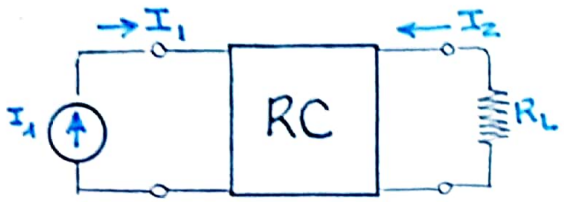
TS 13



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

Alternativa ①

$$\begin{cases} I_2 = -\dfrac{V_2}{R_L} \\ V_2 = Z_{21}I_1 + Z_{22}I_2 \end{cases} \rightarrow \quad -I_2R_L = I_1Z_{21} + I_2Z_{22}$$

$$-\frac{I_2}{I_1} = \frac{Z_{21}}{Z_{22}+R_L}$$

NORMALIZO A $R_L = 1$

$$-\frac{I_2}{I_1} = \frac{Z_{21}}{Z_{22}+1} = \frac{6H}{Z_{22}+1} = H\frac{s^2+5s+4}{s^2+8s+12}$$

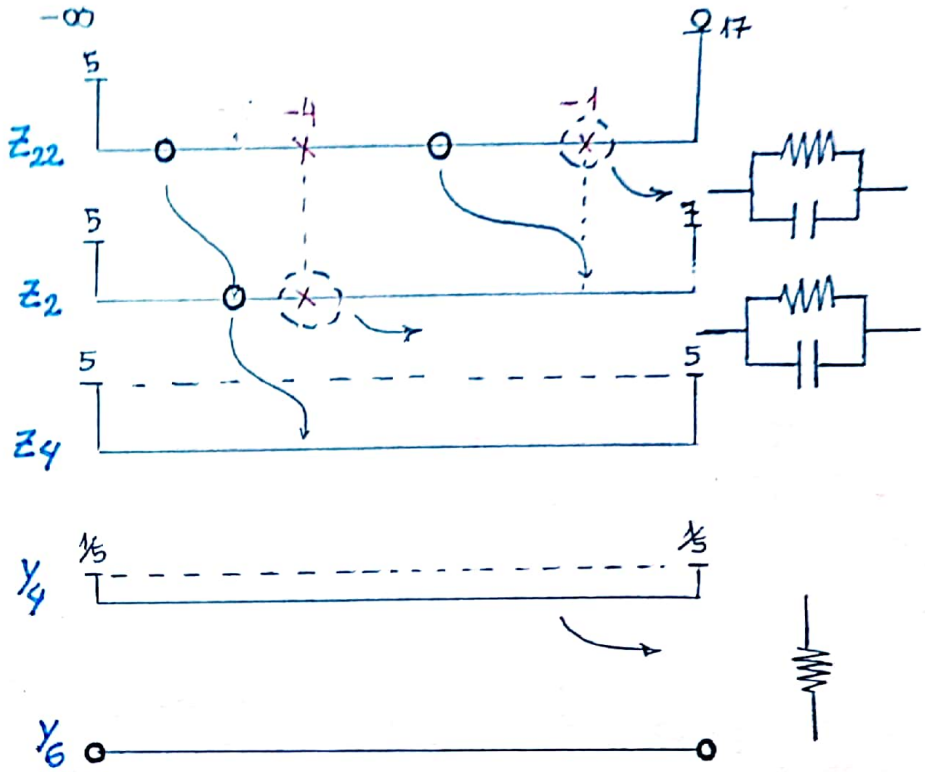
$$-\frac{I_2}{I_1} = \frac{6H}{Z_{22}+1} = \frac{6H}{\left(\frac{s^2+8s+12}{s^2+5s+4}\right)\cdot 6} = \frac{6H}{\frac{5s^2+43s+68}{s^2+5s+4}+1}$$

$$Z_{22} = \frac{5s^2+43s+68}{s^2+5s+4} = \frac{K_1}{s+1} + \frac{K_2}{s+4} + K_\infty$$

$$K_1 = (s+1)Z_{22}\Big|_{s=-1} = 10 \qquad K_2 = (s+4)Z_{22}\Big|_{s=-4} = 8$$

$$\left.\begin{aligned} Z_1 &= \frac{10}{s+1} \\ Z_3 &= \frac{8}{s+4} \end{aligned}\right\} \quad Z_4 = Z_{22} - Z_1 - Z_3 = Z_{22}(\infty)$$

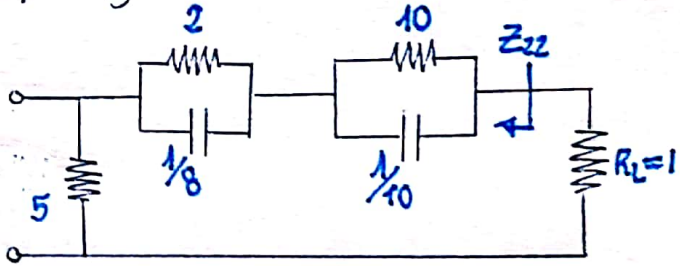
$$Z_4 = 5$$



$$Z_2 = Z_{22} - \frac{K_1}{s+1} = \frac{5s^2+43s+68-10s-40}{(s+1)(s+4)} = \frac{5\left(s+\frac{28}{5}\right)}{s+4}$$

$$Z_4 = Z_2 - \frac{K_2}{s+4} = \frac{5s+28-8}{s+4} = \frac{5(s+4)}{s+4} = 5$$

$$Y_4 = \frac{1}{5}$$



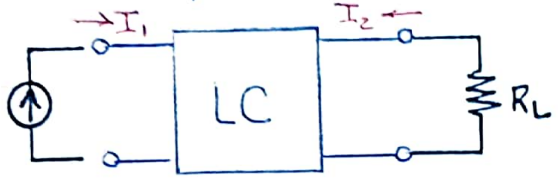
$$-\frac{I_2}{I_1}\Big|_{s\to 0} = \frac{H}{3} = \frac{5}{5+2+10+1}$$

$$\frac{H}{3} = \frac{5}{18}$$

$$-\frac{I_2}{I_1}\Big|_{s\to\infty} = H = \frac{5}{5+1} = \frac{5}{6} \quad \longleftrightarrow \quad H = \frac{5}{6}$$

$$H = \frac{5}{6}$$

$$T(s)=\frac{V_2}{I_1}=\frac{K(s^2+9)}{s^3+2s^2+2s+1}$$



$$\begin{cases} V_2 = I_1 Z_{21} + I_2 Z_{22} \\ I_2 = -\frac{V_2}{R_L} \end{cases} \qquad V_2 = I_1 Z_{21} + \left(-\frac{V_2}{R_L}\right) Z_{22}$$

$$V_2\left(1+\frac{Z_{22}}{R_L}\right) = I_1 Z_{21}$$

$$\frac{V_2}{I_1} = \frac{Z_{21}}{1+\frac{Z_{22}}{R_L}}$$

NORMALIZO $R_L = 1$

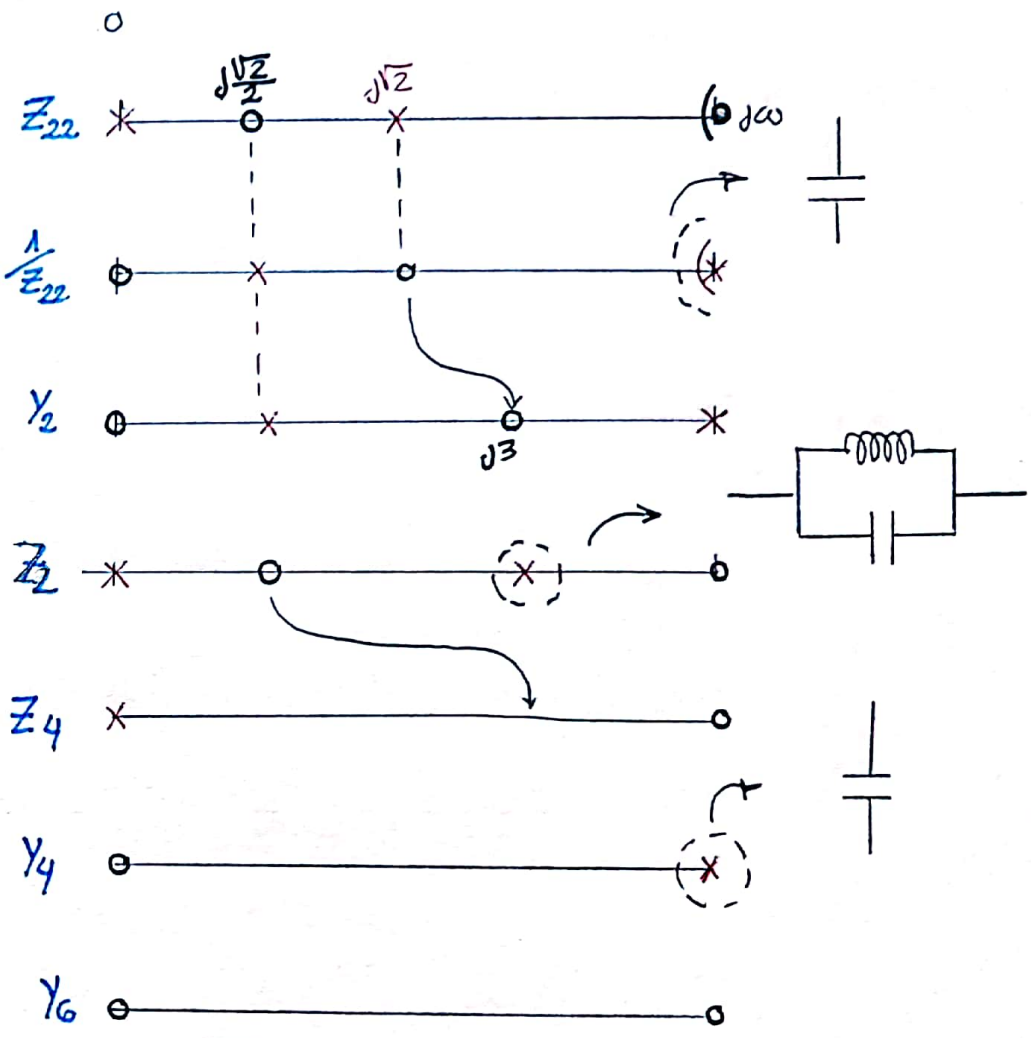
$$T(s) = \frac{Z_{21}}{1+\frac{Z_{22}}{R_L}} = \frac{K(s^2+9)}{s^3+2s^2+2s+1} = \frac{P/N}{1+M/N}$$

$$T(s) = \frac{Z_{21}}{1+Z_{22}} = \frac{K\frac{s^2+9}{s(s^2+2)}}{\frac{2(s^2+\frac{1}{2})}{s(s^2+2)}+1} \rightarrow Z_{22} = \frac{2(s^2+\frac{1}{2})}{s(s^2+2)}$$

$$Z_{22} = \frac{2(s^2+\frac{1}{2})}{s(s^2+2)} \rightarrow Y'_{22} = \frac{s(s^2+2)}{2(s^2+\frac{1}{2})}$$

$$Y_2 = Y'_{22} - K'_\infty s \;/\; K'_\infty = \frac{1}{s} Y'_{22}\Big|_{s^2=-9} = \frac{-9+2}{2(-9+\frac{1}{2})} = \frac{7}{17}$$

$$Y_2 = \frac{s^3+2s-\frac{14}{17}s^3-\frac{7}{17}s}{2(s^2+\frac{1}{2})} = \frac{\frac{3}{17}s(s^2+9)}{2(s^2+\frac{1}{2})}$$



$$Z_2 = \frac{2(s^2+\frac{1}{2})}{\frac{3}{17}s(s^2+9)}$$

$$Z_4 = Z_2 - \frac{2K_1 s}{s^2+9} \;/\; 2K_1 = \frac{s^2+9}{s}\cdot Z_2\Big|_{s^2=-9} = \frac{289}{27}$$

$$Z_4 = \frac{2s^2+1-\frac{17}{9}s^2}{\frac{3}{17}s(s^2+9)} = \frac{\frac{1}{9}}{\frac{3}{17}s} \rightarrow Z_4 = \frac{17}{27s}$$

$$Y_4 = \frac{27}{17}s$$