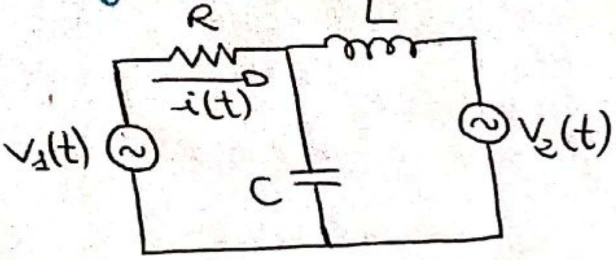
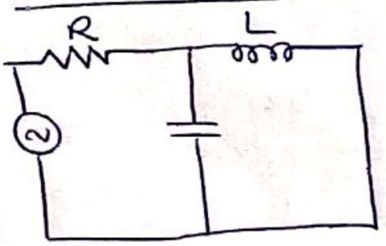
TEMA 3 - CORRIENTE ALTERNA

1. Ejemplo Prado



Circuito A



Datos

$R = 1k\Omega$

$L = 1mH = 10^{-3} H$

$C = 2nF = 2 \cdot 10^{-9} F$

$V_1(t) = 10\cos(10^6 \frac{rad}{s} t) V$

$V_2(t) = 3\cos(2 \cdot 10^6 \frac{rad}{s} t + \frac{\pi}{6}) V$

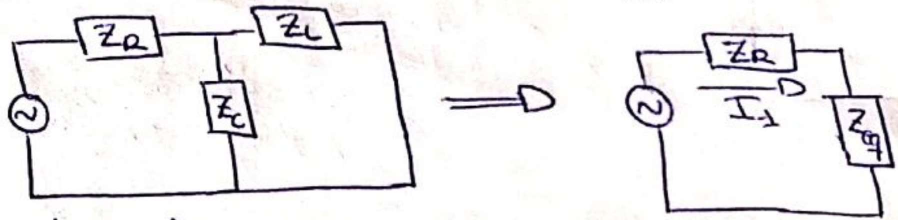
$Z_R = 1k\Omega$

$Z_L = jwL = 1000j\,\Omega$

$Z_C = \frac{1}{jwC} = -j0.5 \cdot 10^3 \Omega = 0.5 \cdot 10^3 e^{-j\frac{\pi}{2}} \Omega$

$V_1 = 10e^{j(10^6 t)}$

Fasor $\rightarrow V_1 = 10V$



$\frac{1}{Z_{eq}} = \frac{1}{Z_C} + \frac{1}{Z_L}$; $Z_{eq} = \frac{Z_L Z_C}{Z_L + Z_C} = \frac{500000\Omega}{500j\Omega} = -1000j\,\Omega = +1000e^{j\frac{\pi}{2}}$

Aplicamos método de mallas:

$$V_1 = I_1 Z_R + I_1 Z_{eq}$$

$$I_1 = \frac{V_1}{Z_R + Z_{eq}} = \frac{10}{(1000 - 1000j)\Omega} = \frac{10000 + 10000j}{2000000} = (0.005 + 0.005j) A$$

$$= 0.0071 e^{j\frac{\pi}{4}}$$

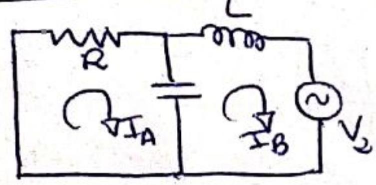
~~$i_A(t) = 0.0071 \cos t$~~

Añadimos la dependencia temporal:

$$i_A(t) = 0.0071\, e^{j(10^6 t \frac{rad}{s} + \frac{\pi}{4})} A$$

$$i_A(t) = 0.0071 \cos(10^6 t + \frac{\pi}{4}) A$$

Circuito B



Las impedancias son:

$Z_R = 1k\Omega$

$Z_L = jwL = 2000j\,\Omega$

$Z_C = \frac{1}{jwC} = -j250\Omega = 250e^{-j\frac{\pi}{2}} \Omega$

Ahora el fasor:

$V_2 = 3e^{j\frac{\pi}{6}}\ V$

~~Ahora se asocian Z_c y Z_L en paralelo~~ y Aplicamos método de mallas:

$0 = I_A Z_R + I_A Z_C - I_B Z_C \qquad V_2 = I_B Z_L + I_B Z_C - I_A Z_C$

$I_A = \dfrac{I_B Z_C}{Z_R + Z_C} \qquad I_B = \dfrac{V_2 + I_A Z_C}{Z_L + Z_C}$

$\Rightarrow I_A = \dfrac{\frac{V_2 + I_A Z_C}{Z_L + Z_C} \cdot Z_C}{Z_R + Z_C}$

$Z_R + Z_C = (400 - 250j)\,\Omega \qquad Z_L + Z_C = 1750j\,\Omega$

$(Z_R + Z_C)(Z_L + Z_C) = 175000j + 437500$

$I_A = V_2 + I_A Z_C \cdot \underbrace{\dfrac{Z_C}{(Z_R + Z_C)(Z_L + Z_C)}}$

$\dfrac{-250j}{437500 + 175000j} = \dfrac{-43750000 - 109375000j}{2.2203 \cdot 10^{11}} = 0.00053056e^{j}$

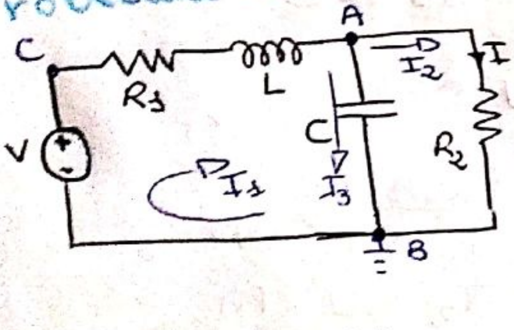
$I_A = (-0.0003 - j0.0003)\,A = 0.0004e^{j3.92699}\,A$

$i_A(t) = 0.0004e^{(2\cdot 10^6 t + 3.92699)}\,A$

$i_A^2(t) = 0.0004\cos\left(2\cdot 10^6 t + \frac{5\pi}{4}\right)$

$i_A(t)\text{ total} = \left[0.0071\cos\left(10^4 t + \frac{\pi}{4}\right) + 0.0004\cos\left(2\cdot 10^6 t + \frac{5\pi}{4}\right)\right] A$

Problema 57 Libro



Datos

$V = 20e^{j\frac{\pi}{3}} \quad R_1 = 2\Omega \quad R_2 = 1\Omega$

$Z_L = 1j\Omega \quad Z_C = -2j\Omega$

$\boxed{A}\quad I_1 = I_2 + I_3$

$I_2 = \dfrac{V_A}{Z_R} \qquad I_3 = \dfrac{V_A}{Z_C} \qquad I_1 = \dfrac{V_C - V_A}{Z_{R_1} + Z_L}$

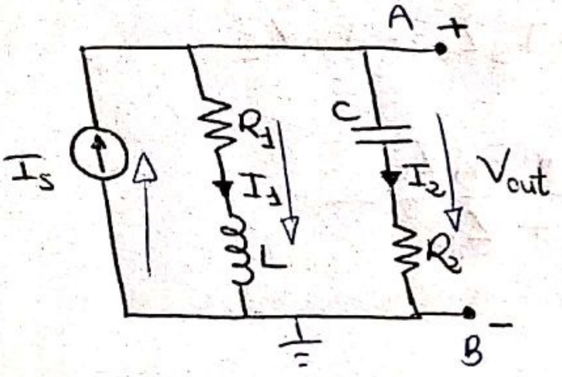
$\dfrac{V_C - V_A}{Z_{R_1} + Z_L} = \dfrac{V_A}{Z_{R_2}} + \dfrac{V_A}{Z_C} \Rightarrow \dfrac{V_C}{Z_{R_1} + Z_L} = \underbrace{\left(\dfrac{1}{Z_{R_2}} + \dfrac{1}{Z_C} + \dfrac{1}{Z_{R_1} + Z_L}\right)} V_A$

$\dfrac{20e^{j\frac{\pi}{3}}}{(2+1j)\,\Omega} = \dfrac{20e^{j\frac{\pi}{3}}}{\sqrt{5}e^{j0.463647}} = 4\sqrt{5}e^{j0.5835499}$

$1 + \dfrac{1}{-2j} + \dfrac{1}{2+j} = 1 + \dfrac{j}{2} + \dfrac{2-j}{5} = \dfrac{7}{5} + \dfrac{3}{10}j \Rightarrow \dfrac{\sqrt{205}}{10}e^{j0.21103333}$

$$V_A = \frac{4\sqrt{5}\, e^{j0.5836499}}{\frac{\sqrt{205}}{10} e^{j0.21109333}} = \frac{40\sqrt{41}}{41} e^{j0.37245657}\ A$$

Problema 59 Libro



Datos

$i_s(t) = 0.3\cos\left(10^4 t - \frac{3\pi}{4}\right) A$

$R_1 = 20\,\Omega \quad R_2 = 10\,\Omega$

$L = 6\,mH \quad C = 3.33\,\mu F$

¿V_{out}?

Impedancias
$$\begin{cases} Z_{R_1} = 20\,\Omega \quad Z_{R_2} = 10\,\Omega \\ Z_L = j\omega L = j\cdot 10^4 \cdot 6\cdot 10^{-3} = 60j\,\Omega \\ Z_C = \frac{1}{j\omega C} = -j\,30.03\,\Omega \end{cases}$$

Fasor $I_s = 0.3e^{-j\frac{3\pi}{4}}$

Aplicamos ley de nudos:

$\boxed{A}$ $I_s = I_1 + I_2$

$$\left.\begin{matrix} I_s = I_1 + I_2 \\ I_1 = \frac{V_A}{Z_{R_1}+Z_L} \quad I_2 = \frac{V_A}{Z_C + Z_{R_2}} \end{matrix}\right\} I_s = \left(\frac{1}{Z_{R_1}+Z_L} + \frac{1}{Z_C+Z_{R_2}}\right) V_A$$

$$\frac{1}{Z_{R_1}+Z_L} = \frac{1}{(20+60j)\,\Omega} = \frac{20-60j}{4000} = (0.005 - 0.015j)\,\Omega$$

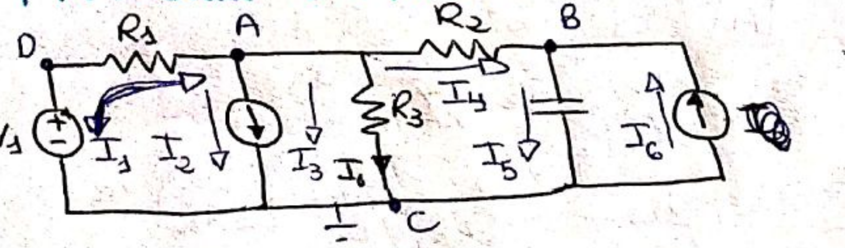
$$+\ \frac{1}{Z_C+Z_{R_2}} = \frac{1}{(10-30.03j)\,\Omega} = \frac{10+30.03j}{1001.8009} = 0.009998 + 0.029976j$$

$\to \cancel{0.005998}$ $0.014982 + 0.014976j = \cancel{0.0161324e^{j1.18985}}$ $0.02118 e^{j0.78519788} = A$

$\cancel{V_A = \frac{I_s}{0.0161324 e^{j1.18985}}}$ $V_A = \frac{I_s}{A} = 14.16e^{-j\pi}$

$V_{out}(t) = 14.16\cos(10^4 t - \pi)\,V$

Problema 61 Libro



Datos

$V_1 = 12e^{j0}\,(V)$

$I_2 = 2e^{j0}\,(A)$

$I_6 = 4e^{j0}\,(A)$

$R_1 = R_3 = 2\,\Omega$

$R_2 = 1\,\Omega$

$Z_C = -1j\,\Omega$

Aplico ley de nudos:

$\boxed{A}$ $I_1 = I_2 + I_3 + I_4$ Ya tenemos $I_2 = 2A$ e $I_6 = 4A$

$\boxed{B}$ $I_4 + I_6 = I_5$

$$I_3 = \frac{V_A}{R_3} \quad I_4 = \frac{V_A - V_B}{R_2} \quad I_5 = \frac{V_B}{Z_C}$$

$$I_1 = \frac{V_0 - V_A}{R_1} = \frac{V_1 - V_A}{R_1}$$

Calcular impedancias:

$Z_{R_1} = Z_{R_3} = 2\Omega \quad Z_C = -1j\Omega$

$Z_{R_2} = 1\Omega$

Sustituimos en la ley de nudos:

$$\begin{cases} \dfrac{V_1 - V_A}{Z_{R_1}} = 2 + \dfrac{V_A}{Z_{R_3}} + \dfrac{V_A - V_B}{Z_{R_2}} \\[2ex] \dfrac{V_A - V_B}{Z_{R_2}} + 4 = \dfrac{V_B}{Z_C} \end{cases}$$

$$\Rightarrow \begin{cases} \dfrac{V_1}{Z_{R_1}} - 2 = V_A\left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}\right) - \dfrac{1}{R_2} V_B \Rightarrow 4 = 2V_A - V_B \\ \qquad \Rightarrow V_B = -4 + 2V_A \\[2ex] \dfrac{1}{Z_{R_2}} V_A - V_B\left(\dfrac{1}{Z_{R_2}} + \dfrac{1}{Z_C}\right) = -4 \Rightarrow V_A - V_B(1+j) = -4 \\ \qquad \Rightarrow V_B = \dfrac{-4 - V_A}{-1-j} \end{cases}$$

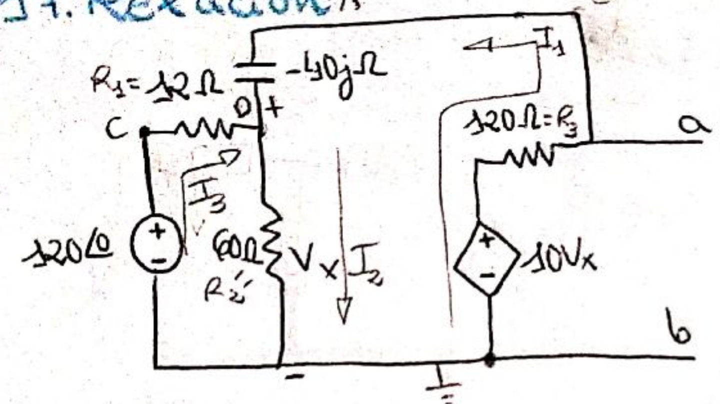
$$-4 + 2V_A = \frac{-4 - V_A}{-1-j} \Rightarrow \underbrace{+4 + 4j + 2V_A - 2jV_A = -4 - V_A}_{V_A(+1+2j) = +4j}$$

$$V_A = 4e^{-j0.643}\ V$$

$$I_3 = I_0 = \frac{V_A}{R_3} = \frac{4e^{-j0.643}}{2} = 2e^{-j0.643}$$

$$i_0(t) = 2\cos(\omega t - 0.643)\ A$$

17. Relación *



¿Equivalente Thevenin?

¿V_{th}? ¿Z_{th}?

Ley de nudos:

$\boxed{D}$ $I_1 + I_3 = I_2$

$Z_{R_1} = 12\Omega \quad Z_{R_3} = 120\Omega$

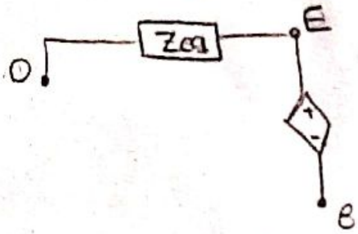
$Z_{R_2} = 60\Omega \quad Z_C = 40e^{-j\frac{\pi}{2}}\Omega$

$\boxed{I_2}$ $V_D - \cancel{V_B}^{0} = I_2 R_2 \Rightarrow I_2 = \dfrac{V_x}{Z_{R_2}}$

$\boxed{I_3}$ $V_C - V_x = I_3 R_1 \Rightarrow I_3 = \dfrac{120 - V_x}{Z_{R_1}}$

$V_C = \dfrac{120V - V_A}{Z_{R_1}}$

$\boxed{I_1}$ R_3 y C en serie $\Rightarrow Z_{eq} = (120 - 40j)\Omega$



$V_E = 10V_x$

$V_D = V_x$

$I_1 = \dfrac{V_E - V_D}{Z_{eq}} = \dfrac{9V_x}{Z_{eq}} = \dfrac{9(208+144j)}{120-40j} = 18e^{-j5.355589}$

Sustituyo:

$$\frac{9V_x}{Z_{eq}} + \frac{120 - V_x}{Z_{R_1}} = \frac{V_x}{Z_{R_2}}$$

$$\frac{120}{Z_{R_1}} = \left(\frac{1}{Z_{R_2}} - \frac{9}{Z_{eq}} + \frac{1}{Z_{R_1}}\right)V_x \Rightarrow 10 = \left(\frac{1}{10} - \frac{9}{120-40j}\right)V_x$$

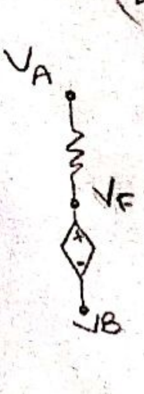
$$100 = \left(1 - \frac{9}{12-4j}\right)V_x$$

$$100 = \left(\frac{3-4j}{12-4j}\right)V_x$$

$$100 = \left(\frac{5e^{j5.35589}}{4\sqrt{10}e^{j5.96143}}\right)V_x$$

$$\Rightarrow 100 = \frac{\sqrt{10}}{8}e^{-0.60554j}V_x \Rightarrow V_x = 80\sqrt{10}e^{j0.60554}\,V$$

$$V_x = (208 + 144j)V$$



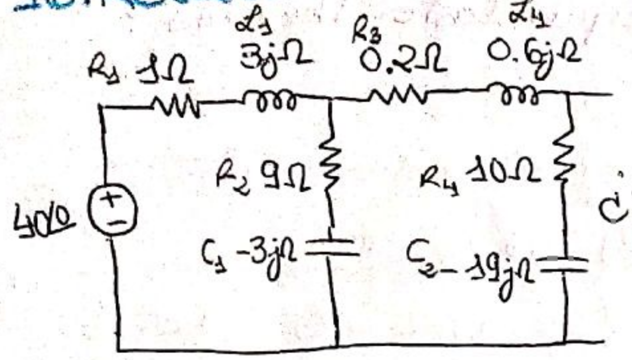
$V_F = 10V_x$

$V_F - V_B = 10V_x$

$V_F - V_A = I_1 R_3 \Rightarrow V_A = V_F - I_1 R_3 = 800\sqrt{10}e^{j0.60554} + 2160e^{-j5.35589} =$

$208 + 144j - 1296 - 1728j = -1088 - 1584j$

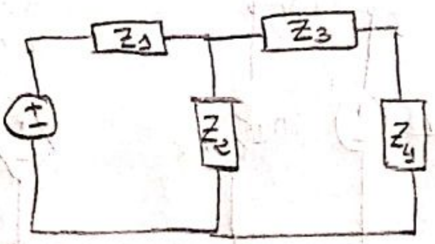
16. Relación



¿V_0?

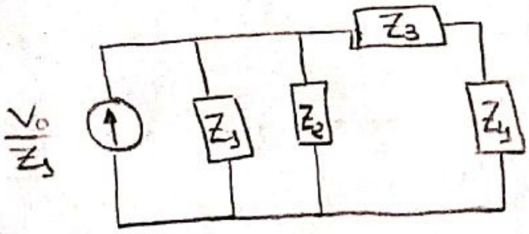
$\underbrace{Z_1=(1+3j)\,\Omega}_{R_1 \text{ y } L_1 \text{ en serie}}$

$\underbrace{Z_2=(9-3j)\,\Omega}_{R_2 \text{ y } C_1 \text{ en serie}}$

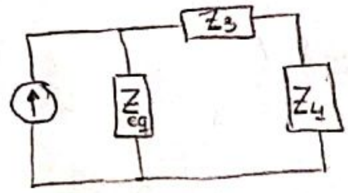


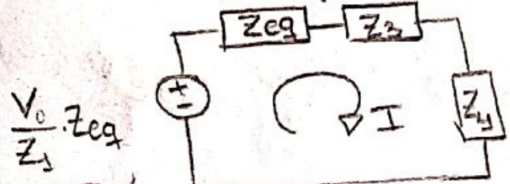
$\underbrace{R_3 \text{ y } L_4 \text{ en serie}}_{Z_3=(0.2+0.6j)\,\Omega}$ $\underbrace{R_4 \text{ y } C_2 \text{ en serie}}_{Z_4=(10-19j)\,\Omega}$

$$Z_{eq}=\frac{1}{\frac{1}{Z_1}+\frac{1}{Z_2}}=\frac{1}{\frac{1}{1+3j}+\frac{1}{9-3j}}=\frac{18+24j}{10}$$



Z_1 y Z_2 en paralelo





$$\underbrace{\frac{V_0}{Z_1}\cdot Z_{eq}}$$

$$\frac{40}{1+3j}\cdot\left(\frac{18+24j}{10}\right)=\frac{720+960j}{10+30j}=\frac{7200+9600j-21600j+28800}{1000}=(36-12j)\,V \text{ (V nueva)}$$

Hallar

$$V_{nueva}=I\,(Z_{eq}+Z_3+Z_4)\Rightarrow I=\frac{V_{nueva}}{Z_{eq}+Z_3+Z_4}=\frac{36-12j}{12-16j}=\frac{432+576j-144j+192}{400}$$

$$=\frac{624+432j}{400}=\left(\frac{39}{25}+\frac{27}{25}j\right)A$$

Ahora hallamos V_0 con V_{nueva} y Z_4 (ley de Ohm):

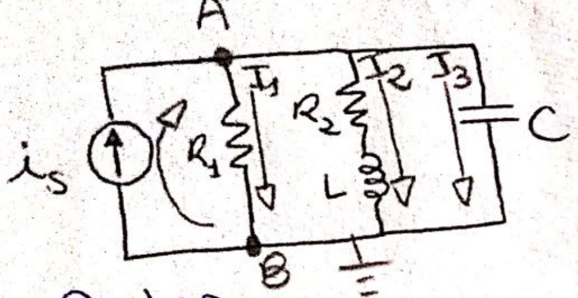
$$V_0=I\,Z_4=\left(\frac{39}{25}+\frac{27}{25}j\right)(10-19j)=\frac{78}{5}-\frac{741}{25}j+\frac{54}{5}j+\frac{513}{25}=\left(\frac{903}{25}-\frac{471}{25}j\right)V$$

$$=40.73819\,e^{j5.802412}$$

$$V_0(t)=40.73819\cos(\omega t+5.802412)$$

1

15. Relación



¿Intensidades que atraviesan cada elemento? ¿V_s?

Calculamos impedancias:

$Z_{R_1} = 10\,\Omega$ $Z_{R_2} = 6\,\Omega$ $Z_L = j\omega L = 8j\,\Omega$ $Z_C = \frac{1}{j\omega C} = -j5\,\Omega$

R_2 y L están en serie $\Rightarrow Z_{eq} = (6+8j)\,\Omega$

Aplicamos ley de nudos:

$\boxed{A}$ $I_0 = I_1 + I_2 + I_3$

Datos

$i_s(t) = 8\cos(200000t)$

$R_1 = 10\,\Omega$ $I_0 = 8e^{j0}$ A

$R_2 = 6\,\Omega$

$L = 40\,\mu H$

$C = 1\,\mu F$

$\boxed{I_1}$ $V_A - \cancel{V_B}^{0V} = I_1 Z_{R_1} \Rightarrow I_1 = \frac{V_A}{Z_{R_1}} = \frac{40e^{j5.6396842}}{10} = 4e^{j5.6396842}$ A

$\boxed{I_2}$ $V_A - \cancel{V_B}^{0V} = I_2 Z_{eq} \Rightarrow I_2 = \frac{V_A}{Z_{eq}} = \frac{40e^{j5.6396842}}{10e^{j0.927295}} = 4e^{j4.7123898}$ A

$\boxed{I_3}$ $V_A - \cancel{V_B}^{0V} = I_3 Z_C \Rightarrow I_3 = \frac{V_A}{Z_C} = \frac{40e^{j5.6396842}}{5e^{j\pi}} = 8e^{j2.498091546}$ A

Sustituimos en la ley de nudos:

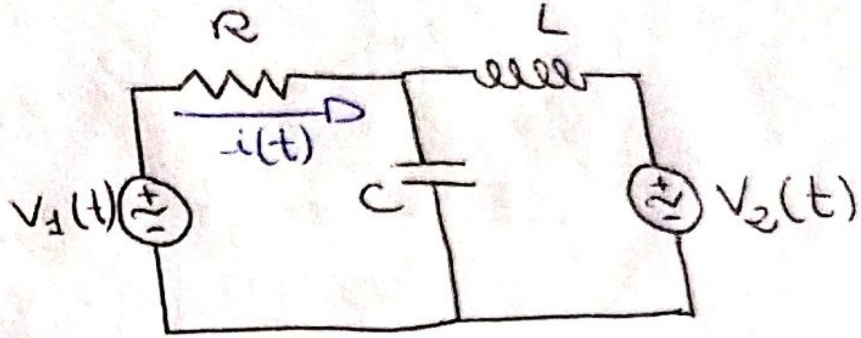
$$8 = \frac{V_A}{Z_{R_1}} + \frac{V_A}{Z_{eq}} + \frac{V_A}{Z_C} \Rightarrow 8 = \underbrace{\left(\frac{1}{Z_{R_1}} + \frac{1}{Z_{eq}} + \frac{1}{Z_C}\right)}V_A$$

$$\frac{1}{10} + \frac{1}{6+8j} + \frac{1}{-5j} = \frac{1}{10} + \frac{6-8j}{100} + \frac{j}{5} = \frac{16+12j}{100} \Rightarrow V_A = \frac{800}{16+12j} = \frac{12800-9600j}{400} = (32-24j)\,V$$

$$V_A = 40e^{j5.6396842} \Rightarrow V_A(t) = v_s(t) = 40\cos(200000t + 5.6396842)\ V$$

$$i_1(t) = 4\cos(200000t + 5.63968842)\ A = i_{R_1}(t)$$
$$i_2(t) = 4\cos(200000t + 4.71238898)\ A = i_{R_2}(t) = i_L(t)$$
$$i_3(t) = i_C(t) = 8\cos(200000t + 2.498091546)\ A$$

1. EJERCICIO



Datos

$R = 10^3\,\Omega$

$L = 10^{-3}\,H$

$C = 2nF = 2\cdot 10^{-9}\,F$

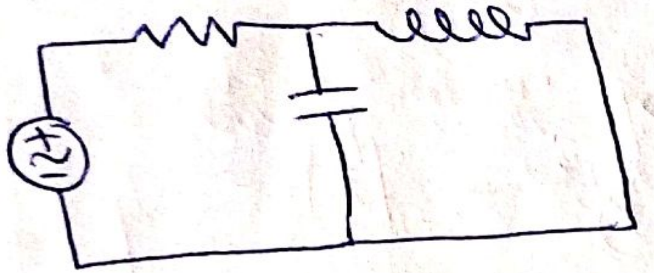
$V_1(t) = 10\cos(10^6 t)\,V$

$V_2(t) = 3\cos\left(2\cdot 10^6 t + \frac{\pi}{6}\right)V$

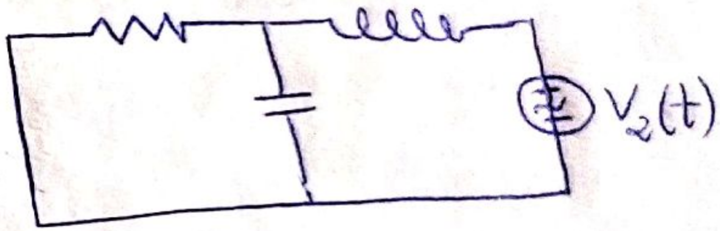
$\omega_1 = 10^6\,rad/s$

$\omega_2 = 2\cdot 10^6\,rad/s$

(A)



(B)

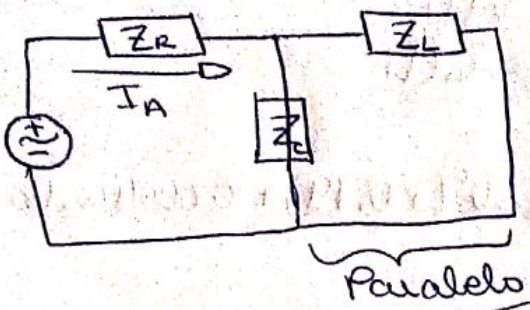


1°) Resuelvo circuito A: $\omega_1 = 10^6\,rad/s$

$$Z_R = R = 10^3\,\Omega$$

$$Z_L = j\omega L = j\cdot 10^6\,\frac{rad}{s}\cdot 10^{-3}\,H = j\cdot 10^3\,\Omega = 10^3 e^{j\pi/2}\,\Omega$$

$$Z_C = \frac{1}{j\omega C} = \frac{1}{j\cdot 10^6\frac{rad}{s}\cdot 2\cdot 10^{-9}F} = -j\cdot 0.5\cdot 10^3\,\Omega = 0.5\cdot 10^3\cdot e^{-j\pi/2}\,\Omega$$

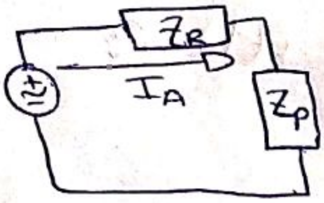


$v(t) = 10\cos(10^6 t)\,V$

$V_1 = 10V \equiv$ Fasor

$V_1 = I_A(Z_R + Z_p) \Rightarrow I_A = \dfrac{10V}{10^3\Omega - j\cdot 10^3\Omega}$

$I_A = 0.0071\cdot e^{j\cdot 0.79}\,A$



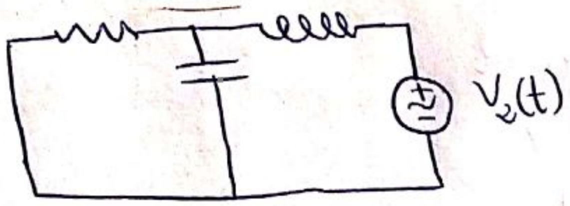
$\dfrac{1}{Z_p} = \dfrac{1}{Z_C} + \dfrac{1}{Z_L}$

$\hookrightarrow Z_p = 10^3 e^{-j\frac{\pi}{2}}\,\Omega$

① $* e^{j\omega t}$ $\quad i_A(t) = 0.0071\cdot e^{j(10^6 t + 0.79)}\,A$

② $i_A(t) = 0.0071\cos(10^6 t + 0.79)\,A$

2°) Resuelvo circuito 2:



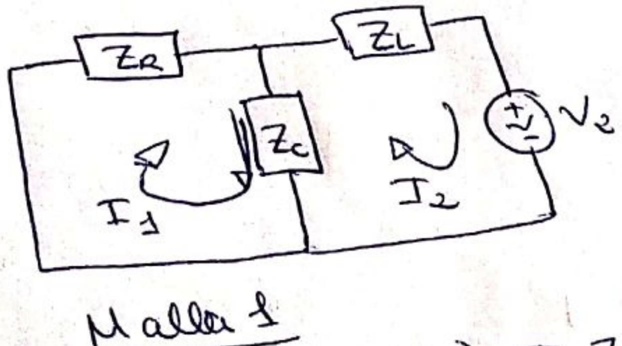
$\omega_2 = 2\cdot 10^6\,\frac{rad}{s}$

$Z_R = R = 10^3\,\Omega$

$Z_L = 2\cdot 10^3\cdot j\,\Omega = 2\cdot 10^3 e^{j\pi/2}\,\Omega$

$Z_C = \dfrac{1}{j\omega C} = \dfrac{1}{j\cdot 2\cdot 10^6\cdot 2\cdot 10^{-9}} =$

$0.25\cdot 10^3 e^{-j\frac{\pi}{2}}$



$V_2(t) = 3\cos(2\cdot 10^6\,\frac{rad}{s} + \frac{\pi}{6})\,V$

$V_2 = 3e^{j\frac{\pi}{6}}\,V$

Malla 1

$0V = I_1(Z_R + Z_C) - I_2 Z_C$

$0V = I_1(10^3 - j\cdot 0.25\cdot 10^3)\,\Omega + j\cdot 0.25\cdot 10^3 I_2$

Malla 2

$-V_2 = I_2(Z_L + Z_C) - I_1 Z_C$

$-3e^{j\frac{\pi}{6}}\,V = I_2(2\cdot 10^3 j - 0.25\cdot 10^3 j) + I_1\cdot 0.25\cdot 10^3 j$

$I_1 = 0.0004e^{-j\,2.34}\,A \leftarrow I_A = I_B$

$I_2 = 0.0017e^{-j\,1.01}\,A$

$i_A(t) = 0.0004\, e^{j(2\cdot 10^6 t - 2.34)} A = i_B(t)$

$i_B(t) = 0.0004 \cos(2\cdot 10^6 t - 2.34) A = i_A(t)$

Aplico ppº de superposición:

$i_R(t) = i_A(t) + i_B(t) = (0.0071 \cos(10^6 t + 0.79) + 0.0004 \cos(2\cdot 10^6 t - 2.34)) A$

<u>Cálculo de potencia</u>

$p(t) = v(t)\, i(t)$

1ª) Posibilidad: $V_R(t) = V_A(t) + V_B(t)$

2ª) Posibilidad (solo para R)

$V_R(t) = i(t)\cdot R$

$i(t) = C \cdot \frac{dv(t)}{dt}$

$v(t) = \alpha \cdot \frac{d\, i(t)}{dt}$

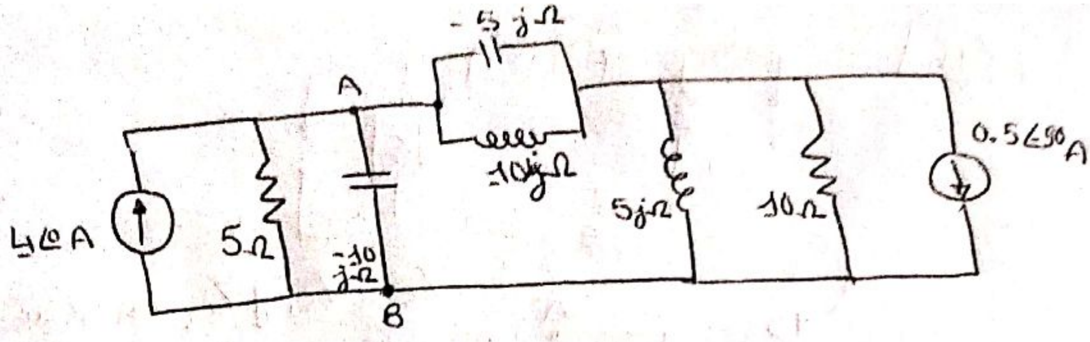
Nunca utilizo números complejos para calcular potencia. Porque la potencia es una magnitud real

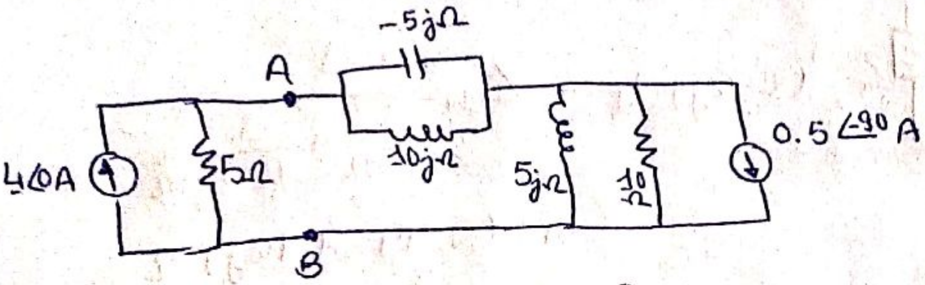
Ejercicio 27

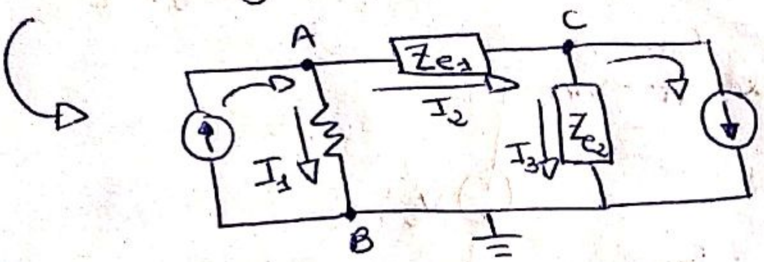
Incógnitas

$V_{th} = ?$

$Z_{th} = ?$







$Z_{e_1} = -10j\,\Omega$

$Z_{e_2} = (2+4j)\,\Omega$

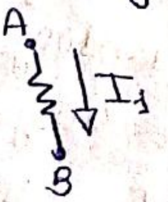
Aplico ley de nudos:

$\boxed{A}$ $4A = I_1 + I_2$

$\boxed{C}$ $I_2 = I_3 - 0.5\,jA$

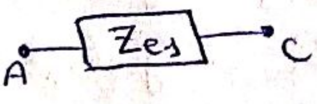
Ley de Ohm generalizada:

$\boxed{5\Omega}$



$V_A - V_B = I_1 R \Rightarrow I_1 = \frac{V_A}{5\Omega}$

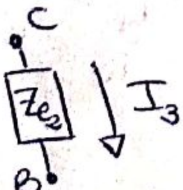
$\boxed{Z_{e_1}}$



$V_A - V_C = I_2(-10j\,\Omega)$

$I_2 = \frac{V_A - V_C}{-10j\,\Omega}$

$\boxed{Z_{e_2}}$

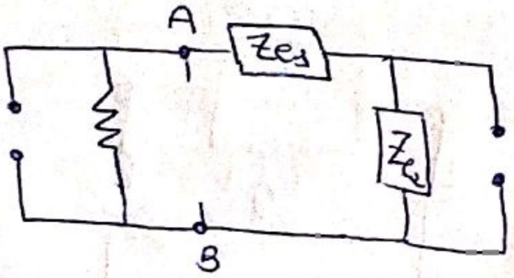


$V_C - V_B = Z_{e_2} I_3 \Rightarrow I_3 = \frac{V_C}{(2+4j)\,\Omega}$

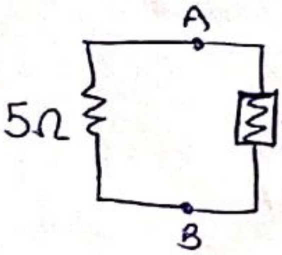
Volvemos a los nudos:

$$\left.\begin{array}{l} \boxed{A}\quad 4A = \frac{V_A}{5\Omega} + \frac{V_A - V_C}{-10j\,\Omega} \\ \boxed{C}\quad \frac{V_A - V_C}{-10j\,\Omega} = \frac{V_C}{(2+4j)\,\Omega} - 0.5jA \end{array}\right\} V_A = (10.$$

$\boxed{Z_{th}}$



$Z_{e_3} = Z_{e_1}$ y Z_{e_2} en serie

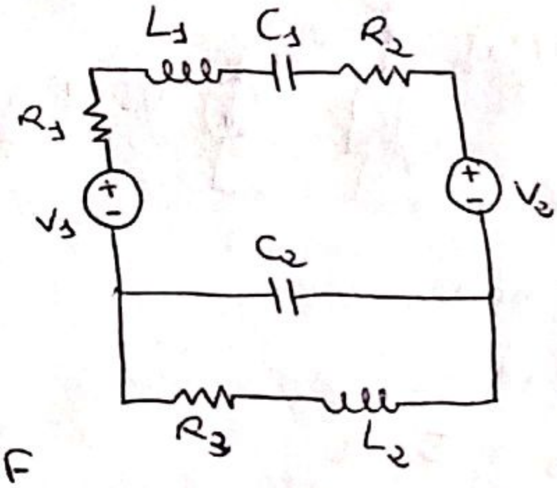


$Z_{e_3} = (2-6j)\Omega$

$$Z_{th} = \frac{1}{\frac{1}{5\Omega} + \frac{1}{(2-6j)\Omega}}$$

$$Z_{th} = (2.94 - 1.76j)\,\Omega$$

Ejercicio 21



Datos

$R_1 = 100\Omega$

$R_2 = 100\Omega$

$R_3 = 800\Omega$

$L_1 = 10^{-2}H$

$L_2 = 4\cdot 10^{-2}H$

$C_1 = 10^{-6}F$

$C_2 = 0.25\cdot 10^{-6}F$

$V_1(t) = \frac{4}{\sqrt{2}}\cos(10^4 t - \frac{\pi}{4})V$

$V_2(t) = -\frac{4}{\sqrt{2}}\,\mathrm{sen}(10^4 t + \frac{\pi}{4})V$

¿$i_{L_1}(t), i_{L_2}(t)$?

$\boxed{V_1 = \frac{4}{\sqrt{2}} e^{-j\frac{\pi}{4}}}$

$\omega = 10^4$ rad/s

$Z_{L_1} = j\omega L_1 = 100j\,\Omega$

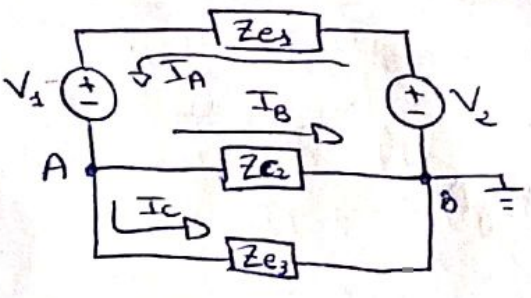
$Z_{L_2} = j\omega L_2 = 400j\,\Omega$

$Z_{C_1} = 1/j\omega C_1 = -100j\,\Omega$

$Z_{C_2} = 1/j\omega C_1 = -400j\,\Omega$

$\rightarrow v_2(t) = -\frac{4}{\sqrt{2}}\cos(10^4 t - \frac{\pi}{4}) \rightarrow V_2 = -\frac{4}{\sqrt{2}} e^{-j\frac{\pi}{4}} = (\text{Uso } -1 = e^{j\pi}) =$

$= e^{j\pi}\cdot\frac{4}{\sqrt{2}}\cdot e^{-j\pi/4} = \boxed{\frac{4}{\sqrt{2}} e^{j\frac{3\pi}{4}}}$



$Z_{e_1} = 200\Omega$

$Z_{e_3} = (800+400j)\Omega$

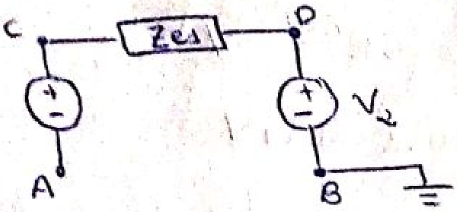
$\boxed{A}$ $I_A = I_B + I_C$

Ley de Ohm generalizada:

$\boxed{Z_{e_2}}$ $V_A - \cancel{V_B}^{\to 0} = V_A = I_C Z_{e_2}$ $\quad I_C = \dfrac{V_A}{Z_{e_2}}$

$\boxed{Z_{c_2}}$ $V_A - \cancel{V_B}^{\to 0} = V_A = I_B Z_{c_2}$ $\quad I_B = \dfrac{V_A}{Z_{c_2}}$

$\boxed{Z_{c_1}}$



$V_D - V_C = I_A \cdot Z_{e_1}$

Me fijo en las fuentes de tensión

$V_D - \cancel{V_B}^{\to 0V} = V_2$

$V_C - V_A = V_1 \Rightarrow V_C = V_1 + V_A$ $\quad V_2 - V_1 - V_A = I_A \cdot Z_{e_1}$

$\quad \Rightarrow I_A = \dfrac{V_2 - V_1 - V_A}{Z_{e_1}}$

Sustituimos:

$$\frac{V_2 - V_1 - V_A}{Z_{e_1}} = \frac{V_A}{Z_{c_2}} + \frac{V_A}{Z_{e_2}} \Rightarrow V_A = (-2+4j)\,V$$

Sustituyo V_A en I_A e I_C:

$\left\{ I_C = 0.005\, j^{\frac{\pi}{2}}\, A \right.$ $\quad I_A = -0.01A = 0.01\, e^{j\pi} A$

$* e^{j10^4 t}$

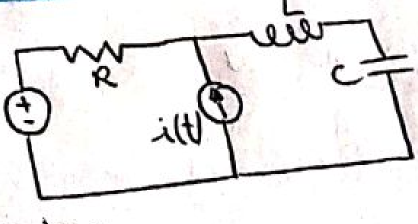
$\Rightarrow i_C(t) = 0.005\, e^{j(10^4 t + \pi/2)} A$

$i_A(t) = 0.01\, e^{j(10^4 t + \pi)} A$

$i_C(t) = i_{L_2}(t) = 0.005 \cos\left(10^4 t + \frac{\pi}{2}\right) A$

$i_A(t) = i_{L_1}(t) = 0.01 \cos\left(10^4 t + \pi\right) A$

Ejercicio 22



Datos

$R = 100\,\Omega$

$L = 10^{-2}\,H$

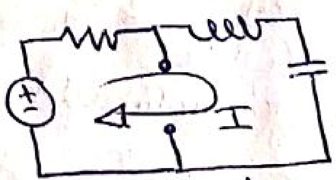
$C = 0.5 \cdot 10^{-6}\,F$

$v(t) = \sqrt{2} \cos\left(10^4 t + \frac{\pi}{4}\right) V$

$i(t) = \sqrt{2} \cos\left(2 \cdot 10^4 t + \frac{\pi}{4}\right) mA$

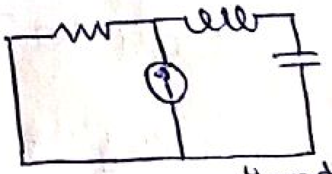
P° Superposición

Ⓐ



$\omega_A = 10^4 \frac{rad}{s}$

Ⓑ



$\omega_B = 2 \cdot 10^4 \frac{rad}{s}$

Resuelvo circuito A:

$Z_R = 100\,\Omega$ $\quad Z_L = j\omega_A L = 100j\,\Omega$

$Z_C = \dfrac{1}{j\omega_A C} = -200j\,\Omega$

$V = \sqrt{2}\, e^{j\frac{\pi}{4}}$

Uso método mallas:

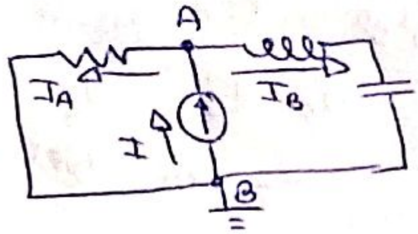
$$V = I(Z_R + Z_L + Z_C)$$

$$I = \frac{V}{Z_R + Z_L + Z_C} = 0.01\, e^{j\frac{\pi}{2}} A$$

$$V_C = Z_C \cdot I = 2V \Rightarrow V_c(t) = 2 e^{j 10^4 t} V$$

$$v_c^A(t) = 2\cos(10^4 t) V$$

Resuelvo circuito B:



$$Z_R = 100 \Omega$$
$$Z_L = j\omega_B L = 200j \Omega$$
$$Z_C = \frac{1}{j\omega_B C} = -100j \Omega$$

Aplico ley de nudos:

$\boxed{A}$ $I = I_A + I_B$

Ley de Ohm generalizada

$\boxed{Z_R}$ $V_A - \cancel{V_B}^{0V} = Z_R I_A \Rightarrow I_A = \frac{V_A}{Z_R}$

$\boxed{Z_{eq} = Z_C + Z_L}$ $V_A - \cancel{V_B}^{0V} = Z_{eq} I_B \Rightarrow I_B = \frac{V_A}{Z_{eq}}$

$$\{ i(t) = \sqrt{2}\cos\left(2\cdot 10^4 t + \frac{\pi}{4}\right) mA \Rightarrow I = \sqrt{2}\, e^{j\frac{\pi}{4}} mA \}$$

$$I = I_A + I_B$$

$$\hookrightarrow \sqrt{2}\, e^{j\frac{\pi}{4}} = \frac{V_A}{Z_R} + \frac{V_A}{Z_L + Z_C} \Rightarrow V_A = 0.1 e^{j\frac{\pi}{2}} V$$

Calculo $I_B = \frac{V_A}{Z_L + Z_C}$ = No lo tiene la profe

Ley de Ohm generalizada a Z_C

$$V_c = I \cdot Z_C = \frac{V_A}{Z_L + Z_C} Z_C = 0.1 e^{-j\frac{\pi}{2}} V$$

$$v_c(t) = 0.1 e^{j(2\cdot 10^4 t - \pi/2)} V$$

$$v_c^B(t) = 0.1\cos\left(2\cdot 10^4 t - \frac{\pi}{2}\right) V$$

$$v_c(t) = \left[2\cos(10^4 t) + 0.1\cos\left(2\cdot 10^4 t - \frac{\pi}{2}\right)\right] V$$