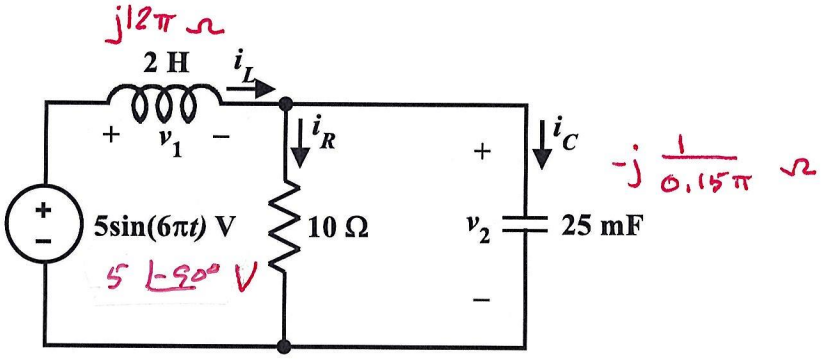
EE 3340

Homework Problem #009

For the circuit shown below, use the phasor analysis method to determine the AC steady-state part of $v_1(t)$, $v_2(t)$, $i_L(t)$, $i_R(t)$ and $i_C(t)$. Express your answers in polar form with the phase angles in degrees.



Using mesh analysis:

$$j12\pi\,\mathbf{I}_L + 10(\mathbf{I}_L - \mathbf{I}_C) = 5\angle -90^\circ \quad \text{or} \quad -j5$$

$$10(\mathbf{I}_C - \mathbf{I}_L) - j\frac{1}{0.15\pi}\mathbf{I}_C = 0$$

In matrix form:

$$\begin{bmatrix} j12\pi + 10 & -10 \\ -10 & 10 - j\frac{1}{0.15\pi} \end{bmatrix}\begin{bmatrix} \mathbf{I}_L \\ \mathbf{I}_C \end{bmatrix} = \begin{bmatrix} -j5 \\ 0 \end{bmatrix}$$

Solving yields:

$$\mathbf{I}_L = -0.1402 - j0.0017 \approx 0.1402\angle -179.3^\circ \text{ A}$$

$$\mathbf{I}_C = -0.1338 - j0.0301 \approx 0.1371\angle -167.3^\circ \text{ A}$$

Then

$$\mathbf{V}_1 = j12\pi\,\mathbf{I}_L \approx 5.28\angle -89.3^\circ \text{ V}$$

$$\mathbf{V}_2 = -j\frac{1}{0.15\pi}\mathbf{I}_C \approx 0.291\angle 102.7^\circ \text{ V}$$

$$\mathbf{I}_R = \mathbf{I}_L - \mathbf{I}_C = -0.0064 + j0.0284$$

$$\approx 0.0291\angle 102.7^\circ \text{ A}$$