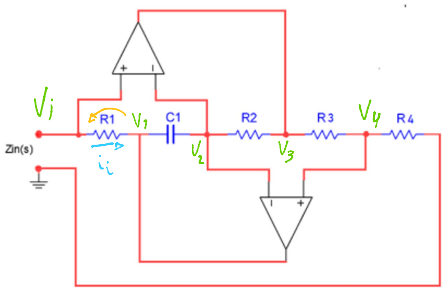
TP1-5

Ejercicio #5
Para los siguientes dipolos activos determinar la Impedancia de Excitación.
Utilizar un simulador para graficar el módulo y la fase de Zin, adoptando los valores:

R1=R2=R3=R4 = 1 kΩ ; C1=C2 = 1 µF



$$Z_{in} = \frac{V_i}{i_i}$$

$$i_L = (V_i - V_1) \cdot G_1$$

Nodos:
→ Solos los que NO son salidas de OPAMP o V_i

V_2: $V_2 \cdot (G_2 + sC) - V_1 \cdot sC - V_3 \cdot G_2 = 0$

V_4: $V_4 \cdot (G_4 + G_3) - V_3 \cdot G_3 = 0$

$V_i = V_2 = V_4$

$$\begin{cases} V_i \cdot (G_4 + G_3) - V_3 \cdot G_3 = 0 \\ V_i (G_2 + sC) - V_1 sC - V_3 G_2 = 0 \\ i_i = (V_i - V_1) \cdot G_1 \end{cases}$$

$$\rightarrow V_3 = V_i \cdot \frac{(G_4 + G_3)}{G_3} \quad ; \quad V_1 sC = V_i \cdot (G_2 + sC) - V_i \, G_2 \frac{(G_4 + G_3)}{G_3}$$

$$\rightarrow V_1 sC = V_i \cdot \left[\frac{G_3 G_2 + sCG_3 - G_2 G_4 - G_2 G_3}{G_3} \right]$$

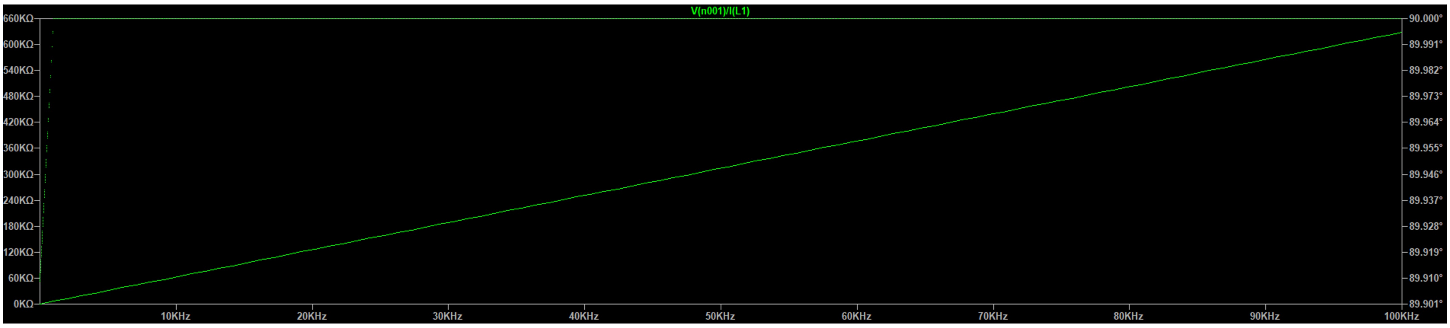
$$V_1 = V_i \left(\frac{sC G_3 - G_2 G_4}{sC G_3} \right)$$

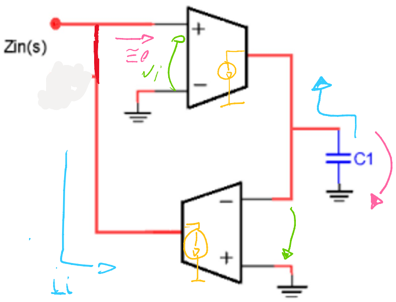
$$i_i = V_i \cdot \left(1 - \frac{sCG_3 + G_2 G_4}{sCG_3} \right) \cdot G_1 = V_i \cdot \left(\frac{sCG_3 - sCG_3 + G_2 G_4}{sCG_3} \right) \cdot G_1$$

$$Z_{in} = \frac{V_i}{V_i \cdot \left(\frac{G_2 G_4 \cdot G_1}{sCG_3} \right)} = \frac{sCG_3}{G_2 G_4 G_1} = s \cdot \frac{C G_3}{G_2 G_4 G_1}$$

Se comporta como una Inductancia

Simulación:





$$Z_{in} = \frac{V_i}{i_i}$$

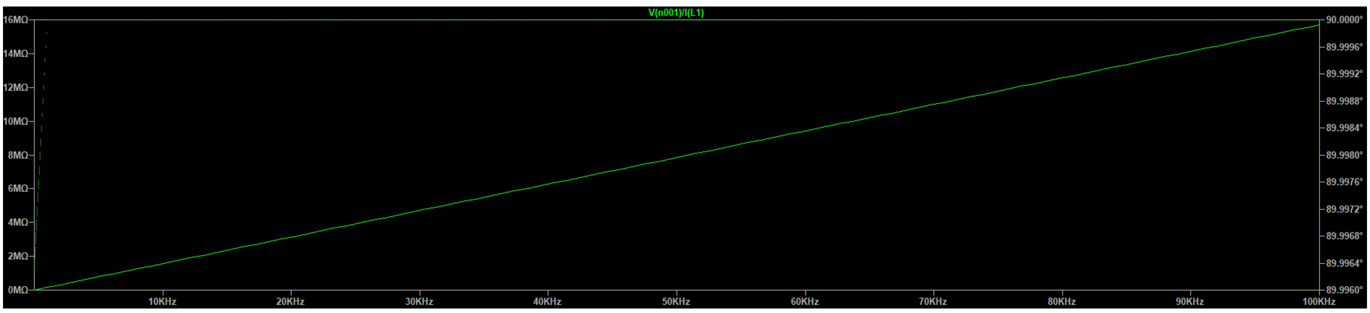
$$i_i = g_{m_2} \cdot V_c$$

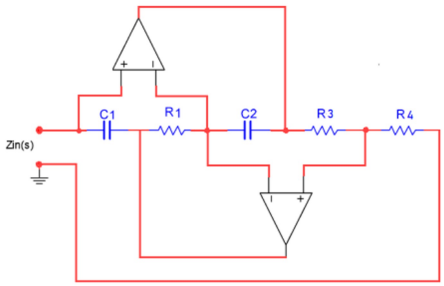
$$V_c = i_c \cdot \frac{1}{sC_1} = \frac{g_{m_1} \cdot V_i}{sC_1}$$

$$Z_{in} = \frac{V_i}{V_i \frac{g_{m_1} \cdot g_{m_2}}{sC_1}} = \frac{sC_1}{g_{m_1} g_{m_2}} \quad [H/y]$$

→ Inductor

Simulación: → $g_m = 200\,nS$ → $Z_{in} = sL$, $L \approx 25\,Hy$





↳ Usando la generica → $Z_{in} = \frac{Z_1 Z_3 Z_5}{Z_2 Z_4}$

→ $Z_{in} = \frac{1}{sC_1} \cdot \frac{1}{R_1} \cdot \frac{1}{sC_2} \cdot \frac{1}{R_3} \cdot \frac{1}{R_4} = \frac{1}{s\, C_1 C_2 R_1 R_3 R_4}$

↳ CAP con Fuentes

Simulación: