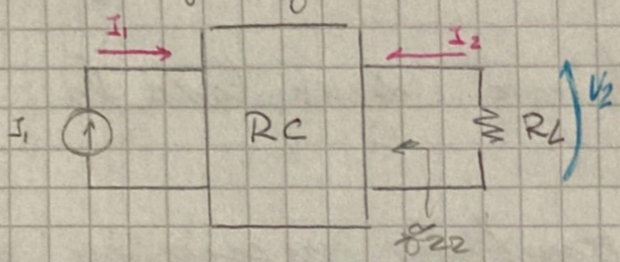
Clase 9/11 Síntesis de cuadripolos simplemente cargados

TS 12, ej 5 guía 7



$$\frac{-I_2}{I_1} = H\,\frac{s^2+5s+4}{s^2+8s+12}$$

$Z_{21} = 6H$

parámetro de cuadripolo se mide en vacío, $I_2 = 0$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0}$$

Hallar el cuadripolo

$$-\left.\frac{I_2}{I_1}\right|_{V_2=(-I_2 R\ell)} = H\,\frac{s^2+5s+4}{s^2+8s+12} = \frac{F_T}{F_e}$$

síntesis descargadas

Terminado en derivación

$$V_2 = Z_{21} I_1 + Z_{22} I_2 \longrightarrow -I_2 R\ell = Z_{21} I_1 + Z_{22} I_2$$

$$-I_2 (R\ell + Z_{22}) = Z_{21} I_1 \longrightarrow -\frac{I_2}{I_1} = \frac{Z_{21}}{R\ell + Z_{22}}$$

$$\cancel{H}\,\frac{s^2+5s+4}{s^2+8s+12} = \frac{6\cancel{H}}{R\ell + Z_{22}}$$

Asumo $\Omega_z = R$
$\therefore R\ell = 1$

NOTA

$$-\left.\frac{I_2}{I_1}\right|_{V_2=0} = \frac{Z_{21}}{Z_{22}}$$

las condiciones de carga hacen que no tenga restricciones a la salida

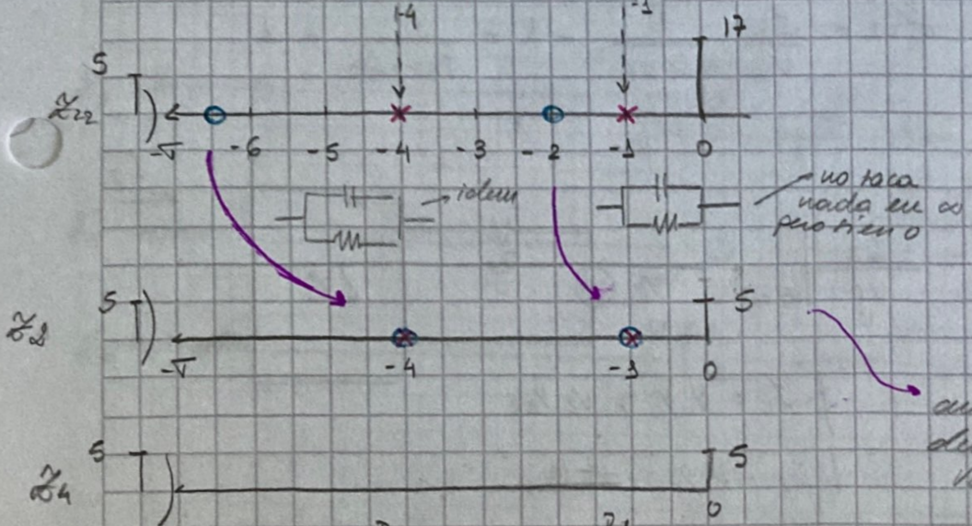
$$Z_{22} = \frac{Z_{21}}{T(s)} - 1 \qquad Z_{22} = 64 \cdot \frac{1}{4} \frac{s^2+8s+12}{s^2+5s+4} - 1$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0}$$ → alternancia → eje $-\sigma$ → $Z(0) > Z(\infty)$ → xq tendría un cap en serie

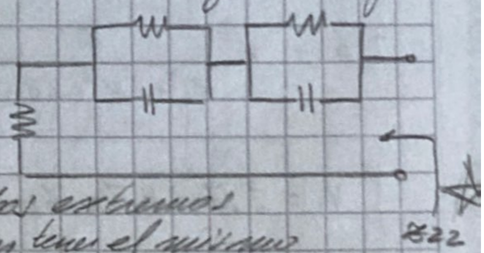
$$Z_{22} = \frac{5s^2+43s+68}{s^2+5s+4} = \frac{5(s^2+43/5\,s+68/5)}{s^2+5s+4} = 5\,\frac{(s+\tilde{2})(s+\tilde{6,5})}{(s+4)(s+1)}$$

$Z_{22}(0) = 17 \qquad Z_{22}\big|_{s\to\infty} = 5$

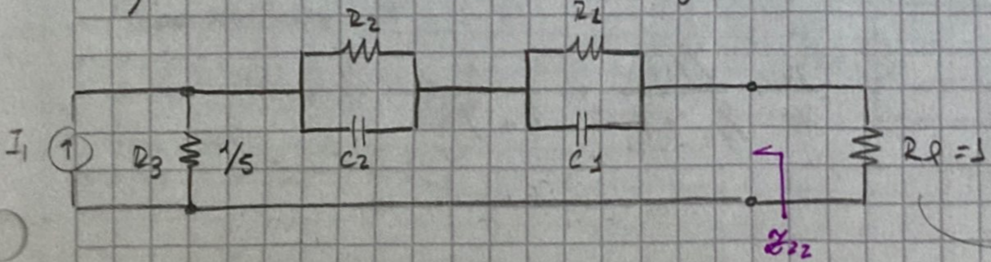
Z_{21} no tiene singularidades, me fijo en la $T(s)$ ddddi tengo que remover



Estimamos que va a tener la siguiente forma:



ambos extremos deben tener el mismo valor, xq es una res



$(R_1 C_1)^{-1} = 4$
$(R_2 C_2)^{-1} = 1$

para considerarla dentro del cuadripolo T, tengo que poner la R_ℓ en serie

$$D = \left.\frac{I_1}{(-I_2)}\right|_{V_2=0}$$

TS12

1) b) $Z_{22} = \dfrac{5s^2+43s+68}{s^2+5s+4}$

$Z_2 = Z_{22} - \dfrac{k_1}{s+1}$ $\qquad k_1 = \lim\limits_{s\to -1} \cancel{(s+1)} \cdot \dfrac{5s^2+43s+68}{(s+4)\cancel{(s+1)}}$

$k_1 = 10$

$$Z_2 = \frac{5s^2+43s+68-10s-40}{s^2+5s+4} = \frac{5s^2+33s+28}{s^2+5s+4} = \frac{5(s+5,6)}{s+4}$$

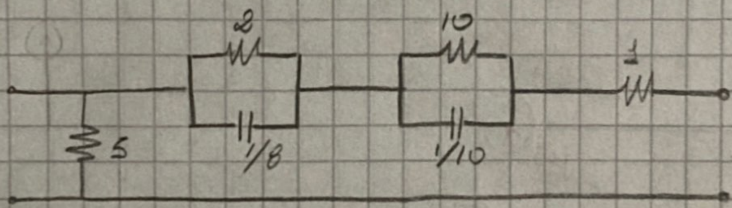
$Z_4 = Z_2 - \dfrac{k_4}{s+4}$ $\qquad k_4 = \lim\limits_{s\to -4} (s+4)\dfrac{5s+28}{s+4} = 8$

$$Z_4 = \frac{5s+28-8}{s+4} = \frac{5\cancel{(s+4)}}{\cancel{s+4}} = 5$$

$R_1 = 10 \quad C_1 = 1/10$
$R_2 = 2 \quad C_2 = 1/8$
$R_3 = 5$

c) Se puede verificar con parámetros T

$D = \dfrac{I_1}{(-I_2)}\Big|_{V_2=0} \longrightarrow \dfrac{(-I_2)}{I_1}\Big|_{V_2=0} = \dfrac{1}{D}$ $\longrightarrow$ la condición de medición me obliga a poner R_L en serie



$$T = \begin{bmatrix} 1 & 0 \\ G_3 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & \frac{1}{1/R_2+sC_2} \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & \frac{1}{1/R_1+sC_1} \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & R_L \\ 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1 & 0 \\ 1/5 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 8/(s+4) \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 10/(s+1) \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} - & - \\ G_3 & \frac{8G_3}{s+4}+1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 10/(s+1) \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} - & - & - \\ G_3 & \frac{G_3 10}{s+1} + \frac{8G_3}{(s+4)} + 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \longrightarrow D = G_3\left(1 + \frac{10}{s+1} + \frac{8}{s+4}\right) + 1$$

$$D = \frac{1}{5}\left(\frac{s^2+5s+4+10s+40+8s+8}{(s+1)(s+4)}\right) + 1 = \frac{s^2+23s+52+5s^2+25s+20}{5(s+1)(s+4)}$$

NOTA $\quad D = \dfrac{6(s^2+8s+12)}{5(s+1)(s+4)} \longrightarrow \dfrac{1}{D} = \dfrac{5(s^2+5s+4)}{6(s^2+8s+12)}$ ✓ $\qquad H = \dfrac{5}{6}$

2) $T(s) = \left.\frac{V_2}{I_1}\right|_{I_2 = -V_2/Z_L} = \frac{k(s^2+9)}{s^3+2s^2+2s+1}$

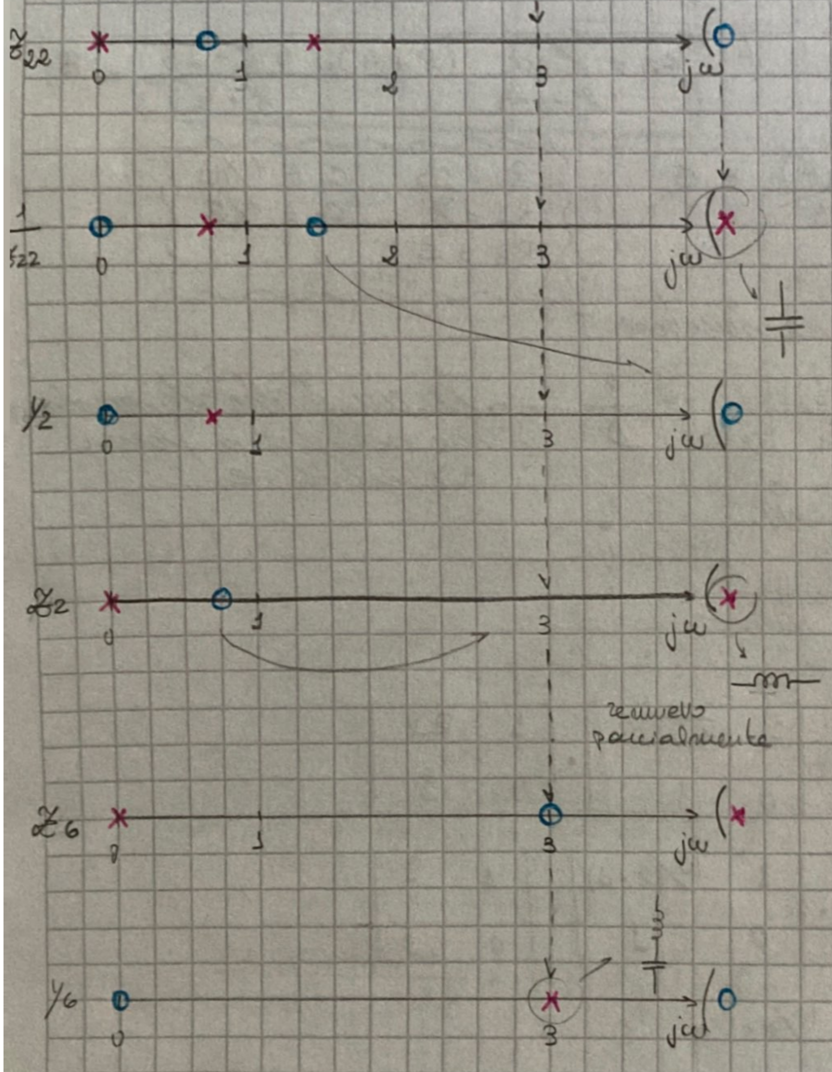
$$Z_{22} = \frac{1}{T(s)\,Z_{21}} - 1$$

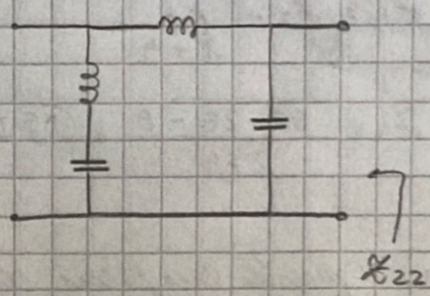
$$T(s) = \frac{k.(s^2+9)}{\underbrace{(s^3+2s)}_{\text{impar}}+\underbrace{(2s^2+1)}_{\text{par}}} = k.\frac{\frac{(s^2+9)}{(s^3+2s)}}{1+\frac{2s^2+1}{s^3+2s}} = \frac{Z_{21}}{1+Z_{22}}$$

Par

$$Z_{22} = \frac{2s^2+1}{s^3+2s} = \frac{2(s^2+1/2)}{s(s^2+2)} \qquad Z_{21} = \frac{s^2+9}{s^3+2s}$$

Alimento con I, lo último que tengo que sacar de Z_{22} es un componente en derivación





b) Para verificar el circuito tengo que buscar el valor de los componentes

$$Y_2 = \frac{1}{Z_{22}} - k_\infty . s \qquad k_\infty = \lim_{s\to\infty} \frac{s^3+2s}{2s^2+1}\cdot\frac{1}{s} = \frac{1}{2} = C_1$$

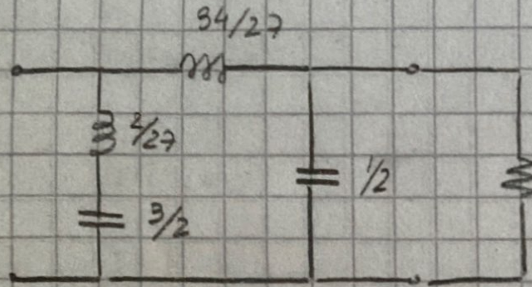
$$Y_2 = \frac{s^3+2s - s^3 - s/2}{2(s^2+1/2)} = \frac{3/2\ s}{2(s^2+1/2)}$$

NOTA

$$Z_6\Big|_{s=j3} = \frac{1}{Y_2} - k'_\infty s = 0 \qquad k'_\infty = \lim_{\substack{s^2 \to -9 \\ s \to j3}} \frac{4(s^2+1/2)}{3s^2} = \frac{34}{27} = L_1$$

$$Z_6 = \frac{4(s^2+1/2)}{3s} - \frac{34}{27}\cdot s = \frac{4s^2+2-\frac{34}{9}s^2}{3s} = \frac{\frac{2}{9}(s^2+9)}{3s} = \frac{2}{27}\,\frac{s^2+9}{s}$$

$$Y_6 = \frac{27}{2}\cdot\frac{s}{s^2+9} \longrightarrow C_2 = \frac{27}{2}\cdot\frac{1}{9} = \frac{3}{2} \qquad L_2 = \frac{2}{27}$$



$$T = \frac{V_2}{I_1}\Big|_{I_2=0} = \frac{1}{C}$$

↳ Puedo dejar el denominador

$$T = \begin{bmatrix} 1 & 0 \\ \frac{1}{sL_2}+sC_2 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & sL_1 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ sC_1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{1}{R_L} & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1 & 0 \\ \frac{3}{2}\left(\frac{s^2+9}{s}\right) & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & s\cdot\frac{34}{27} \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ s\cdot\frac{1}{2} & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} & \\ \frac{3}{2}\,\frac{s^2+9}{s} & \frac{17}{9}(s^2+9)+1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{s}{2} & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} & \\ \frac{3}{2}\,\frac{s^2+9}{s} + \frac{17}{18}s(s^2+9) + \frac{s}{2} & \frac{17}{9}(s^2+9)+1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

$$C = (s^2+9)\left(\frac{3}{2s} + \frac{17}{18}s + \frac{17}{9}\right) + \frac{s}{2} + 1 = (s^2+9)\left(\frac{3/2 + 17/18\,s^2 + 17/9\,s}{s}\right) + \frac{s+2}{2}$$

$$C =$$