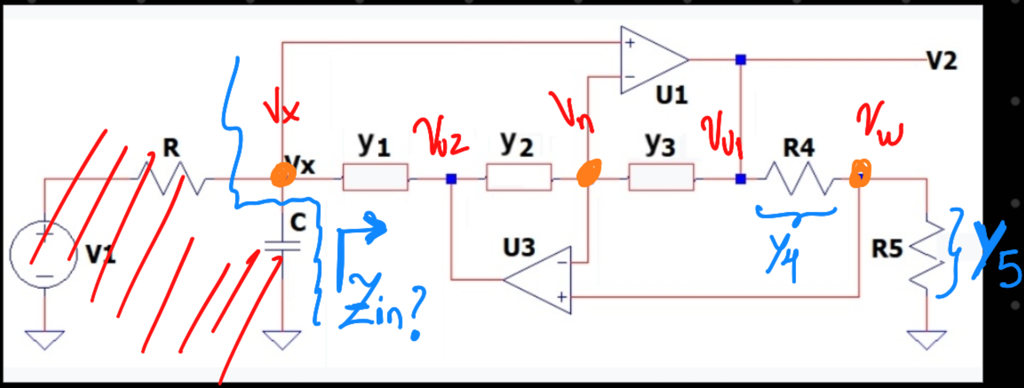


Análisis GIC de manera genérica

(1) $V_x \cdot Y_1 - V_{U2} Y_1 = I_{in}$

(2) $V_n (Y_2 + Y_3) - V_{U2} Y_2 - V_{U1} Y_3 = 0$

(3) $V_w (Y_4 + Y_5) - V_{U1} Y_4 = 0$

Extras

$V_x = V_n = V_w$

$Z_{in} = \frac{V_{in}}{I_{in}}$

$V_{in} = V_x$

(1) $V_x \cdot Y_1 - V_{U2} Y_1 = I_{in}$

(2) $V_x (Y_2 + Y_3) - V_{U2} Y_2 - V_{U1} Y_3 = 0$

(3) $V_x (Y_4 + Y_5) - V_{U1} Y_4 = 0$

→ Incognitas $V_x ; V_{U2} ; V_{U1}$

(2') $V_{U2} = \frac{V_x (Y_2 + Y_3)}{Y_2} - V_{U1} \frac{Y_3}{Y_2}$

(3') $V_{U1} = V_x \frac{(Y_4 + Y_5)}{Y_4}$

(3') en (2')

(4) $V_{U2} = V_x \left[\frac{(Y_2 + Y_3)}{Y_2} - \frac{Y_3 (Y_4 + Y_5)}{Y_2 Y_4} \right]$

④ en ①

$$Y_1\left\{V_x - V_x \frac{1}{Y_2}\overbrace{\left[(Y_2+Y_3) - \frac{Y_3(Y_4+Y_5)}{Y_4}\right]}^{\lambda}\right\} = I_{in}$$

$$Y_1\left\{V_x\left(1-\frac{\lambda}{Y_2}\right)\right\} = I_{in}$$

$$Z_{in} = \frac{V_x}{I_{in}} = \frac{1}{Y_1\left(1-\frac{\lambda}{Y_2}\right)} = \frac{\frac{Y_2}{Y_1}}{Y_2-\lambda}$$

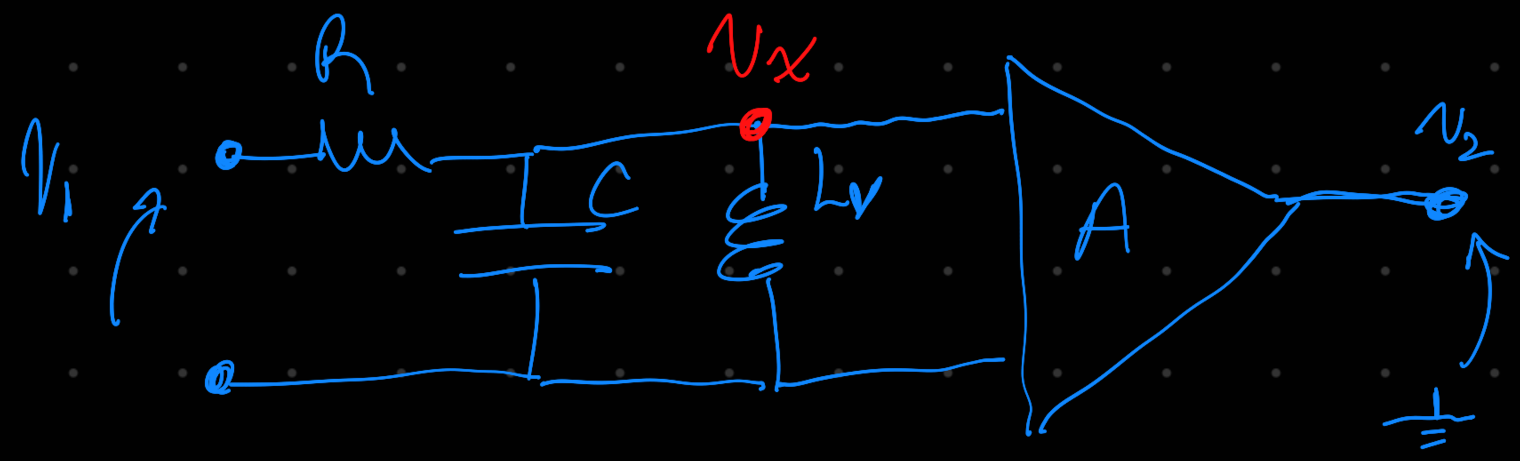
$$Z_{in} = \frac{\frac{Y_2}{Y_1}}{\frac{\cancel{Y_2Y_4} - \cancel{Y_4Y_2} - \cancel{Y_3Y_4} + \cancel{Y_3Y_4} + Y_3Y_5}{Y_4}} \Rightarrow \frac{Y_2Y_4}{Y_1Y_3Y_5}$$

$$Z_{in} = \frac{\frac{1}{Z_2Z_4}}{\frac{1}{Z_1Z_3Z_5}} \Rightarrow \frac{Z_1Z_3Z_5}{Z_2Z_4}$$

Caso de estudio

Para poder "ver" un inductor en derivación Y_2 debe ser un capacitor ya que Y_4 es un resistor en el circuito de estudio.

Por lo tanto, reemplazo con todo resistores menos Y_2 y el circuito queda de la siguiente manera



$$\frac{V_2}{V_1} = \frac{V_x}{V_1} \cdot \frac{V_2}{V_x}$$

$\frac{V_2}{V_x}$ sale de la ecuación (3)

(3) $$V_2 = V_x \frac{(Y_4 + Y_5)}{Y_4} \Longrightarrow \frac{V_2}{V_x} = \frac{Y_4 + Y_5}{Y_4}$$

$$y\ sL_v = Z_{GIC} = \frac{Z_1 Z_3 Z_5}{Z_2 Z_4} \Rightarrow \frac{R_1 R_3 R_5}{\frac{1}{sC_2} R_4}$$

$$s L_v = sC_2 \frac{R_1 R_3 R_5}{R_4} \quad \therefore L_v = C_2 \frac{R_1 R_3 R_5}{R_4}$$

Ahora analizo el RLC

$$\frac{V_x}{V_{in}} = \frac{\left(sC + \frac{1}{sL}\right)^{-1}}{\left(sC + \frac{1}{sL}\right)^{-1} + R} = \frac{\frac{sL}{\cancel{s^2LC+1}}}{\frac{sL + (s^2LC+1)R}{\cancel{s^2LC+1}}}$$

$$\frac{V_x}{V_{in}} = \frac{sL}{sL + s^2LCR + R} = \frac{\frac{s}{RC}}{s^2 + s\frac{1}{RC} + \frac{1}{LC}}$$

$$H(s) = \frac{\frac{s}{RC}}{s^2 + s\frac{1}{RC} + \frac{1}{LC}}$$

Se multiplica $H(s) \cdot \frac{v_2}{v_x}$ y se expande L_v.

$$H(s) = \frac{V_2}{V_1} = \frac{\frac{s}{RC}}{s^2 + s\frac{1}{RC} + \frac{R_4}{C_2 R_1 R_3 R_5 C}} \qquad \frac{Y_4 + Y_5}{Y_4}$$

$$K = \frac{Y_4 + Y_5}{Y_4} = 1 + \frac{Y_5}{Y_4} \qquad \frac{W_0}{Q} = \frac{1}{RC}$$

$$\Rightarrow 1 + \frac{R_4}{R_5}$$

$$W_0^2 = \frac{R_4}{C_2 C R_1 R_3 R_5} \qquad Q = \frac{RC}{W_0}$$

Se propone

$$\begin{cases} C_2 = C \\ R_1 = R_3 = R_5 \end{cases}$$

$$K = 1 + \frac{R_4}{R_5} \rightarrow (K-1) R_5 = R_4$$

$$\omega_0^2 = \frac{(K-1)\cancel{R_1}}{C^2 R_1^{\cancel{3}\,2}} \Rightarrow \frac{(K-1)}{C^2 R_1^2}$$

$$\rightarrow \quad \omega_0 = \frac{\sqrt{K-1}}{R_1 C}$$

$$\frac{\omega_0}{Q} = \frac{1}{RC} \rightarrow \frac{Q}{\omega_0} = RC$$

$$Q = R\cancel{C} \frac{\sqrt{K-1}}{R_1 \cancel{C}}$$

$$\rightarrow \quad Q = \frac{R}{R_1} \sqrt{K-1}$$

tenemos

$$K = 1 + \frac{R_4}{R_5}$$

$$C = C_2$$

$$\omega_0 = \frac{1}{R_1 C}\sqrt{K-1}$$

$$R_1 = R_3 = R_5$$

$$R_4 = (K-1) R_5$$

$$Q = \frac{R}{R_1}\sqrt{K-1}$$

$$R_1 = \frac{\sqrt{K-1}}{\omega_0 C}$$

$$R = \frac{Q}{\sqrt{K-1}} \cdot R_1$$

$$\Updownarrow$$

$$R = \frac{Q}{\omega_0 C}$$

Si se propone $C = 100\,nF$ y $K=2$ por simplicidad

$$R_1 = \frac{1}{\omega_0\, 100\,nF} \qquad R = 20 R_1$$

$R_1 = 159.2\ \Omega \qquad R = 3.18\,k\Omega$

Normalización

$$H(s) = K \frac{s \frac{w_0}{Q}}{s^2 + s\frac{w_0}{Q} + w_0^2}$$

$$N_w = w_0 \quad \wedge \quad N_\Omega = R_1 = R_3 = R_5 = 1$$

$$w_0^2 = 1^2 \rightarrow \frac{K-1}{1\,\cancel{R_1^2}\,C^2} = 1^2 \Rightarrow C' = \sqrt{K-1}$$

$$R_4 = (K-1)\cancel{R_5}^{\,1} = K-1$$

$$C' = \sqrt{R_4}$$

$$Q = \frac{R}{1\cancel{R}}\sqrt{K-1} = R\,C'$$