## Síntesis de funciones de excitación

**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:

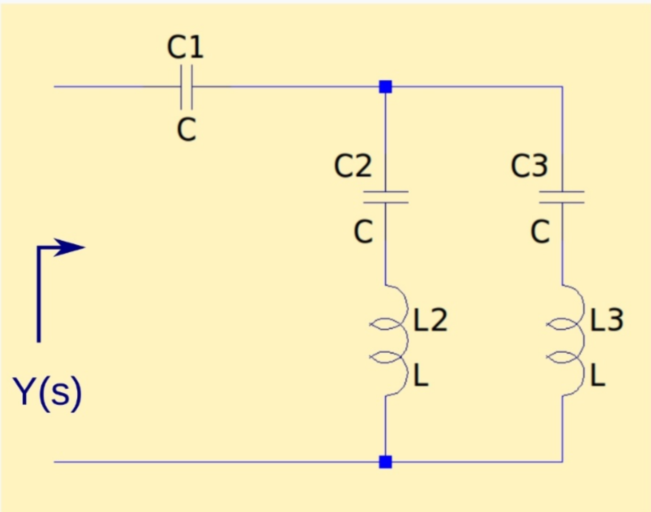
**a)** Síntesis de $Z(s)$ mediante el método de Foster en su versión "paralelo" o "derivación".

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

**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.



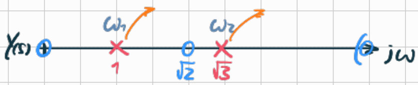

Bonus:

- +20 💎 Simulación simbólica en Python
- +20 🎓 Simulación circuital y sacar conclusiones de los saltos de fase.
- +5 🍺 Presentación en jupyter notebook

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

a) Foster derivación:

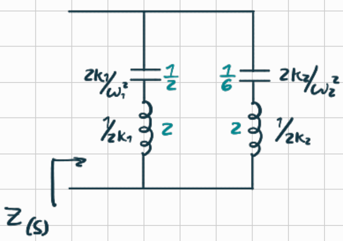
$$Y(s) = \frac{1}{Z(s)} = \frac{s(s^2+2)}{(s^2+3)(s^2+1)}$$




$$Y(s) = \cancel{\frac{K_0}{s}} + \cancel{K_\infty s} + \sum \frac{2K_i s}{s^2+\omega_i^2}$$

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

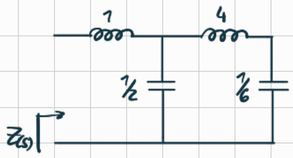
$$2K_2 = \lim_{s^2\to -3} \frac{\cancel{s^2+3}}{\cancel{s}} \frac{\cancel{s}(s^2+2)}{\cancel{(s^2+3)}(s^2+1)} = \lim_{s^2\to -3} \frac{(s^2+2)}{(s^2+1)} = \frac{1}{2}$$



b). Cauer I: remoción de polos en alta frec

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

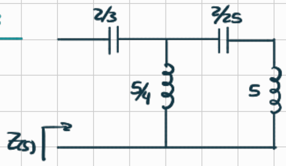
$$\begin{array}{l}
s^4+4s^2+3 \;\big|\; s^3+2s \\
-\;s^4+2s^2+0 \quad s \quad L = 1 \\
s^3+2s \;\big|\; 2s^2+3 \\
-\;s^3+\tfrac{3}{2}s \quad \tfrac{1}{2}s \quad C = \tfrac{1}{2} \\
2s^2+3 \;\big|\; \tfrac{1}{2}s \\
-\;2s^2+0 \quad 4s \quad L = 4 \\
\tfrac{1}{2}s \;\big|\; 3 \\
\varnothing \quad \tfrac{1}{6}s \quad C = \tfrac{1}{6}
\end{array}$$




• Cauer II: remoción de polos en dc

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

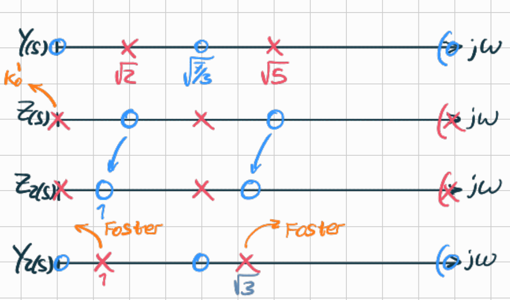
$$\begin{array}{l}
3+4s^2+s^4 \;\big|\; 2s+s^3 \\
-\;3+\tfrac{3}{2}s^2+0 \quad \tfrac{3}{2}\tfrac{1}{s} \quad C = \tfrac{2}{3} \\
2s+s^3 \;\big|\; \tfrac{5}{2}s^2+s^4 \\
-\;2s+\tfrac{4}{5}s^3 \quad \tfrac{4}{5}\tfrac{1}{s} \quad L = \tfrac{5}{4} \\
\tfrac{5}{2}s^2+s^4 \;\big|\; \tfrac{1}{5}s^3 \\
-\;\tfrac{5}{2}s^2+0 \quad \tfrac{25}{2}\tfrac{1}{s} \quad C = \tfrac{2}{25} \\
\tfrac{1}{5}s^3 \;\big|\; s^4 \\
\varnothing \quad \tfrac{1}{5}\tfrac{1}{s} \quad L = 5
\end{array}$$

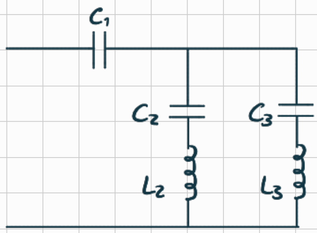



#2

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

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




$$Z_{2(s)} = Z_{(s)} - \frac{K_0'}{s} = \frac{(s^2+2)(s^2+5)}{3s(s^2+7/3)} - \frac{K_0'}{s}$$

$$Z_{2(s)}\Big|_{s=j1} = \left(Z_{(s)} - \frac{K_0'}{s}\right)\Big|_{s=j1} = 0 \longrightarrow K_0' = s\,Z_{(s)}\Big|_{s=j} = \frac{(s^2+2)(s^2+5)}{3(s^2+7/3)}\Big|_{s=j} = 1 \qquad C_1 = 1$$

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

$$Y_{2(s)} = \frac{3s^3+7s}{s^4+4s^2+3}$$

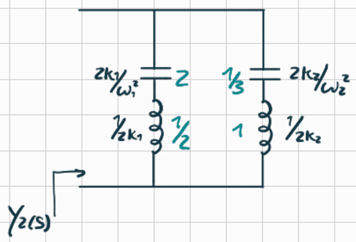
* Foster:

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

$$Y_{2(s)} = \frac{K_0}{s} + K_\infty s + \sum \frac{2K_i s}{s^2+\omega_i^2}$$

$$2K_1 = \lim_{s^2 \to -1} \frac{\cancel{s^2+1}}{\cancel{s}} \frac{\cancel{s}(3s^2+7)}{\cancel{(s^2+1)}(s^2+3)} = \lim_{s^2 \to -1} \frac{3s^2+7}{s^2+3} = 2$$

$$2K_2 = \lim_{s^2 \to -3} \frac{\cancel{s^2+3}}{\cancel{s}} \frac{\cancel{s}(3s^2+7)}{(s^2+1)\cancel{(s^2+3)}} = \lim_{s \to -3} \frac{3s^2+7}{s^2+1} = 1$$




* Circuito final: