T R-C A :

$$T_{R\text{-}CA} = \begin{vmatrix} \frac{Z_{11A}}{Z_{21A}} & \frac{\Delta Z_A}{Z_{21A}} \\ \frac{1}{Z_{21A}} & \frac{Z_{22A}}{Z_{21A}} \end{vmatrix} = \frac{1}{Z_{21A}} \begin{vmatrix} Z_{11A} & \Delta Z_A \\ 1 & Z_{22A} \end{vmatrix}$$

$$T_{VNIC} = \begin{vmatrix} -k & 0 \\ 0 & 1 \end{vmatrix}$$

$$T_{R\text{-}CB} = \begin{vmatrix} \frac{Z_{11B}}{Z_{21B}} & \frac{\Delta Z_B}{Z_{21B}} \\ \frac{1}{Z_{21B}} & \frac{Z_{22B}}{Z_{21B}} \end{vmatrix} = \frac{1}{Z_{21B}} \begin{vmatrix} Z_{11B} & \Delta Z_B \\ 1 & Z_{22B} \end{vmatrix}$$

$$\left.\frac{V_2}{I_1}\right|_{I_2=0} = \frac{1}{C_{Ttotal}} \qquad T_{total} = T_{R\text{-}CA} \times T_{VNIC} \times T_{R\text{-}CB}$$

$$T_{total} = \left(\frac{1}{Z_{21A} \times Z_{21B}}\right) \begin{vmatrix} Z_{11A} & \Delta Z_A \\ 1 & Z_{22A} \end{vmatrix} \begin{vmatrix} -k & 0 \\ 0 & 1 \end{vmatrix} \begin{vmatrix} Z_{11B} & \Delta Z_B \\ 1 & Z_{22B} \end{vmatrix}$$

$$T_{total} = \left(\frac{1}{Z_{21A}\ Z_{21B}}\right) \begin{vmatrix} -K \cdot Z_{11A} & \Delta_{ZA} \\ -K & Z_{22A} \end{vmatrix} \begin{vmatrix} Z_{11B} & \Delta_{ZB} \\ 1 & Z_{22B} \end{vmatrix}$$

$$C_{total} = \frac{1}{Z_{21A} \cdot Z_{21B}} \cdot -K Z_{11B} + Z_{22A}$$

$$C_{total} = \frac{Z_{22A} - K Z_{11B}}{Z_{21A}\ Z_{21B}}$$

$$\frac{1}{C} = \frac{Z_{21A} \cdot Z_{21B}}{Z_{22A} - K \cdot Z_{11B}} = \frac{V_2}{I_1}\Big|_{I_2 = 0}$$

$$\left.\frac{V_2}{I_1}\right|_{I_2=0} = \frac{1}{s^3+2s^2+2s+1}$$

↑ Polinomio de Butter de 3er orden

$$\frac{1}{s^3+2s^2+2s+1} = \frac{Z_{21A} \cdot Z_{21B}}{+Z_{22A} - K \cdot Z_{11B}} = \left.\frac{V_2}{I_1}\right|_{I_2=0}$$

$$\frac{V_2}{I_1} = \frac{\frac{N}{Q}(s)}{\frac{D}{Q}(s)} = \frac{\frac{Z_{21A}\ Z_{21B}}{Q(s)}}{\frac{Z_{22A} - K\ Z_{11B}}{Q(s)}}$$

$$\frac{D}{Q}(s) = \frac{s^3+2s^2+2s+1}{Q(s)} = \frac{(s^2+s+1)\cdot(s+1)}{Q(s)}$$

Q(s) debe ser al menos de grado 3

adopto $Q(s) = s.(s+2).(s+3)$

$$\frac{D}{Q}(s) = \frac{(s^2+s+1).(s+1)}{s.(s+2).(s+3)} = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{s+3} + K_0$$

$$K_0 = \lim_{s\to\infty} \frac{D}{Q}(s) = 1$$

$$A = \lim_{s\to 0} \frac{(s^2+s+1)\ (s+1)}{\cancel{s}.(s+2).(s+3)} . \cancel{s} = \frac{1}{6}$$

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

$$C = \lim_{s\to -3} \frac{(s^2+s+1).(s+1)}{s.(s+2)\cancel{(s+3)}} \cancel{(s+3)} = \frac{-14}{3}$$

$$\frac{D}{Q}(s) = \underbrace{1 + \frac{1/6}{s} + \frac{3/2}{s+2}}_{Z_{22A}} + \underbrace{\frac{(-14/3)}{s+3}}_{-Z_{11B}K}$$

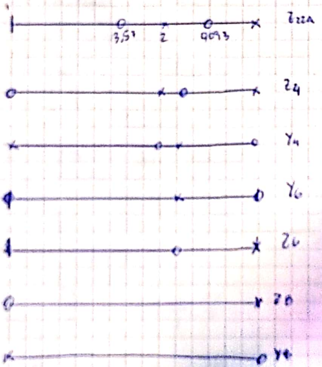
$$\frac{R}{a}(s) = \frac{1}{s(s+2)(s+3)} = Z_{2+A} + Z_{+B}$$

$$Z_{2+A} = 1 + \frac{1}{6s} + \frac{3}{2(s+2)} \qquad K_{Z+B} = \frac{14}{3(s+3)}$$

$$Z_{2+A} = \frac{K_A}{s(s+2)} \qquad Z_{2+B} = \frac{K_B}{s+3}$$

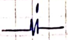
$$Z_{22A} = \frac{6s^2+12s+s+2+9s}{6s(s+2)} = \frac{6s^2+22s+2}{6s(s+2)} = \frac{s^2+\frac{11}{3}s+\frac{1}{3}}{s(s+2)}$$

$$Z_{22A} = \frac{(s+0{,}093)\,(s+3{,}57)}{s\,(s+2)}$$



$$Z_4 = Z_{22A} - K_\infty \qquad K_\infty = \lim_{s\to\infty} Z_{22A}$$

$$Z_4 = \frac{s^2 + \frac{11}{3}s + \frac{1}{3}}{s(s+2)} - 1$$

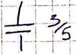


$$Z_4 = \frac{\cancel{s^2} + \frac{11}{3}s + \frac{1}{3} - \cancel{s^2} - 2s}{s(s+2)} = \frac{\frac{5}{3}s + \frac{1}{3}}{s(s+2)}$$

$$Y_4 = \frac{s(s+2)}{\frac{5}{3}\left(s+\frac{1}{5}\right)}$$

$$Y_6 = Y_4 - K_1 \cdot s$$

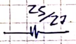
$$K_1 = \lim_{s\to\infty} \frac{Y_4}{s} = \frac{s(s+2)}{\frac{5}{3}s^2 + \frac{1}{3}s} = \frac{3}{5}$$



$$Y_6 = \frac{s(s+2)}{\frac{5}{3}\left(s+\frac{1}{5}\right)} - \frac{3}{5}\cdot s = \frac{s(s+2) - s^2 - \frac{1}{5}s}{\frac{5}{3}\left(s+\frac{1}{5}\right)} = \frac{\cancel{s^2} + 2s - \cancel{s^2} - \frac{s}{5}}{\frac{5}{3}\left(s+\frac{1}{5}\right)}$$

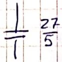
$$Y_6 = \frac{\frac{9}{5}s}{\frac{5}{3}\left(s+\frac{1}{5}\right)} = \frac{27s}{25\left(s+\frac{1}{5}\right)}$$

$$Z_6 = \frac{25\left(s+\frac{1}{5}\right)}{27s}$$

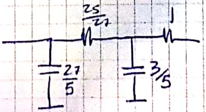


$$Z_8 = Z_6 - Z_6(\infty) = \frac{25\left(s+\frac{1}{5}\right)}{27s} - \frac{25}{27} = \frac{25s + 5 - 25s}{27s} = \frac{5}{27s}$$

$$Y_9 = \frac{27s}{5}$$



Red A.



otra forma

$$
\begin{array}{l|l}
s^2+\frac{11}{3}s+\frac{1}{3} & s^2+2s \\
\hline
s^2+2s+1 & 1 \\
\frac{5}{3}s+\frac{1}{3} &
\end{array}
$$

$$
\begin{array}{l|l}
s^2+2s & \frac{5}{3}s+\frac{1}{3} \\
\hline
s^2+\frac{1}{5}s & \frac{3}{5}s \\
\frac{9}{5}s &
\end{array}
$$

$\frac{3}{5}$

$$
\begin{array}{l|l}
\frac{5}{3}s+\frac{1}{3} & \frac{9}{5}s \\
\hline
\frac{5}{3}s+ & \frac{25}{27} \\
\frac{1}{3} &
\end{array}
$$

$25/27$

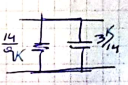
$$
\begin{array}{l|l}
\frac{9}{5}s & \frac{1}{3} \\
\hline
\frac{9}{5}s & \frac{27}{5}s \\
0 &
\end{array}
$$

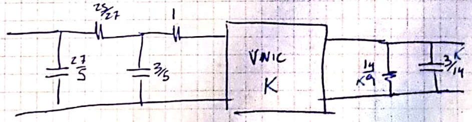
$\frac{27}{5}$

Red B

$K. Z_{11B} = \frac{14}{3(s+3)}$ $\qquad Z_{21B} = \frac{KB}{s+3}$

$Z_{11B} = \dfrac{1}{s\frac{3}{14}+\frac{9}{14}}$





Con K ajustamos la ganancia sin modificar la forma.