TS 10

Hoja: 1

Fecha:

1) $Z_{(s)} = \dfrac{(s^2+3)(s^2+1)}{s(s^2+2)}$

a) Síntesis por Foster en Paralelo

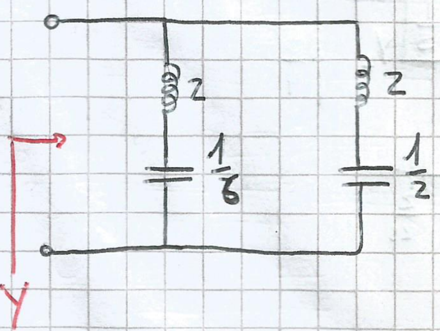
$$Y_{(s)} = \frac{s(s^2+2)}{(s^2+3)(s^2+1)} = \frac{2K_1 \cdot s}{s^2+3} + \frac{2K_2\, s}{s^2+1}$$

$\dfrac{\text{impar}}{\text{par}}$; $Gr\{P\} - Gr\{Q\} = -1 \implies$ red no disipativa ($Y \in FRP$)

- $\lim\limits_{s^2 \to -3} Y_{(s)} = \lim\limits_{s^2 \to -3} \dfrac{2K_1 s}{s^2+3} \implies 2K_1 = \lim\limits_{s^2 \to -3} \dfrac{s^2+3}{s} Y_{(s)} = \lim\limits_{s^2 \to -3} \dfrac{s^2+2}{s^2+1} = \dfrac{-1}{-2} = \dfrac{1}{2}$

- $\lim\limits_{s^2 \to -1} Y_{(s)} = \lim\limits_{s^2 \to -1} \dfrac{2K_2 s}{s^2+1} \implies 2K_2 = \lim\limits_{s^2 \to -1} \dfrac{s^2+1}{s} Y_{(s)} = \lim\limits_{s^2 \to -1} \dfrac{s^2+2}{s^2+3} = \dfrac{1}{2}$

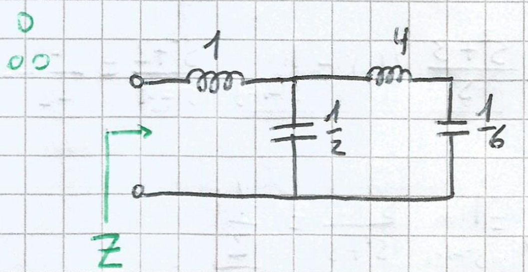
$$Y_{(s)} = \frac{1}{\frac{s}{2K_1} + \frac{3}{2K_1 s}} + \frac{1}{\frac{s}{2K_2} + \frac{1}{2K_2 s}} = \frac{1}{2s + \frac{1}{s\frac{1}{6}}} + \frac{1}{2s + \frac{1}{s\frac{1}{2}}}$$



b) $Z = \dfrac{s^4+4s^2+3}{s^3+2s}$

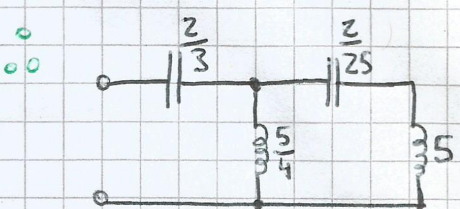
• Cauer removiendo $K_\infty \cdot s$:

$$\begin{array}{l|l}
s^4+4s^2+3 & s^3+2s \\
-\;s^4+2s^2+0 & s \quad Z_1 \quad 1 \\
\hline
s^3+2s & 2s^2+3 \\
-\;s^3+\frac{3}{2}s & \frac{1}{2}s \quad Y_2 \quad \frac{1}{2} \\
\hline
2s^2+3 & \frac{1}{2}s \\
-\;2s^2+0 & 4s \quad Z_3 \quad 4 \\
\hline
\frac{1}{2}s & 3 \\
-\;\frac{1}{2}s & \frac{1}{6}s \quad Y_4 \quad \frac{1}{6} \\
\hline
0 &
\end{array}$$



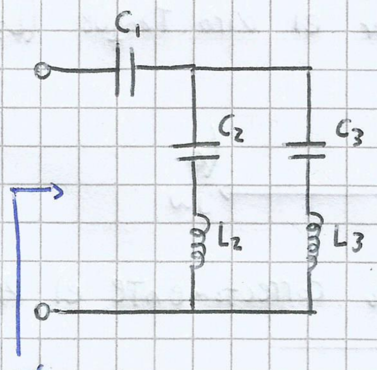
• Cauer removiendo $\frac{K_0}{s}$:

$$\begin{array}{l|l}
3+4s^2+s^4 & 2s+s^3 \\
-\;3+\frac{3}{2}s^2+0 & \frac{3}{2}\frac{1}{s} \quad Z_1 \quad \frac{2}{3} \\
\hline
2s+s^3 & \frac{5}{2}s^2+s^4 \\
-\;2s+\frac{4}{5}s^3 & \frac{4}{5}\frac{1}{s} \quad Y_2 \quad \frac{5}{4} \\
\hline
\frac{5}{2}s^2+s^4 & \frac{1}{5}s^3 \\
-\;\frac{5}{2}s^2+0 & \frac{25}{2}\frac{1}{s} \quad Z_3 \quad \frac{2}{25} \\
\hline
\frac{1}{5}s^3 & s^4 \\
-\;\frac{1}{5}s^3 & \frac{1}{5s} \quad Y_4 \quad 5 \\
\hline
0 &
\end{array}$$



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

• Red deseada:



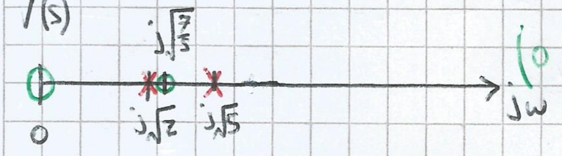
Red no Canónica.
(Debo remover parcialmente)

• L_2 y C_2 resuenan a $\boxed{W_2 = 1 \frac{rad}{seg}}$

Cero de Transferencia $\rightarrow$ $W_2^2 = 1 = \frac{1}{L_2 C_2}$

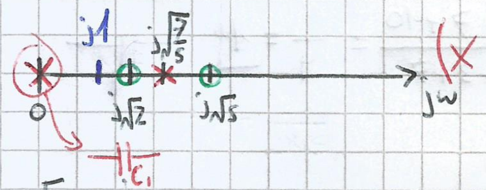
Análisis gráfico

$Y(s)$



Lo primero que se remueve es un capacitor en serie, por lo que al remover debo trabajar en impedancias

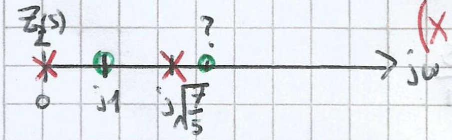
$Z(s)$



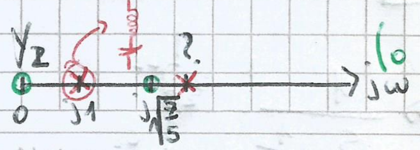
• En impedancia, un capacitor es un polo en el origen $\frac{K_0}{S}$.

• Para lograr un cero de transmisión en $j1$, debo colocar un cero ahí, pasarlo a polo, y luego remover dicho polo.

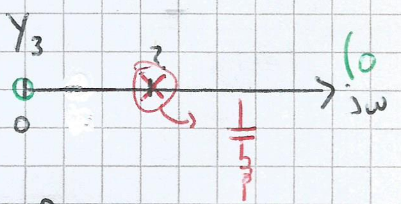
• Realizo una $\underbrace{\text{remoción parcial}}_{\text{del polo en el origen}}$ para mover el cero en $j\sqrt{2}$ a $j1$



• Debo remover el polo en $j1$ para tener el tanque resonando en $j1$ (C_2 y L_2)

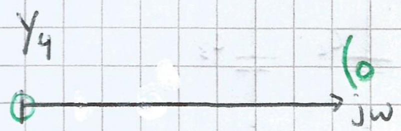


Y_3



- Para tener el otro tanque (L_3 y C_3) remuevo el otro polo

Y_4



Se verifica correctamente el procedimiento ✓

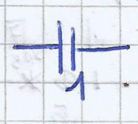
Análisis Algebraico

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

- Remoción parcial de polo en origen:

$$Z_2(s) = Z(s) - \frac{K_0'}{s} \qquad \text{Tal que} \quad Z_2(s)\Big|_{s=j1} = 0 = \left[Z(s) - \frac{K_0'}{s}\right]\Big|_{s=j1}$$

$$\therefore \; K_0' = \left[s \cdot Z(s)\right]\Big|_{s=j1} = \frac{s^4+7s^2+10}{3s^2+7}\Big|_{s=j1} = \frac{1-7+10}{-3+7} = \frac{4}{4} = \boxed{1}$$



- Paso a admitancia y remuevo polo en $j1$:

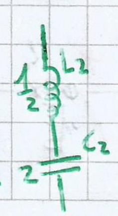
$$Z_2(s) = \frac{s^4+7s^2+10}{3s^3+7s} - \frac{1}{s} = \frac{s^4+7s^2+10-(3s^2+7)}{3s^3+7s} = \boxed{\frac{s^4+4s^2+3}{3s^3+7s}}$$

$$Y_2(s) = \frac{3s^3+7s}{s^4+4s^2+3} = \frac{3s\left(s^2+\frac{7}{3}\right)}{(s^2+1)(s^2+3)}$$

$$Y_3(s) = Y_2(s) - \frac{2K_1 s}{s^2+1} \Longrightarrow Y_2(s) = Y_3(s) + \frac{2K_1 s}{s^2+1}$$

$$\lim_{s^2\to-1} Y_2(s) = \lim_{s^2\to-1} \frac{2K_1 s}{s^2+1} \Longrightarrow \boxed{2K_1 = \lim_{s^2\to-1} \frac{s^2+1}{s} Y_2(s)}$$

$$2K_1 = \lim_{s^2\to-1} \frac{3\left(s^2+\frac{7}{3}\right)}{s^2+3} = \frac{3\left(-1+\frac{7}{3}\right)}{-1+3} = \frac{-3+7}{2} = \boxed{2} \Longrightarrow \boxed{\frac{1}{\frac{s}{2}+\frac{1}{2s}}}$$

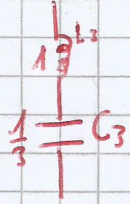


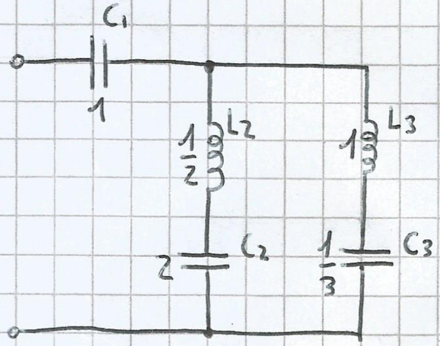
Hoja: 3

Fecha:

$$Y_{3(s)} = Y_{2(s)} - \frac{2s}{s^2+1} = \frac{3s\left(s^2+\frac{7}{3}\right)}{(s^2+1)(s^2+3)} - \frac{2s}{s^2+1} = \frac{3s^3+7s-2s(s^2+3)}{(s^2+1)(s^2+3)}$$

$$Y_{3(s)} = \frac{3s^3+7s-2s^3-6s}{(s^2+1)(s^2+3)} = \frac{s^3+s}{(s^2+1)(s^2+3)} = \frac{s}{s^2+3} = \frac{1}{s+\frac{1}{s\frac{1}{3}}}$$





Notas: