



Universidad Tecnológica Nacional
Facultad Regional Buenos Aires
Departamento De Electrónica

Teoría de los circuitos II

Año: 2021

Curso: R4052

Profesor: Llamedo, Mariano

JTP: Fuoco Cesar

Trabajo Práctico de Nº 7

GRUPO Nº: 3

Integrantes:

Golob, Lautaro	167.258-7
Ceroli, Juan	158.924-6
Diaz, Jhair	158.959-3
Dieguez, Manuel	168.124-2
Rodriguez, Fernando	155.647-2

OBSERVACIONES:

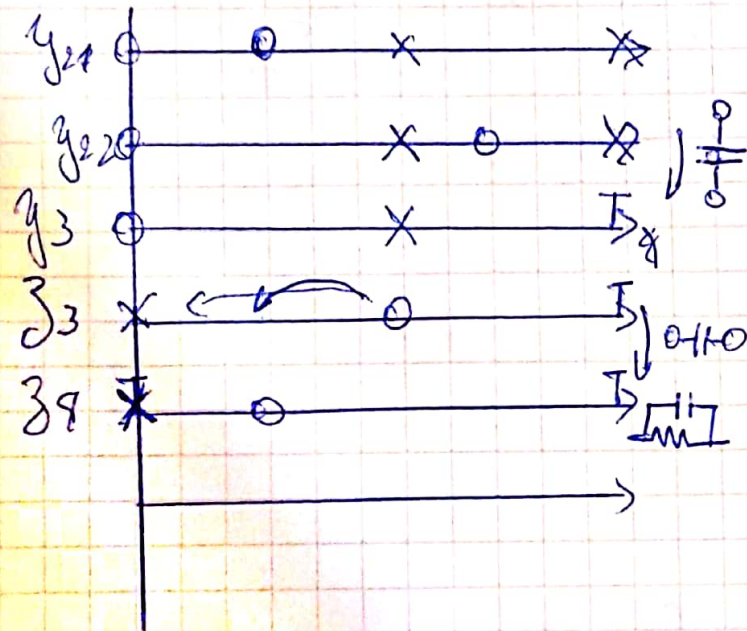
Presentado: 12/10/2021

Aprobado:

Firmado:

$$1) a) -y_{21} = \frac{s(s+1)}{s+2}$$

$$y_{22} = \frac{s(s+2,25)}{s+2}$$



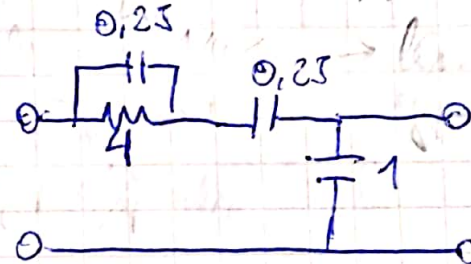
$$\frac{1/4 + 0,125s}{1/4 + 1,125s}$$

$$\lim_{s \rightarrow \infty} \frac{1}{s} y_{22} = 1$$

$$y_3 = y_{22} - 1 = \frac{1/4 s}{s+2}$$

$$z_3 = \frac{s+2}{1/4 s} \rightarrow \frac{1}{s} = 4 \quad z_3 \Big|_{s=-1} = 4$$

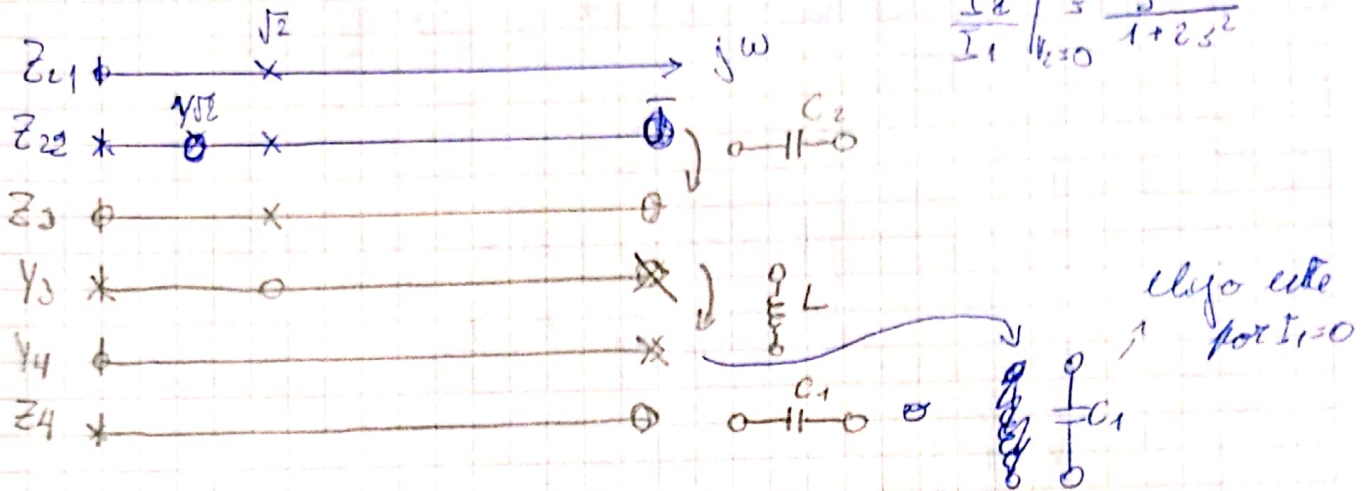
$$z_4 = z_3 - \frac{4}{s} = \frac{s+1}{1/4 s} \Rightarrow R=4, C=0,25$$



$$b) \quad Z_{21} = \frac{s}{s^2+2}$$

$$Z_{22} = \frac{1+2s^2}{s(s^2+2)}$$

$$\frac{I_2}{I_1} \Big|_{t=0} = \frac{s^2}{1+2s^2}$$



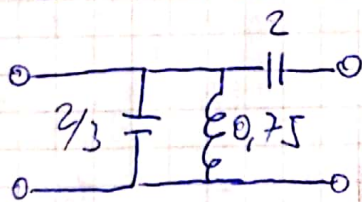
$$C_2^{-1} = \lim_{s \rightarrow 0} s Z_{22}(s) = 1/2 \rightarrow C_2 = 2$$

$$Z_3 = Z_{22} - \frac{1}{2s} = \frac{1+2s^2-0.5s^2-1}{s(s^2+2)} = \frac{1.5s^2}{s(s^2+2)}$$

$$Y_3 = \frac{s^2+2}{1.5s} \rightarrow \lim_{s \rightarrow 0} s Y_3(s) = \frac{4}{3} = \frac{1}{L}$$

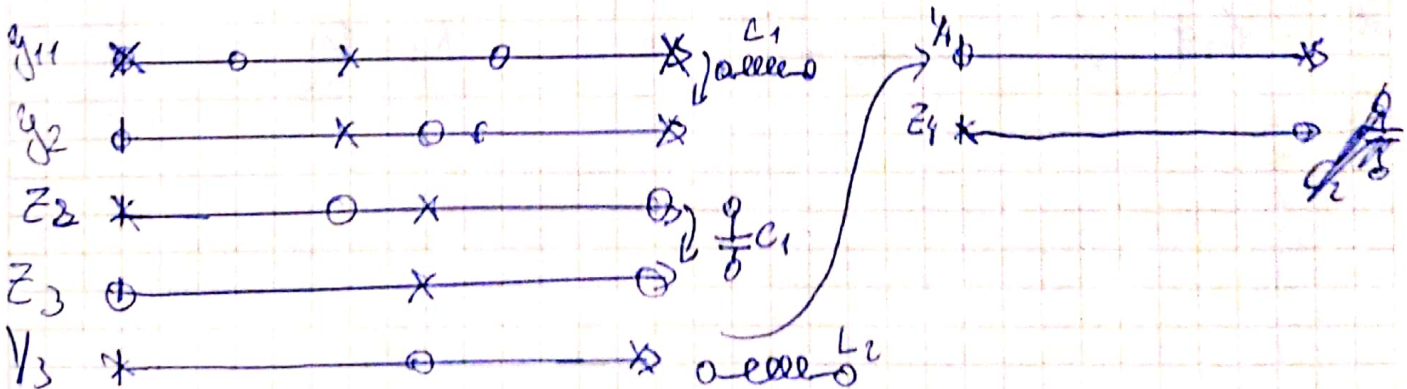
$$Y_4 = \frac{s^2+2-2}{1.5s} = \frac{s^2}{1.5s} \rightarrow C_1 = 2/3$$

$$Z_4 = \frac{1.5s}{s} = 1.5$$



$$c) \quad -Y_{21} = \frac{1}{s(s^2+4)}$$

$$Y_{11} = \frac{(s^2+1)(s^2+9)}{s(s^2+4)}$$



$$\lim_{s \rightarrow 0} s y_{11} = 9/4 = \frac{1}{L_1}$$

$$y_2 = \frac{s^4 + 10s^2 + 9}{s(s^2 + 4)} - \frac{9/4}{s} = \frac{s^4 + 7.75s^2}{s(s^2 + 4)} = \frac{s(s^2 + 7.75)}{s^2 + 4} = \frac{1}{Z_2}$$

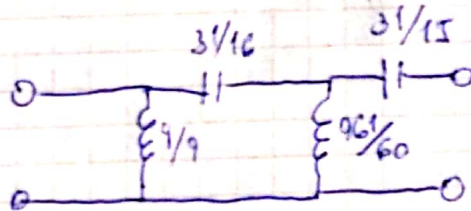
$$\lim_{s \rightarrow 0} s Z_2 = \frac{16}{31} = \frac{1}{C_1}$$

$$Z_3 = Z_2 - \frac{16/31}{s} = \frac{s^2 + 7.75}{s} - \frac{16/31}{s} = \frac{15.1s^2}{s(s^2 + 7.75)}$$

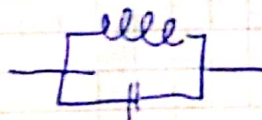
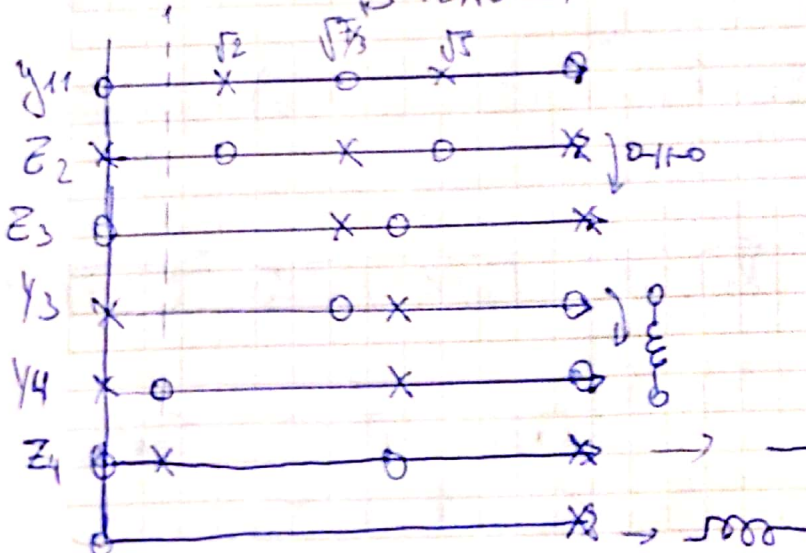
$$Z_3 = \frac{s^2 + 4}{s(s^2 + 7.75)} - \frac{16/31}{s} = \frac{15.1s^2}{s(s^2 + 7.75)}$$

$$\lim_{s \rightarrow 0} s y_3 = \frac{961}{60} = \frac{1}{L_1}$$

$$y_4 = \frac{s^2 + 7.75}{15/31s} - \frac{961/60}{s} = \frac{s^2}{15/31s} \Rightarrow Z_4 = \frac{1}{C_2 \left[\frac{31}{15} s \right]}$$



$$d) -y_{21} = \frac{s(s^2 + 1)}{(s^2 + 2)(s^2 + 5)} \quad y_{11} = \frac{3s(s^2 + 7/3)}{(s^2 + 2)(s^2 + 5)}$$



$$\lim_{s \rightarrow 0} s y_1^{-1} = \lim_{s \rightarrow 0} \frac{(s^2+2)(s^2+5)}{(s^2+7/3)3} = 10/7 = 1/c_1$$

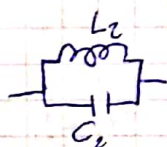
$$Z_2 = \frac{s^4 + 10s^2 + 10}{3s(s^2+7/3)} - \frac{10/7}{s} = \frac{s^4 + 19/7 s^2}{3s(s^2+7/3)}$$

$$y_2 = \frac{3(s^2+7/3)}{s(s^2+19/7)} \quad \text{or} \quad \lim_{s \rightarrow 0} s y_2 = \frac{49}{19}$$

$$1/L_1 = k_0 = \left. \frac{3(s^2+7/3)}{s^2+19/7} \right|_{s^2=-1} = 7/3$$

$$y_3 = \frac{3(s^2+7/3)}{s(s^2+19/7)} - \frac{7/3}{s} = \frac{2/3 s^2 + 2/3}{s(s^2+19/7)}$$

$$Z_3 = \frac{s(s^2+19/7)}{2/3(s^2+1)}$$



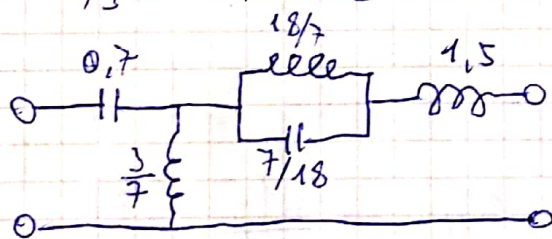
$$(3C_2 + \frac{4}{sL_2})^{-1}$$

$$\frac{sL_2}{s^2C_2L_2 + 1} = \frac{s \frac{1}{C_2}}{\frac{s^2+1}{C_2L_2}}$$

$$\lim_{s \rightarrow -1} \frac{s^2+1}{s} Z_3 = \frac{18}{7} = 1/c_2 \rightarrow L_2 = \frac{18}{7}$$

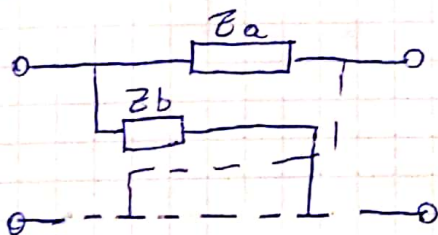
$$Z_4 = \frac{s(s^2+19/7)}{2/3(s^2+1)} - \frac{s \frac{18}{7}}{s^2+1} = \frac{\frac{29}{27}s^3 + s}{2/3(s^2+1)} = \frac{s}{2/3}$$

$$L_3 = 1,5$$



$$2) \frac{Z_b - Z_a}{Z_b + Z_a}$$

$$\left. \frac{V_1}{I_1} \right|_{I_2=0} = Z_{11} = (Z_a + Z_b) // (Z_a + Z_b) = \frac{Z_a + Z_b}{2}$$



$$\left. \frac{I_1}{V_1} \right|_{V_2=0} = Y_{11} = \frac{1}{(Z_a // Z_b) + (Z_a // Z_b)} = \frac{1}{2(Y_a + Y_b)^{-1}}$$

$$Z_{11} = \frac{s^2+1}{s} K$$

$$Y_{11} = \frac{s^2+1}{s(s^2+2)} K$$

$$Y_{11} = \frac{Z_{11}}{Z_a + Z_b} \rightarrow \frac{1}{s^2+2} = \frac{1}{Z_a + Z_b}$$

$$Z_a = (s^2+2)/Z_b$$

$$2Z_{11} = Z_a + Z_b$$

$$2 \frac{s^2+2}{s} - Z_b = Z_a$$

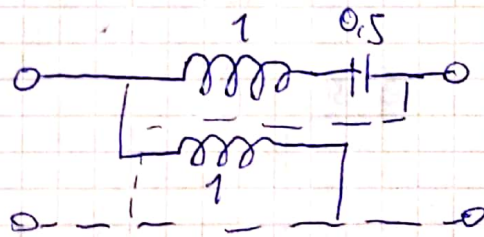
$$\frac{2(s^2+2)}{s} - Z_b = Z_a$$

$$s^2+2 = Z_a Z_b$$

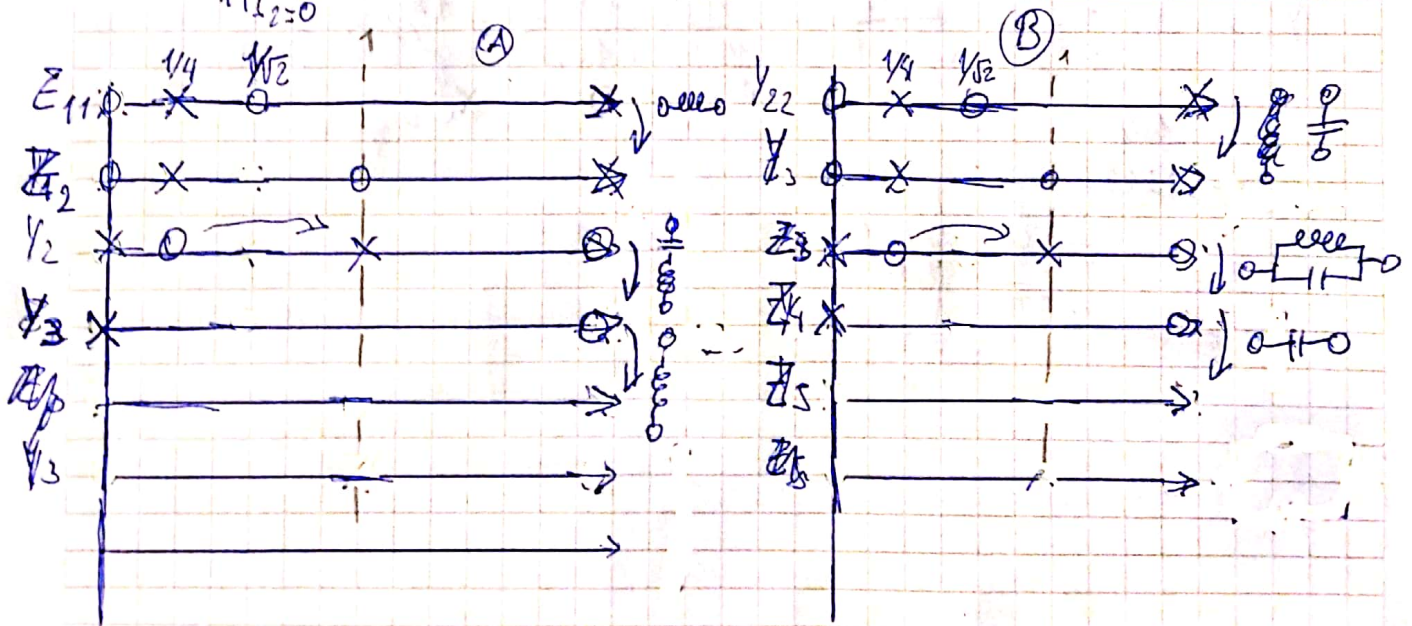
$$Z_{11} = \frac{s(s^2+2)}{s^2+1} = Z_a Z_b$$

$$s^2+2 = 2 \frac{(s^2+2)}{s} Z_b - Z_b^2$$

$$s Z_b = s \quad \vee \rightarrow Z_a = \frac{s^2+2}{s} = \sqrt{s} + \frac{2}{\sqrt{s}} \quad L=1 \quad C=0,5$$



$$3) \frac{V_2}{V_1} \Big|_{I_2=0} = \frac{s^2+1}{2s^2+1} = \frac{Z_{21}}{Z_{11}} = -\frac{Y_{21}}{Y_{22}} \quad D = \frac{s^2+1/2}{s}$$



$$T(s) = \frac{V_2}{V_1} \Big|_{I_2=0} = \frac{s^2+1}{2s^2+1}$$

$$Z_{11} = \frac{s(2s^2+1)}{s^2+1/16}$$

$$Z_{21} = \frac{s(s^2+1)}{s^2+1/16}$$

$$\lim_{s \rightarrow \infty} s h'_{\infty} = \frac{s(2s^2+1)}{s^2+1/16} \Rightarrow h'_{\infty} = \frac{16}{15} \rightarrow L_1$$

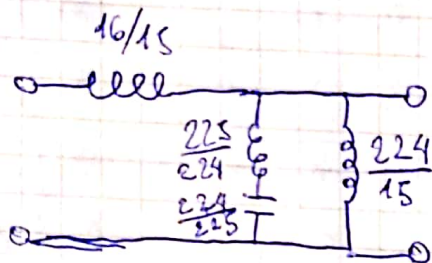
$$Z_2 = \frac{2s^3 + 9 - \frac{16}{15}s^2 - \frac{1}{15}s}{s^2+1/16} = \frac{\frac{14}{15}s(s^2+1)}{s^2+1/16}$$

$$Y_2 = \frac{s^2+1/16}{\frac{14}{15}(s^2+1)s} \Rightarrow \lim_{s \rightarrow -1} \frac{s^2+1}{s} \cdot Y_2(s) = \frac{225}{224} \approx 1/C$$

$$\frac{1}{C} = \frac{225}{224}$$

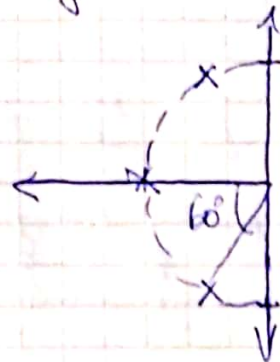
$$Y_3 = Y_2 - \frac{\frac{225}{224}}{\frac{s^2+1}{s}} = \frac{\frac{1}{16}s^2 + 1/16}{\frac{14}{15}(s^2+1)s} = \frac{1}{224} \frac{1}{s}$$

$$C = \frac{224}{15}$$



$$4) \left| \frac{V_2}{V_1} \right| = \frac{h^2}{\sqrt{1+\omega^6}} = |T(j\omega)| \quad Z_L = 50 \Omega \rightarrow \text{normalizado a } 50 \Omega$$

$$0 = 1 + \omega^6 \xrightarrow{\omega \frac{h}{\omega}} 0 = 1 - s^6 \rightarrow s^6 = 1 = e^{j4\pi/6}$$



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

$$\begin{cases} V_1 = Z_{11} I_1 + Z_{12} I_2 \\ V_2 = Z_{21} I_1 + Z_{22} I_2 \\ \underline{V_2} = -\underline{Z_L} \underline{I_2} = -I_2 \end{cases}$$

$$\begin{cases} I_1 = Y_{11} V_1 + Y_{21} V_2 \\ I_2 = Y_{12} V_1 + Y_{22} V_2 \\ V_2 = -Z_L I_2 \end{cases}$$

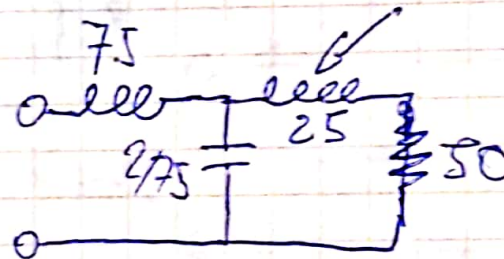
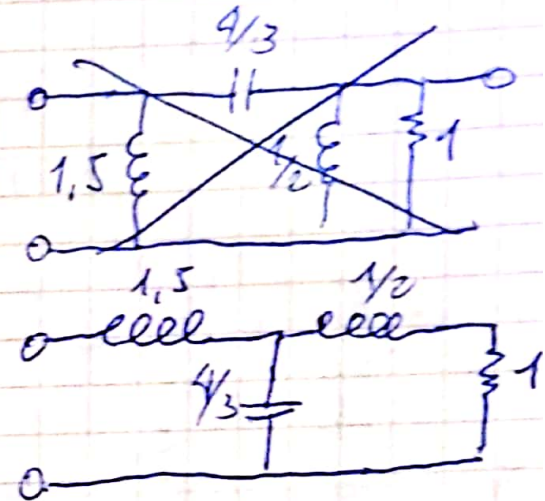
$$\frac{V_2}{V_1} = \frac{-Y_{21}}{\frac{1}{Z_L} + Y_{22}}$$

$$T(s) = \frac{P}{Q} = \frac{P}{M+N} = \frac{\overset{\text{impar}}{P/N}}{1+N/N} = \frac{K}{1+s^3+2s^2+2s}$$

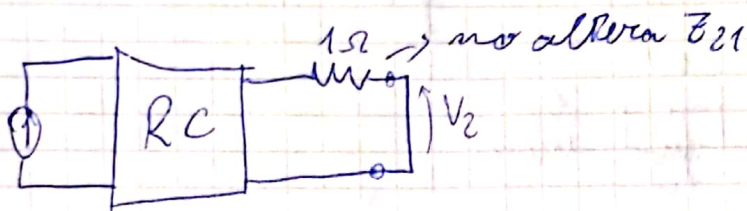
$$\frac{V_E}{V_1} = \frac{K/s^3 + 2s}{1 + \frac{2s^2 + 1}{s^3 + 2s}} \rightarrow Y_{22} = \frac{2(s^2 + 1/2)}{s(s^2 + 2)} \quad \frac{1}{Y_{22}} = \frac{1/2 s^3 + s}{s^2 + 1/2}$$

$$\begin{array}{r} \frac{1}{2} s^3 + s \quad | \quad s^2 + 1/2 \\ - \frac{2}{0,5 s^3 + 0,25 s} \quad | \quad \frac{1}{2} s \\ \hline s^2 + 1/2 \quad | \quad \frac{3}{4} s \\ - \frac{s^2}{s^2} \quad | \quad \frac{4}{3} s \\ \hline \frac{3}{4} s \quad | \quad \frac{1}{2} \\ \frac{3}{4} s \quad | \quad \frac{1}{2} \\ \hline 0 \quad | \quad \frac{3}{2} s \end{array}$$

$\frac{1}{2} s$ (inductor)
 $\frac{4}{3}$ (resistor)
 $\frac{3}{2} s$ (inductor)

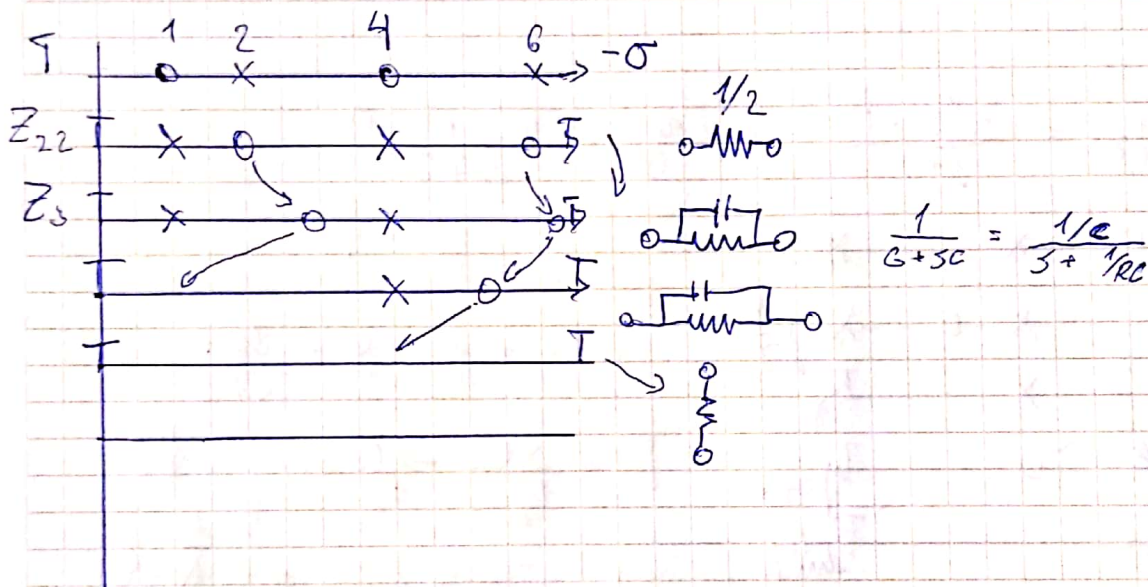


$$5) \quad \frac{-I_2}{I_1} = H \frac{s^2 + 5s + 4}{s^2 + 8s + 12} \quad Z_{21} = 6H$$



$$\frac{-I_2}{I_1} = \frac{Z_{21}}{Z_{22}} = \frac{6H}{Z_{22}} = H \frac{s^2 + 5s + 4}{s^2 + 8s + 12}$$

$$Z_{22} = 6 \frac{(s+2)(s+6)}{(s+1)(s+4)} = \frac{6(s^2 + 8s + 12)}{s^2 + 5s + 4}$$



$$Z_3 = Z_{22} - \frac{1}{2} = \frac{5,5s^2 + 4,5s + 70}{s^2 + 5s + 4}$$

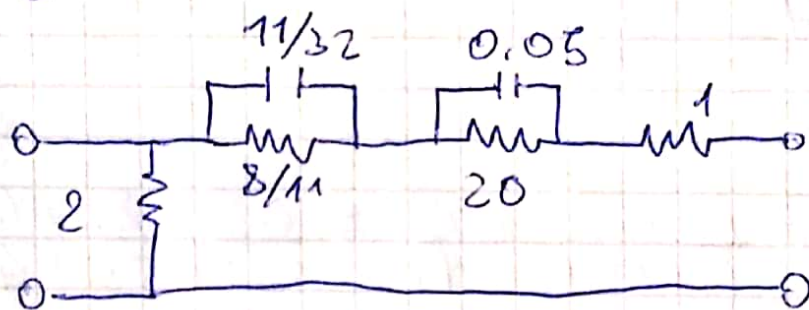
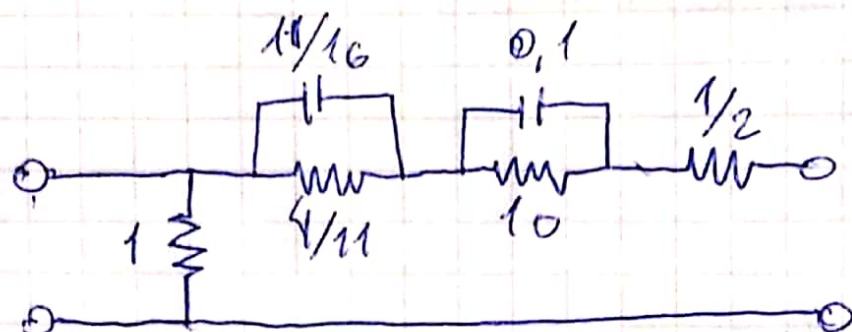
$$\lim_{s \rightarrow -1} Z_3 \cdot (s+1) = 10 \rightarrow C = 0,1 \rightarrow R = 10$$

$$Z_4 = Z_3 - \frac{10/3}{s+1} = \frac{5,5s^2 + 13,5s - 10/3}{(s+1)(s+4)} = \frac{s+20/3}{s+4}$$

$$Z_4 = Z_3 - \frac{10}{s+1} = \frac{5,5s^2 + 35,5s + 30}{(s+1)(s+4)} = \frac{s+60/11}{s+4}$$

$$\lim_{s \rightarrow -4} (s+4) Z_4 = 16/11 \rightarrow C_2 = \frac{11}{16} \quad R_2 = \frac{4}{11}$$

$$Z_5 = Z_4 - \frac{16/11}{s+4} = \frac{s+4}{s+4} = 1 \rightarrow \begin{array}{c} 0 \\ | \\ \text{---} \\ | \\ 0 \end{array} 1$$



↓ denormalizo a 2Ω