 25/(2s) \\ \hline s^4 & \end{array}$$

$$\begin{array}{r|l} 1/s\ s^3 & s^4 \\ \hline - 1/s\ s^3 & 1/(5s) \\ \hline 0 & \end{array}$$



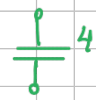
› Cauer 2 (remoción en $s \to \infty$):

$$\begin{array}{r|l} s^4 + 4s^2 + 3 & s^3 + 2s \\ \hline - s^4 + 2s^2 + 0 & s \\ \hline 2s^2 + 3 & \end{array}$$

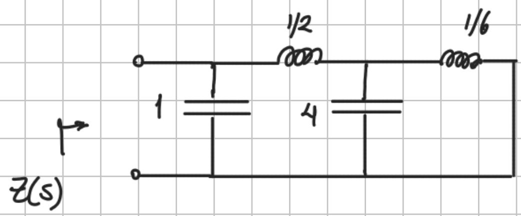


$$\begin{array}{r|l} s^3 + 2s & 2s^2 + 3 \\ \hline - s^3 + 3s/2 & s/2 \\ \hline s/2 & \end{array}$$

$$\begin{array}{r|l} 2s^2 + 3 & s/2 \\ \hline - 2s^2 + 0 & 4s \\ \hline 3 & \end{array}$$



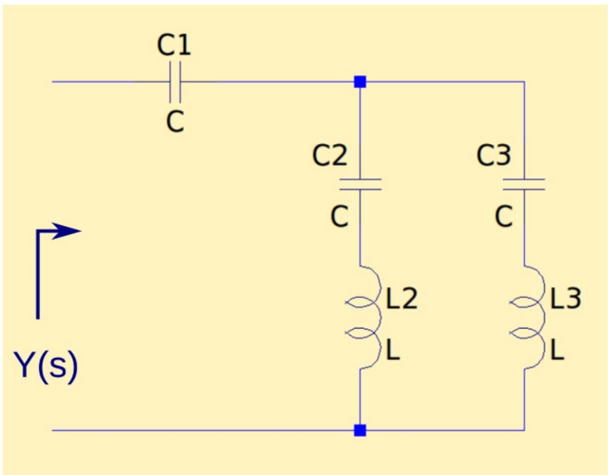
$$\begin{array}{r|l} s/2 & 3 \\ \hline - s/2 & s/6 \\ \hline 0 & \end{array}$$



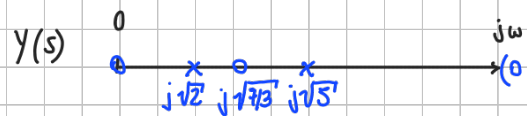
2) Sea

$$Y(s) = \frac{3s(s^2 + 7/3)}{(s^2 + 2)(s^2 + 5)}$$

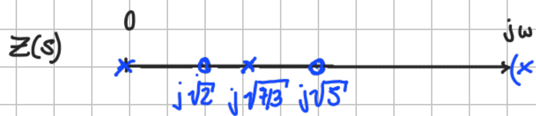
Obtenga los valores de los componentes de la siguiente red sabiendo que L2 y C2 resuenan a 1 r/s.



$\omega_z = 1$



Tengo que remover parcialmente una singularidad en $\omega = 0$ para mover un cero a $\omega_z = 1$.



$$Z(s) = \frac{(s^2+2)(s^2+5)}{3s(s^2+7/3)} = \frac{s^4+7s^2+10}{3s^3+7s}$$

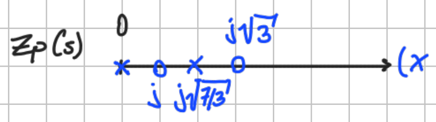
$$Z_p(s) = \frac{s^4+7s^2+10}{3s^3+7s} - \frac{K_0'}{s} \quad ; \quad Z_p(j1) = 0$$

$$K_0' = \left.\frac{s^4+7s^2+10}{3s^2+7}\right|_{s=j1} = 1 \rightarrow Z_p(s) = \frac{s^4+7s^2+10}{3s^3+7s} - \frac{1}{s}$$

$$\rightarrow C_1 = 1/K_0' = 1$$

$$Z_p(s) = \frac{s^5+7s^3+10s-(3s^3+7s)}{s(3s^3+7s)}$$

$$Z_p(s) = \frac{s^5+4s^3+3s}{s\,(3s^3+7s)} = \frac{s^4+4s^2+3}{3s^3+7s} = \frac{(s^2+1)\,(s^2+3)}{3s\,(s^2+7/3)}$$



Sintetizo con el método de Foster (paralelo):

$$Y_p(s) = 1/Z_p(s) = \frac{3s\,(s^2+7/3)}{(s^2+1)\,(s^2+3)} = \frac{2k_1 s}{s^2+1} + \frac{2k_2\, s}{s^2+3}$$

$$2k_1 = \lim_{s^2\to -1} Y(s)\,\frac{(s^2+1)}{s} = \lim_{s^2\to -1} \frac{3\cancel{s}\,(s^2+7/3)}{\cancel{(s^2+1)}\,(s^2+3)}\,\frac{\cancel{(s^2+1)}}{\cancel{s}} = 2$$

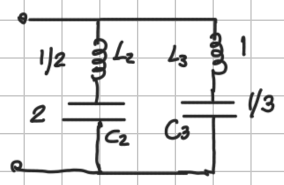
$$2k_2 = \lim_{s^2\to -3} Y(s)\,\frac{(s^2+3)}{s} = \lim_{s^2\to -3} \frac{3\cancel{s}\,(s^2+7/3)}{(s^2+1)\,\cancel{(s^2+3)}}\,\frac{\cancel{(s^2+3)}}{\cancel{s}} = 1$$

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

idem

$sL_2 = s/2 \qquad 1/sC_2 = 1/2s$

$\to L_2 = 1/2 \qquad \to C_2 = 2$



$\Rightarrow \quad Y(s) \mapsto$