ES10

Thursday, September 15, 2022 4:14 PM

Trabajo semanal 10. Entrega 19/9

Síntesis de funciones de excitación

1) Sea la función:

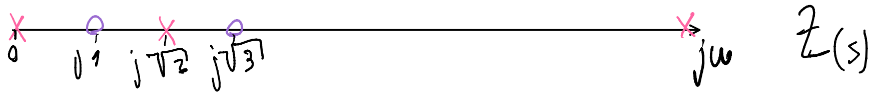
$$Z(s) = \frac{(s^2+3)(s^2+1)}{s(s^2+2)}$$

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.

a)



$$\lim_{s \to \infty} Z(s) = \frac{s^2 \cdot \cancel{s^2}}{\cancel{s} \cdot \cancel{s^2}} \to \infty \quad (\text{Polo})$$

Frac. Simples:

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

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

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

$$K_1 = \lim_{s^2 \to -2} \frac{\cancel{(s^2+2)}}{2s} \cdot \frac{(s^2+3)(s^2+1)}{s\cancel{(s^2+2)}} = \frac{1 \cdot (-1)}{2 \cdot (-2)} = 1/4$$

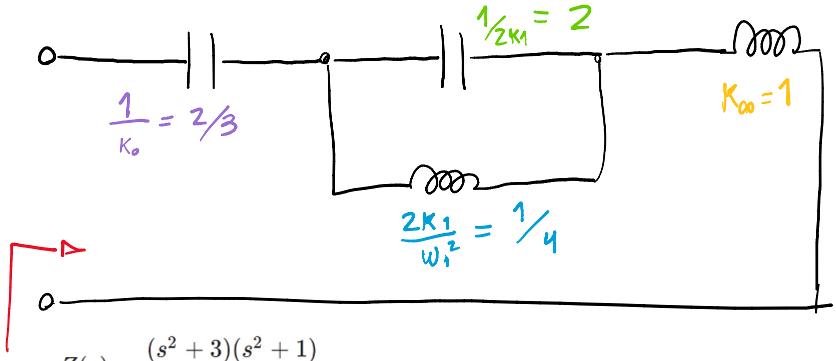
$$K_\infty = \lim_{s \to \infty} \frac{1}{s} \cdot \frac{(s^2+3)(s^2+1)}{s(s^2+2)} = \frac{\cancel{s^2} \cdot \cancel{s^2}}{\cancel{s^2} \cdot \cancel{s^2}} = 1$$

$$Z(s) = \frac{3/2}{s} + \frac{2 \cdot 1/4 \cdot s}{(s^2+2)} + s$$

$$\frac{2K_1 s}{s^2+\omega_i^2} = \frac{1}{s \cdot \frac{1}{2K} + \frac{1}{s\, \frac{2K}{\omega_i^2}}}$$

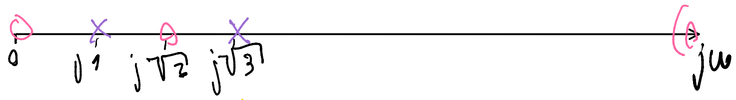
Z Y C L

Foster Serie (Z)



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

Foster //



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

Removen 2 polos finitos

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

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

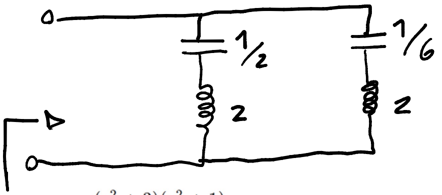
$$Y_2(s) = \frac{s^3+2s - \frac{1}{2}s(s^2+3)}{(s^2+3)(s^2+1)} = \frac{s^3+2s - \frac{1}{2}s^3 - \frac{3}{2}s}{(s^2+3)(s^2+1)}$$

$$Y_2(s) = \frac{s^3 \frac{1}{2} + \frac{1}{2}s}{(s^2+3)(s^2+1)} = \frac{\overset{2K_2}{\frac{1}{2}} \cdot s\,\cancel{(s^2+1)}}{(s^2+3)\cancel{(s^2+1)}} \longrightarrow$$

Por algebra, obtuve el resto del circuito

$$\frac{2Ks}{(s^2+\omega_i^2)} = \frac{1}{s\frac{1}{2K} + \frac{\omega_i^2}{s\,2K}}$$

Y, L, C, Z



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

b) Cauer 1

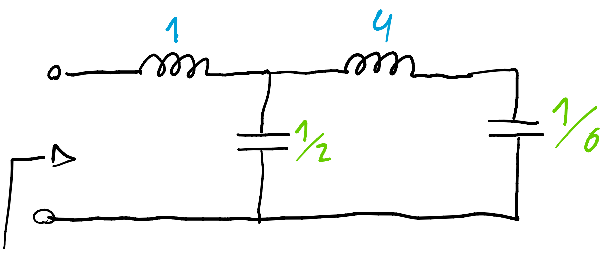
$$Z(s) = \frac{(s^2+3)(s^2+1)}{s(s^2+2)} = \frac{s^4+4s^2+3}{s^3+2s}$$

$$\begin{array}{l|l} s^4+4s^2+3 & s^3+2s \\ -\; s^4+2s^2 & s.1 \end{array}$$

$$\begin{array}{l|l} s^3+2s & 2s^2+3 \\ -\; s^3+\frac{3}{2}s & \frac{1}{2}s \end{array}$$

$$\begin{array}{l|l} 2s^2+3 & \frac{1}{2}s \\ -\; 2s^2 & 4s \end{array}$$

$$\begin{array}{l|l} \frac{1}{2}s & 3 \\ -\; \frac{1}{2}s & \frac{1}{6}s \\ \varnothing & \end{array}$$



$Z(s)$

Cauer II:

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

$$3+4s^2+s^4 \;\big|\; 2s+s^3 \qquad \frac{1}{s\cdot\frac{2}{3}}$$

$$-\;\left(3+\frac{3}{2}s^2\right)$$

$$2s+s^3 \;\big|\; \frac{5}{2}s^2+s^4 \qquad \frac{1}{s\,\frac{5}{4}}$$

$$-\;\left(2s+\frac{4}{5}\cdot s^3\right)$$

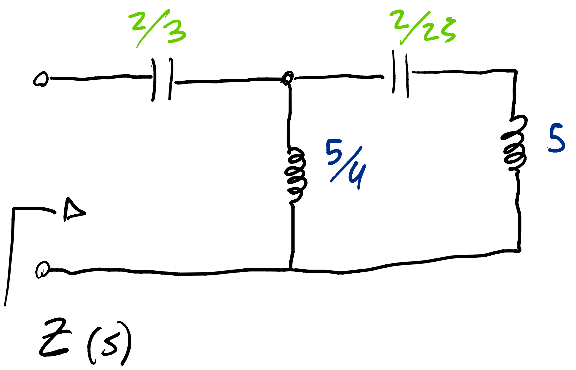
$$\frac{5}{2}s^2+s^4 \;\big|\; \frac{1}{5}s^3 \qquad \frac{1}{s\cdot\frac{2}{25}}$$

$$-\;\frac{5}{2}s^2$$

$$\frac{1}{5}s^3 \;\big|\; s^4 \qquad \frac{1}{s\cdot 5}$$

$$-\;\frac{1}{5}s^3$$

$$\emptyset$$

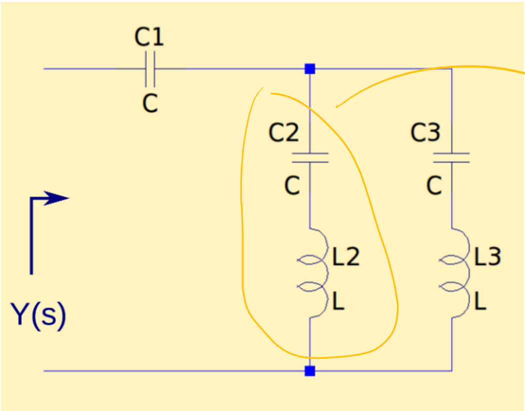


2)

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.



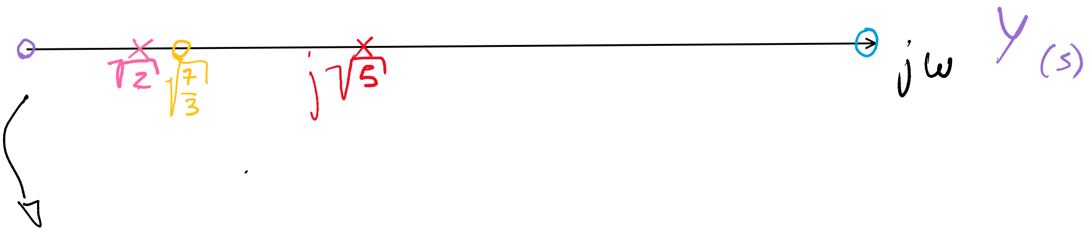
$W_0^2 = \frac{1}{LC} = 1$

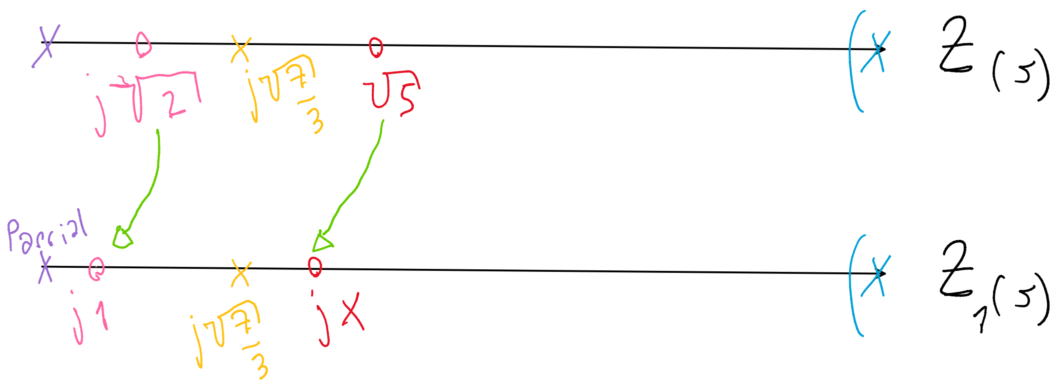
$C_2 \cdot L_2 = 1$

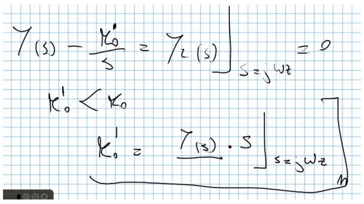
La topologia es el camino que tengo que tomar en el metodo grafico.

La topologia no es canonica, porque es de Orden 4 y tiene 5 componentes. Lo que me dice que hay que remover parcialmente. Ademas la condicion de resonancia del segundo tanque, necesita que haya un polo en w =1

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







$$Z(s) - \frac{K_0'}{s} = Z_2(s) \Big]_{s=j\omega_z} = 0$$

$$K_0' < K_0$$

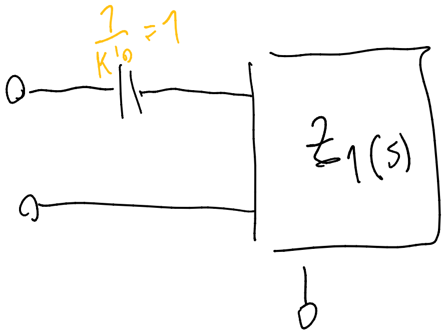
$$K_0' = Z(s)\cdot s \Big]_{s=j\omega_z}$$

$$Z(s) - \frac{K_0'}{s} = Z_1(s) = 0$$

$$K_0' < K_0$$

$$K_0' = Z(s) \cdot s \Big]_{s=j\omega_z} \rightarrow 1$$

$$K_0' = \frac{(s^2+2)(s^2+5)}{3\cancel{s}(s^2+7/3)} \cdot \cancel{s} = \frac{(-1+2)(-1+5)}{3\cdot(-1+7/3)} = \frac{4}{4} = 1$$

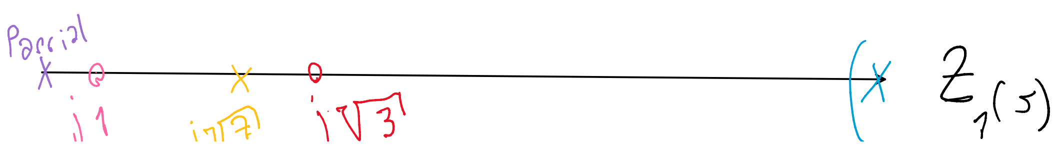


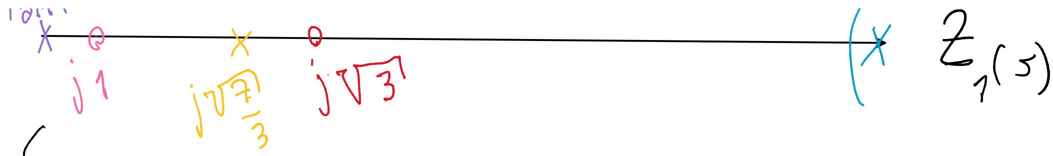
$$Z_1(s) = Z(s) - \frac{1}{s} = \frac{(s^2+2)(s^2+5)}{3s(s^2+7/3)} - \frac{1}{s} =$$

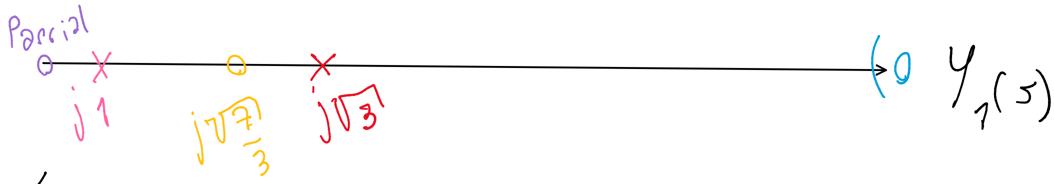
$$Z_1(s) = \frac{(s^2+2)(s^2+5) - 3(s^2+7/3)}{3s(s^2+7/3)}$$ → Los Polos no se mueven

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

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







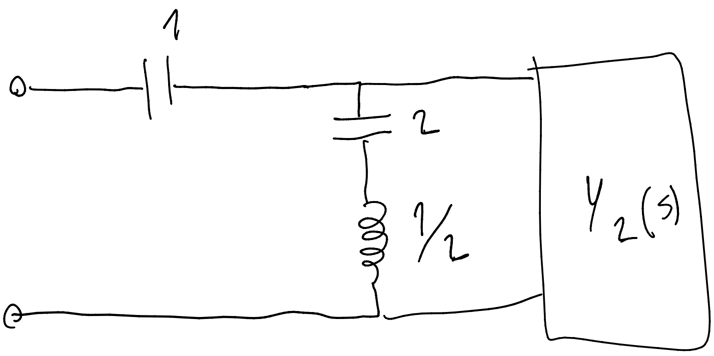
Ahora puedo remover por Foster los dos

Tanques (Y)

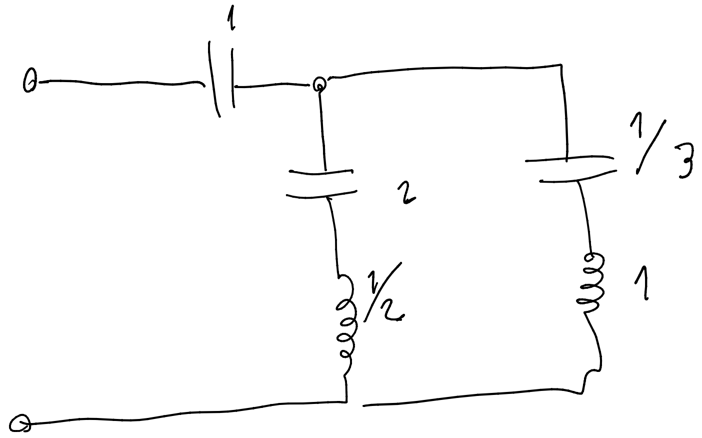
$$Y_1(s) = \frac{3s(s^2+7/3)}{(s^2+1)(s^2+3)}$$

$$2K_1 = \lim_{s^2 \to -1} Y_1(s) \cdot \frac{(s^2+1)}{s} = \frac{3.(s^2+7/3)}{(s^2+3)} = 2$$

$$\frac{2s}{s^2+1} = \frac{1}{s\frac{1}{2} + \frac{1}{s.2}}$$



$$2K_2 = \lim_{s^2 \to -3} Y_1(s) \frac{(s^2+3)}{s} = \frac{3(s^2+7/3)}{(s^2+1)} = 1$$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