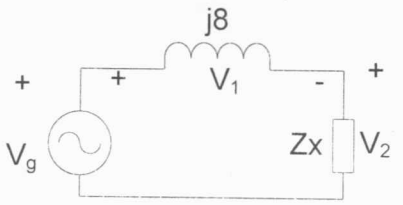
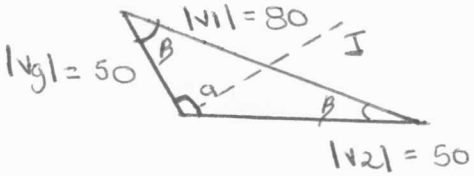
Solución III Examen Parcial
Circuitos Eléctricos I
19-05-2014

1. (4 pts) Dados $|V_g|$=50 V, $|V_1|$=80 V y $|V_2|$=50 V. Sabiendo que el ángulo de la impedancia Zx es negativo encuentre los elementos en serie y en paralelo que la conforman si w = 1000 rad/seg.



Tomando como referencia V_2



Aplicando el teorema del coseno

$$\cos\alpha = \frac{80^2 - 50^2 - 50^2}{-2\times 50\times 50} \Rightarrow \alpha = 106,26^\circ$$

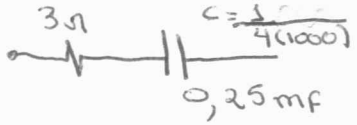
$$\cos\beta = \frac{50^2 - 80^2 - 50^2}{-2\times 80\times 50} \Rightarrow \beta = 36,87^\circ$$

Luego $\overline{V_g} = 50\angle 106,37^\circ$ $\overline{V_2} = 50\angle 0$ $V_1 = 80\angle 143,13$

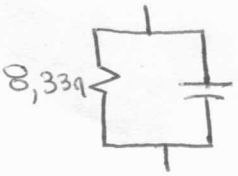
$$\overline{I} = \frac{V_1}{j8} \Rightarrow \overline{I} = \frac{80\angle 143,13}{8\angle 90} = 10\angle 53,13$$

$$Z = \frac{\overline{V}}{\overline{I}} = \frac{50\angle 0}{10\angle 53,13} = 5\angle -53,13 = 3-4j$$

Elementos en Serie



Elementos en Paralelo

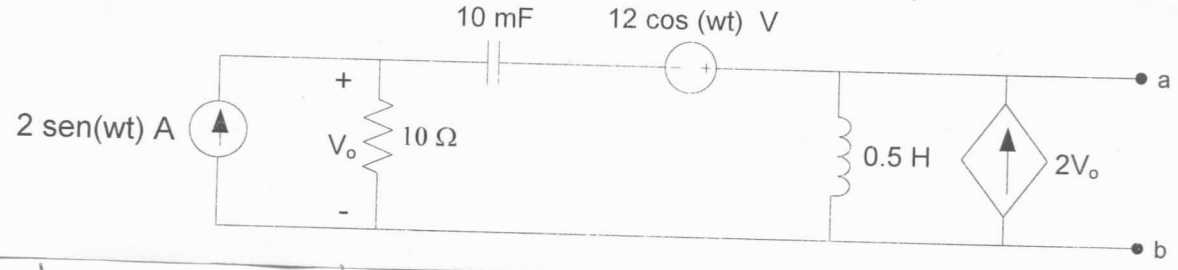


$$Y = \frac{1}{Z} = 0,12 + j0,16$$

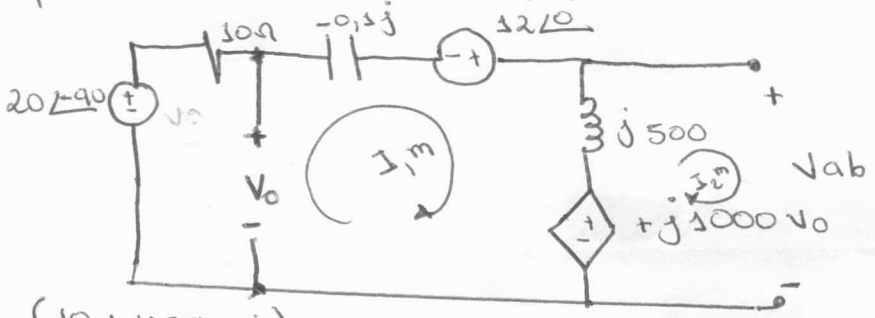
$$R_p = \frac{1}{0,12} = 8,33\,\Omega$$

$$C = \frac{0,16}{1000} = 0,16\,mf$$

2. (4 pts) Determine el equivalente de Thevening visto desde los terminales a y b.



Aplicando transformación de fuentes



$(10+499,9j)I_1^m - j500I_2^m + j1000V_o = 12-20j$

$-j\,500I_1^m + j\,500I_2^m - j\,1000V_o + V_{ab} = 0$

$10I_1^m + 0I_2^m + V_o = -20j$

Resolviendo

$V_{th} = V_{ab}$ si $I_2^m = 0$

$V_{th} = 12,2115 + j\,1,0398$

$V_{th} = 12,25\ \angle 4,86$

$I_N = I_2^m$ si $V_{ab} = 0$

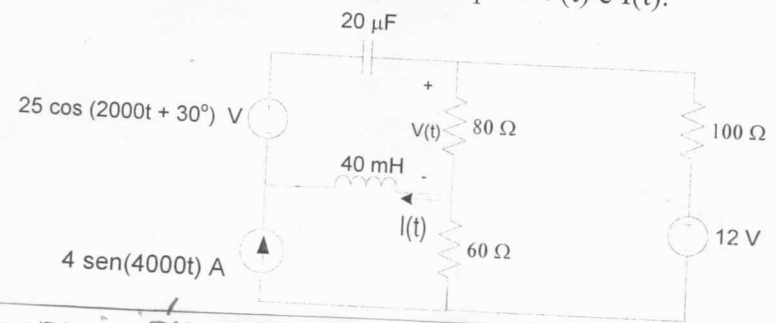
$I_N = I_2^m = -23,177 - j\,2,232$

$I_N = 23,28\ \angle -174,50$

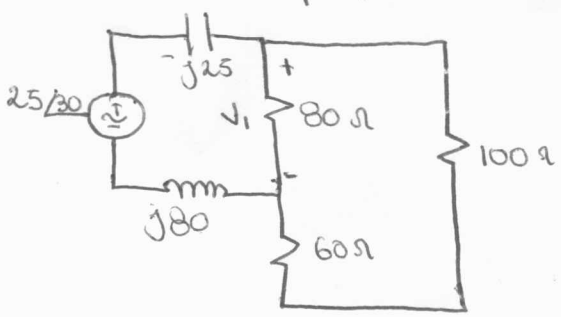
$Z_{th} = V_{th}/I_N = -0,5263 + j\,0,0058$

$Z_{th} = 0,5263\ \angle 179,366$

3. (4pts) Para el circuito de la figura encuentre la expresión para V(t) e I(t).



Aplicando superposición



$V_1 = \dfrac{25\angle 30 * 80 \,//\, 160}{80 \,//\, 160 + j\,55}$

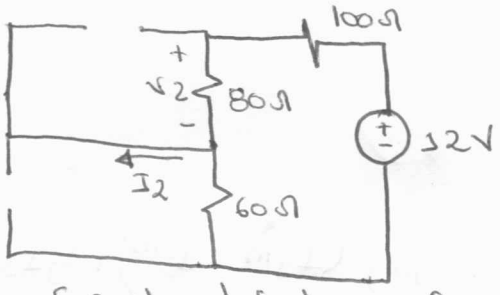
$V_1 = 16,73 - j\,4,76$

$\overline{V_1} = 17,40\ \angle -15,88$

$v_1(t) = 17,40 \cos(2000t - 15,88)$ $\quad \bar{I}_1 = 0,314 - j0,089$

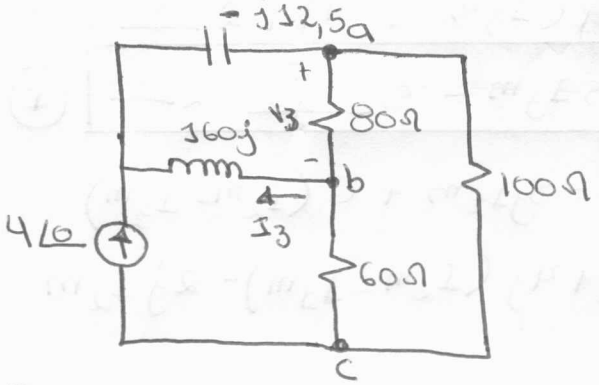
$i_1(t) = 0,32 \cos(2000t - 15,88)$ $\quad \bar{I}_1 = 0,32 \angle -15,88$

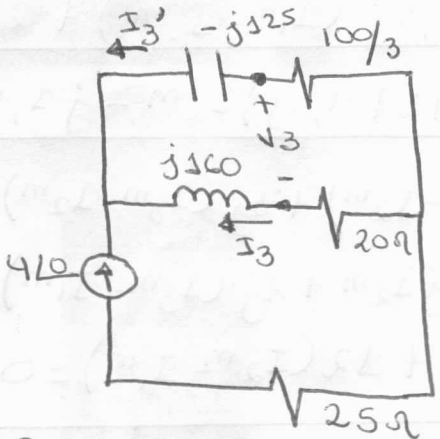
Efecto de la fuente de 12V



$I_2 = 0$ $\quad V_2 = 4$ $\quad V_2 = \frac{12 \times 80}{80+60+100}$

Efecto debido a fuente de Corriente





$R_a = \frac{80 \times 100}{80+60+100} = 100/3\ \Omega$ $\quad R_c = \frac{60 \times 100}{240} = 25\Omega$

$R_b = \frac{80 \times 60}{240} = 20\Omega$

$\bar{I}_3 = \frac{-4\angle 0 * (100/3 - j12,5)}{100/3 - j12,5 + 20 + j160} = \begin{matrix} 0,0107 + j0,908 \\ 0,908 \angle 89,32 \end{matrix}$

$I_3' + I_3 + 4\angle 0 = 0$ $\quad I_3' = -4\angle 0 - I_3 = -4,0107 - j0,908$

$V_3 = \frac{-100}{3} I_3' + 20 I_3 \Rightarrow 133,91 + j48,41 \Rightarrow 142,39 \angle 19,87$

$i_3(t) = 0,908 \operatorname{Sen}(4000t + 89,32)$

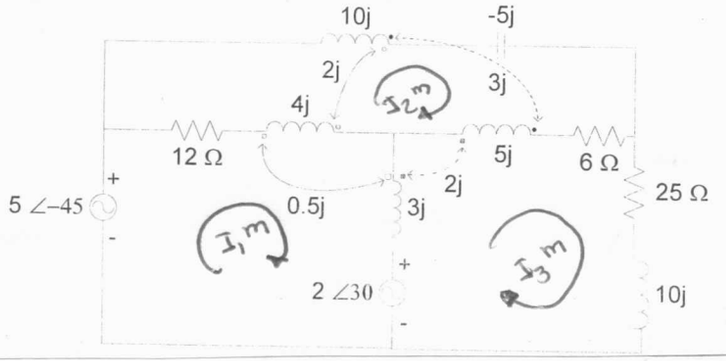
$v_3(t) = 142,39 \operatorname{Sen}(4000t + 19,87)$

Respuesta

$i(t) = 0,32 \cos(2000t - 15,88) + 0 + 0,908 \operatorname{Sen}(4000t + 89,32)$

$v(t) = 17,40 \cos(2000t - 15,88) + 4 + 142,39 \operatorname{Sen}(4000t + 19,87)$

4. (4 pts) Para el circuito de la figura plante las ecuaciones de malla.



$$-5\angle -45 + 12(I_3^m - I_2^m) + 4j(I_1^m - I_2^m) + 0{,}5j(I_3^m - I_3^m) + 2jI_2^m$$
$$+ 3j(I_1^m - I_3^m) + 0{,}5j(I_1^m - I_2^m) + 2j(I_3^m - I_2^m) + 2\angle 30 = 0$$

$$\boxed{(12+8j)I_1^m - (12+4{,}5j)I_2^m - j1{,}5I_3^m - 5\angle -45 - 2\angle 30} \quad (I)$$

$$10jI_2^m + 2j(I_1^m - I_2^m) + 3j(I_3^m - I_2^m) - 5jI_2^m + 6(I_2^m - I_3^m)$$
$$+ 5j(I_2^m - I_3^m) - 3jI_2^m + 2j(I_3^m - I_1^m) + 4j(I_2^m - I_1^m) - 2jI_2^m$$
$$+ 0{,}5j(I_3^m - I_1^m) + 12(I_2^m - I_1^m) = 0$$

$$\boxed{-(12+j4{,}5)I_1^m + (18+4j)I_2^m + (-6+0{,}5j)I_3^m = 0} \quad (II)$$

$$(25+10j)I_3^m - 2\angle 30 + 3j(I_3^m - I_1^m) + 0{,}5j(I_2^m - I_1^m) + 2j(I_2^m - I_3^m)$$
$$+ 5j(I_3^m - I_2^m) + 2j(I_1^m - I_3^m) + 3jI_2^m + 6(I_3^m - I_2^m) = 0$$

$$\boxed{-1{,}5jI_1^m + (-6+9{,}5j)I_2^m + (31+14j)I_3^m = 2\angle 30} \quad (III)$$