NOTA = 18

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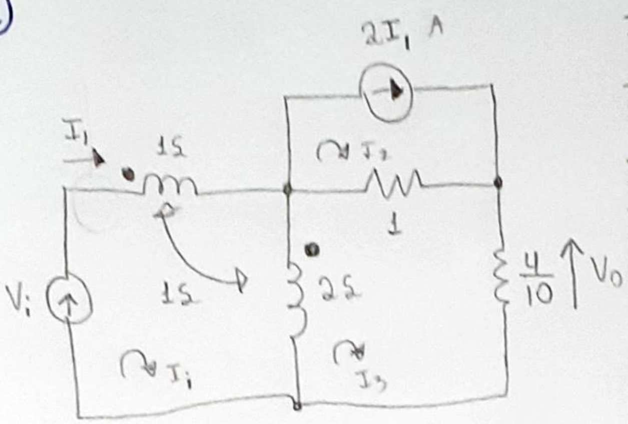
matrícula: 96708 Data: 16/12/20 Prova 3 - ECT221

Q1) 6,0

1



I_1 entra pelo ponto
I_3 sai pelo ponto
} M negativo

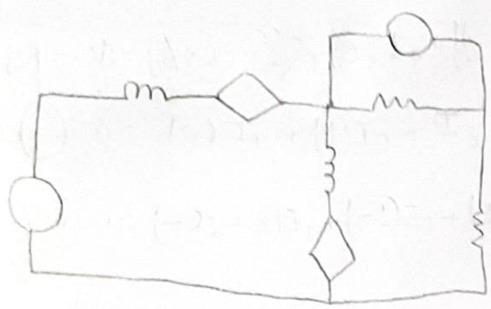
$I_2 = 2I_1$, $V_i = 1\angle 0$ $S = j$

$$\begin{cases} 1 = I_1(S + 2S) + I_3(-2S - S) + 2I_1(S) \\ 1 = (5S)I_1 + (-3S)I_3 \quad (i) \end{cases}$$

$$\begin{cases} 0 = I_1(-S - 2S) + 2I_1(-1) + I_3(2S + 1.4) \\ 0 = I_1(-2 - 3S) + I_3(1.4 + 2S) \quad (ii) \end{cases}$$

de ii: $I_1(2 + 3S) = I_3(1.4 + 2S)$

$$\boxed{I_1 = \frac{I_3(1.4 + 2S)}{(2 + 3S)}} \quad (iii)$$



De (i) e (iii), temos: $1 = I_3\left(\frac{(1.4 + 2S)5S}{2 + 3S} - \frac{3S(2 + 3S)}{(2 + 3S)}\right) \Rightarrow$ substituindo $S = j\omega = j$ $\Rightarrow$

$$1 = I_3\left[\frac{1}{13} + \frac{5}{13}j\right] \Rightarrow I_3 = \frac{\sqrt{26}}{2}\angle -78.69° \text{ A}$$

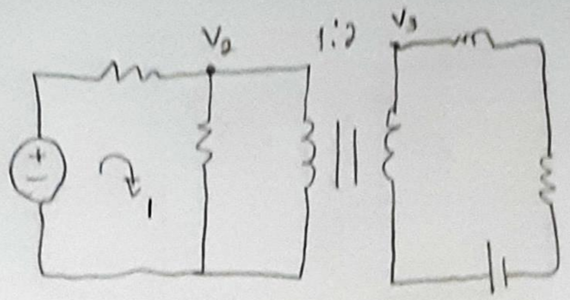
$$V_0 = I_3 \times 0.4 = \frac{\sqrt{26}}{5}\angle -78.69° \text{ V}$$

$$v_0(t) = 1.02\cos(t - 78.69°) \text{ V}$$

✓ 6,0

Q2) 0,0

2



$X_L = 10j$

$\frac{I_2}{I_3} = -n \rightarrow I_2 = -2I_3$

$\frac{V_2}{V_3} = \frac{-1}{n} \rightarrow V_3 = -2V_2$

$V_1 = 3\angle 0°$ $\omega = 200j$

Divisor de tensão: $V_2 = \frac{3V}{9} = 1\angle 0°$

$V_3 = -2V_2 \rightarrow V_3 = 2\angle 180°$

Aplicando superposição na malha 1, temos

$I_{01} = \frac{2\angle 180°}{2 + j10} = 0{,}196\angle 101{,}31°\ A$

zerando a fonte no secundário:

$I_{02} = \frac{2}{2} = 1A$ logo.

Portanto, somando I_{01} e I_{02}, temos

$I_0 = 1 + 0{,}196\angle 101{,}31$

$I_0(t) = 1 + 0{,}196\cos(200t + 101{,}3°)\ A$

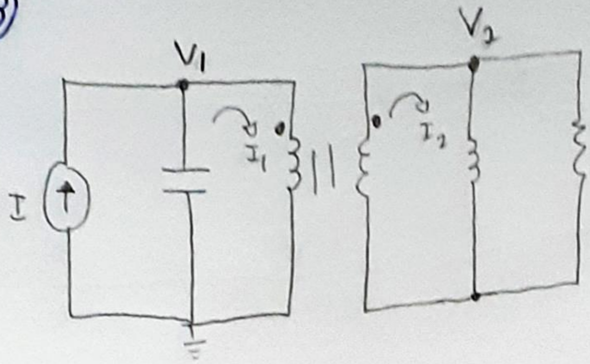
0,0

$i_0(t) = 1 - 0{,}14\cos(200t - 45^o)\ A$

2

Q3) 6,0

3



$X_C = \frac{1}{j\omega C} = \frac{1}{j}$

$\boxed{m = 2}$

$X_L = j\omega L$

m positiva $\Rightarrow \frac{1}{m} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$

$\boxed{V_2 = V_0}$

$V_1 = \frac{V_2}{m}$ e $I_1 = m I_2$

$$\text{LKC}: -I + \frac{V_1}{X_C} + I_1 = 0 \Rightarrow I = \frac{V_2}{mX_C} + mI_2 \Rightarrow \frac{\left(I - \frac{V_2}{mX_C}\right)}{m} = I_2 \Rightarrow \boxed{I_2 = \frac{I}{m} - \frac{V_2}{m^2 X_C}}$$

$$\text{LKC}: -I_2 + \frac{V_2}{X_L} + \frac{V_2}{R} = 0 \Rightarrow \frac{V_2}{m^2 X_C} - \frac{I}{m} + \frac{V_2}{X_L} + \frac{V_2}{R} = 0 \Rightarrow$$

$$V_2\left(\frac{1}{m^2 X_C} + \frac{1}{X_L} + \frac{1}{R}\right) = \frac{I}{m} \Rightarrow V_2 = V_0 = \frac{I}{m}\left(\frac{m^2 X_C X_L R}{X_L R + m^2 X_C R + m^2 X_C X_L}\right) =$$

$\cdot \ \frac{X_L R + m^2 X_C R + m^2 X_C X_L}{m^2 X_C X_L R}$

$\boxed{V_0 = \frac{m X_C X_L R I}{X_L R + m^2 X_C R + m^2 X_C X_L}} \Rightarrow V_0 = \frac{24}{4 - \frac{384j}{\omega} + \frac{3\omega j}{2}}$

$\cdot\cdot \ \frac{2 \cdot j\omega L \cdot 12 \cdot 1 \cdot C}{j\omega C} = 24$

$\boxed{V_0 = \frac{24\omega}{4\omega + \left(\frac{3\omega}{2} - 384\omega^2\right)j}}$

$\cdot\cdot\cdot \ j\omega L R + \frac{4 \cdot 12}{j\omega C} + \frac{4 j\omega L}{j\omega C}$

$-\frac{384}{\omega} + \frac{3\omega}{2} = 0 \Rightarrow -384 + \frac{3\omega^2}{2} = 0$

$\omega^2 = \frac{2}{3} \cdot 384 \Rightarrow \omega^2 = 256$

$\boxed{\omega = 16 \text{ rad/s}}$

3,0

b) $|V_0| = \frac{24}{4 + (24j - 24j)} = \frac{24}{4} = 6\text{ V}$

3,0

$V_0 = 6\cos(16t)\text{ V}$

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④ Q4) 6,0

$$V_g = \frac{4V_m}{\pi} \sum_{n=1}^{\infty} \frac{1}{n} \operatorname{sen}(n\omega_0 t) \qquad s = n\omega_0 j$$

$$V_0 = \frac{X_c}{X_c + R} V_g = \frac{V_g/sC}{(RsC+1)/sC} = \frac{V_g}{1+RsC} \rightarrow H(jn\omega) = \frac{1}{1+RCj\omega_0 n}$$

$$\boxed{H = \frac{1}{\sqrt{1^2 + (RC\omega_0 n)^2}} \angle -tg^{-1}(RC\omega_0 n)}$$

Agora, temos: $\boxed{V_g = \frac{4V_m}{\pi n} \angle 0°}$ ✓

Logo, $V_0 = H \cdot V_g$

$$\dot{V}_0 = \frac{4V_m}{\pi} \sum_{n=1}^{\infty} \frac{1}{n\sqrt{1+(RC\omega_0 n)^2}} \angle -tg^{-1}(RC\omega_0 n)$$

$$\boxed{v_0(t) = \frac{4V_m}{\pi} \sum_{n=1}^{\infty} \frac{1}{n\sqrt{1+(RC\omega_0 n)^2}} \operatorname{sen}\left(n\omega_0 t - tg^{-1}(RC\omega_0 n)\right)}$$

$$n_1 \Rightarrow \frac{4V_m}{1.\pi} \cdot \frac{1}{\sqrt{1+(RC\omega_0)^2}} \operatorname{sen}\left(\omega_0 t - tg^{-1}(RC\omega_0)\right)$$

$$n_2 \Rightarrow \frac{4V_m}{\pi.2} \cdot \frac{1}{\sqrt{1+(RC\omega_0 2)^2}} \operatorname{sen}\left(2\omega_0 t - tg^{-1}(RC\omega_0 .2)\right)$$

$$\boxed{n_3 \Rightarrow \frac{4V_m}{3.\pi} \frac{1}{\sqrt{1+(3RC\omega_0)^2}} \operatorname{sen}\left(3\omega_0 t - tg^{-1}(3RC\omega_0)\right)}$$

✓ 6,0

Q5) 0,0

5

Por inspeção, o componente contínuo de $f(t)$ é $a_0 = 1$. Como ~~f~~(t) é uma função par, então $b_m = 0$ e

$$a_m = 2\left[\frac{1}{\pi}\int_0^{\pi}\frac{t}{\pi}\cos(mt)\,dt\right] = \frac{2}{\pi^2}\left(\cancel{\frac{t\,\mathrm{sen}(t)}{m}}\Bigg|_0^{\pi} - \int_0^{\pi}\frac{\mathrm{sen}(mt)}{m}dt\right) = \frac{2}{\pi^2}\left(\frac{\cos(mt)}{m^2}\right)\Bigg|_0^{\pi}$$

$$\left\{\begin{array}{l} u = t \quad du = dt \\ dv = \cos(mt)\,dt \rightarrow v = \dfrac{\mathrm{sen}(mt)}{m} \end{array}\right\} \Rightarrow a_m = \frac{2}{\pi^2}\left(\frac{(-1)^m - 1}{m^2}\right) \begin{cases} \dfrac{-4}{m^2\pi^2} & m \text{ ímpar} \\ 0 & m \text{ par} \end{cases}$$

$$\boxed{V_i = 1 + \frac{-4}{\pi^2}\sum_{m=1}^{\infty}\frac{1}{m^2}\cos(mt)} \; V$$

0,0