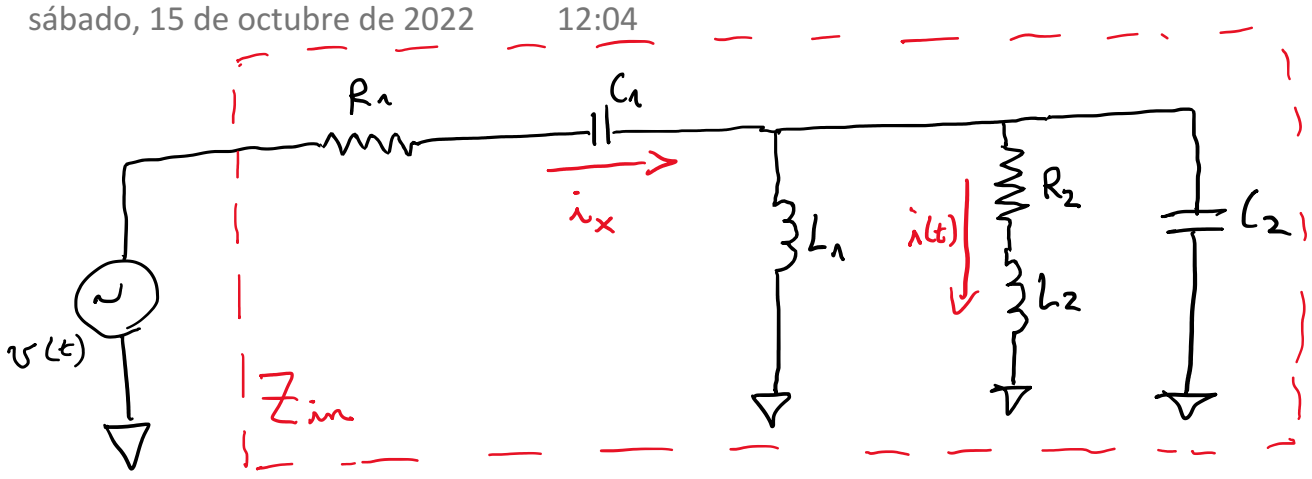
Problema 1

sábado, 15 de octubre de 2022 12:04



Si conociéramos $i_x(t)$ podríamos determinar $i(t)$ con un divisor de corriente. En notación fasorial tenemos:

$$Z_{R_i} = R_i$$

$$Z_{L_i} = j\omega L_i$$

$$Z_{C_i} = \frac{1}{j\omega C_i}$$

donde

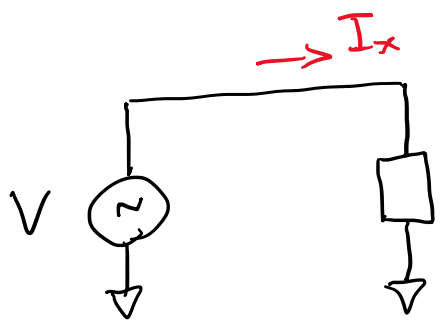
$$Z_{in} = \frac{V}{I_x} \quad \wedge \quad V = 5\angle 0°\,[V] \quad \wedge \quad I_x = I_{mag}\angle \phi_f$$

Reconocemos operaciones serie - paralelo:

$$Z_{in} = R_1 + \frac{1}{j\omega C_1} + \left(j\omega L_1 \,||\, [R_2 + j\omega L_2] \,||\, \frac{1}{j\omega C_2}\right)$$

$$Z_{in} = (10{,}03 - j5{,}14)[\Omega] = 11{,}27\angle -27{,}13°\,[\Omega]$$

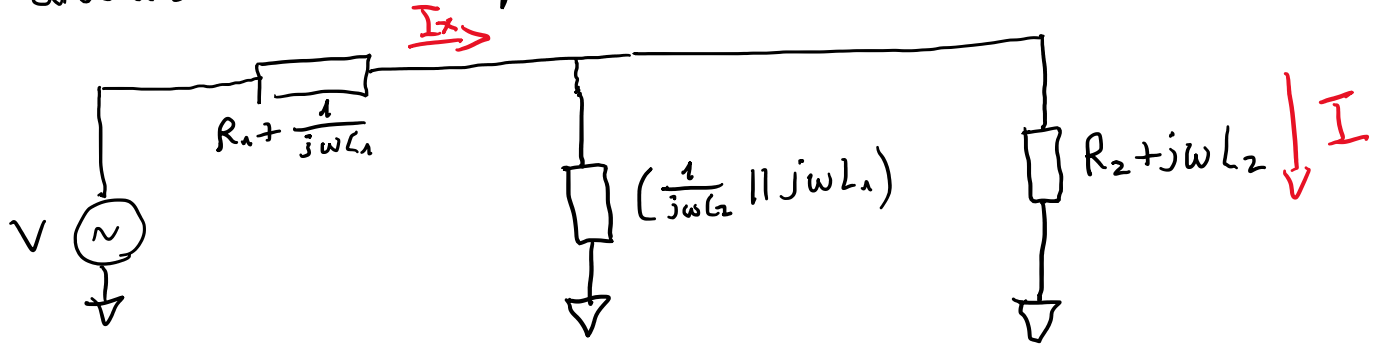
Luego,



$$\Rightarrow I_x = \frac{V}{Z_{in}} = \frac{5\angle 0°}{11{,}27\angle -27{,}13°}\,[A]$$

$$I_x = 0{,}4436\angle 27{,}13°\,[A].$$

El circuito anterior se puede reescribir como:



Por divisor de corriente:

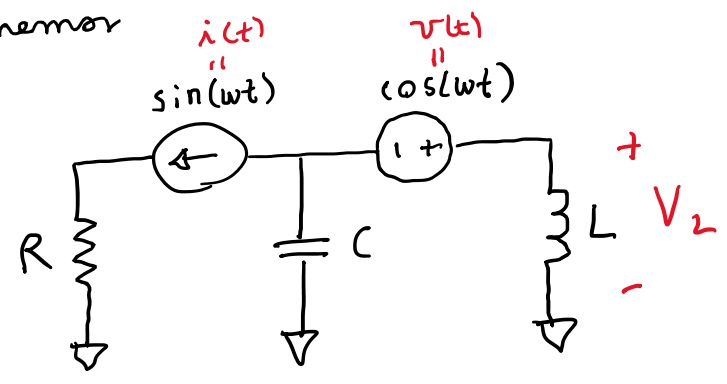
$$I = \frac{I_x\left(\frac{1}{j\omega C_2} \,||\, j\omega L_1\right)}{\left(\frac{1}{j\omega C_2} \,||\, j\omega L_1\right) + R_2 + j\omega L_2} = 0{,}0017\angle 117{,}13°\,[A]$$

$$\Rightarrow \boxed{i(t) = 0{,}0017\cos(2\pi 200t + 117{,}13°)\,[A]}$$

Problema 2

domingo, 16 de octubre de 2022 15:00

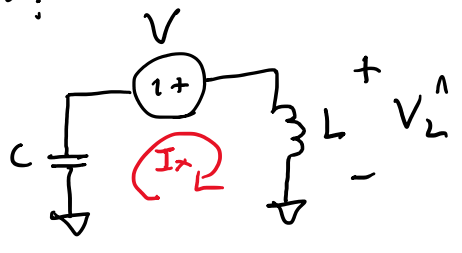
a) Fenemor



V_L se puede calcular con superposición:

$$V_L = V_L^1 + V_L^2$$

Para V_L^1:



con

$$V = 1\angle 0° = 1 + j0 = 1\ [V]$$

Con mallas:

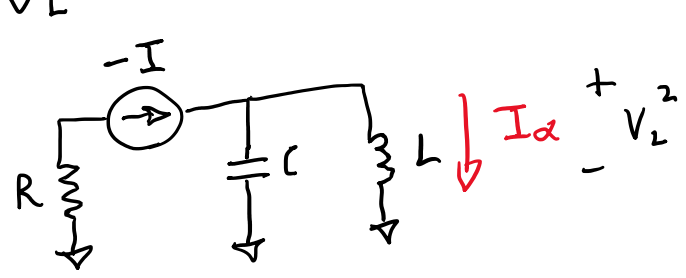
$$V - I_x\, j\omega L - I_x \frac{1}{j\omega C} = 0$$

$$V = I_x \left(\frac{1 - \omega^2 LC}{j\omega C} \right)$$

$$I_x = \left(\frac{V\, j\omega C}{1 - \omega^2 LC} \right) = \frac{j\omega C}{1 - \omega^2 LC}$$

$$V_L^1 = I_x\, j\omega L = \frac{-\omega^2 LC}{1 - \omega^2 LC}$$

Para V_L^2:



con $I = -j$ y por divisor de corriente:

$$I_\alpha = -I \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + j\omega L} = j \frac{1}{(1 - \omega^2 LC)}$$

$$V_L^2 = I_\alpha\, j\omega L = \frac{-\omega L}{(1 - \omega^2 LC)}$$

$$V_L = V_L^1 + V_L^2 = \frac{-\omega L (1 + \omega C)}{1 - \omega^2 LC}$$

b) Si $1 - \omega^2 LC > 0$:

$$V_L = \frac{\omega L (1 + \omega C)}{1 - \omega^2 LC} \angle 180°$$

Si $1 - \omega^2 LC < 0$:

$$V_L = \frac{-\omega L (1 + \omega C)}{1 - \omega^2 LC} \angle 0°$$

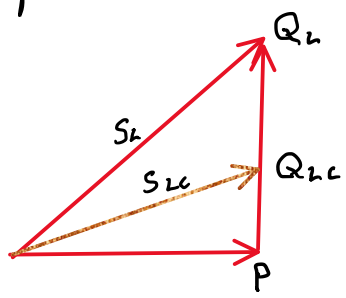
c) $$v_L(t) = \frac{\omega L (1 + \omega C)}{|1 - \omega^2 LC|} \cos(\omega t + \phi),$$

$$\phi = \begin{cases} 180°, & \text{si } 1 - \omega^2 LC > 0 \\ 0°, & \text{e.o.c} \end{cases}$$

Problema 3

domingo, 16 de octubre de 2022 15:13

Se busca pasar de S_L a S_{LC} :



donde $S_L = P + jQ_L$ ∧ $\frac{Q_L}{P} = \tan(\theta_n)$ ∧ $\cos(\theta_n) = \underbrace{0,8}_{F.P}$

$$\Rightarrow \theta_n = \cos^{-1}(0,8) = \underbrace{+}_{\text{retraso}} 36,87^\circ$$

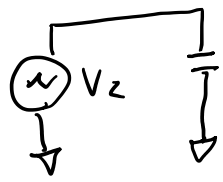
$$\Rightarrow Q_L = P\tan(36,87^\circ) = 55k\tan(36,87^\circ) = 41,25\,[kVA].$$

Para el caso final queremos:

$$Q_{LC} = P\tan(\theta_n^2) \wedge \cos(\theta_n^2) = 0,95 \Rightarrow \theta_n^2 = 18,19^\circ$$

$$Q_{LC} = 55k\tan(18,19^\circ) = 18,072\,[kVA]$$

El cambio en la potencia reactiva se debe al capacitor C, el cual aporta $S_C = 0 + jQ_C = -j\omega C V_C^2$, ya que

$$\Rightarrow$$  $\Rightarrow S_C = \frac{|V_C|^2}{Z_C^*} = \frac{V_C^2}{-\frac{1}{j\omega C}} = -j\omega C V_C^2$

Además, $Q_{C2} = Q_2 + Q_C \Rightarrow Q_C = Q_{C2} - Q_2 = -23,178\,[kVA]$

$$\Rightarrow -23,178k = -\omega C V_C^2$$

$$\boxed{C = \frac{23,178k}{2\pi 50 \cdot 220^2} = 1,52\,[mF]}$$