ELEC 226, Homework 2 Problem:

Each plot on pages 2 and 3 corresponds to one of the following cases of voltage and current waveforms in the RL and RC circuits on page 4:

$v_{\text{in}}(t), \quad v_1(t), \quad i_{\text{L}}(t)$
$v_{\text{in}}(t), \quad v_2(t), \quad i_{\text{L}}(t)$
$v_{\text{in}}(t), \quad v_3(t), \quad i_{\text{C}}(t)$
$v_{\text{in}}(t), \quad v_4(t), \quad i_{\text{C}}(t)$

In each plot, the current is the "largest" sinusoid, with amplitude 1 mA, as labeled on the vertical axis on the right side of the plot. The voltage scale is the vertical axis on the left side of the plot.

In class on Jan. 26, we qualitatively discussed how you can match each plot with the corresponding voltage and current in the RL and RC circuits. In this problem, you will perform a more quantitative analysis and draw *phasor diagrams* (see Section 7-7 in the textbook).

a) Use voltage dividers to find the voltage phasors $\mathbf{V}_1, \mathbf{V}_2, \mathbf{V}_3, \mathbf{V}_4$ and Ohm's Law to find the current phasors $\mathbf{I}_L, \mathbf{I}_C$ .Then write the corresponding time-domain expressions for $v_1(t), \quad v_2(t), \quad v_3(t), \quad v_4(t), \quad i_{\text{L}}(t), \quad i_{\text{C}}(t)$. Use your results to match the plots in Figures 1-4 with the voltages and currents in the RL and RC circuits.

b) Draw a phasor diagram for the RL circuit that shows the following phasors: $\mathbf{V}_{\text{in}}, \mathbf{V}_1, \mathbf{V}_2, \mathbf{I}_L$. (We will discuss this phasor diagram in lab on Jan. 30 & 31.)
For $\mathbf{V}_1$ and $\mathbf{V}_2$, determine whether each is *leading* or *lagging* $\mathbf{V}_{\text{in}}$.

c) Draw a phasor diagram for the RC circuit that shows the following phasors: $\mathbf{V}_{\text{in}}, \mathbf{V}_3, \mathbf{V}_4, \mathbf{I}_C$.
For $\mathbf{V}_3$ and $\mathbf{V}_4$, determine whether each is *leading* or *lagging* $\mathbf{V}_{\text{in}}$.

d) Verify KVL in your phasor diagrams: $\mathbf{V}_{\text{in}} = \mathbf{V}_1 + \mathbf{V}_2$, $\mathbf{V}_{\text{in}} = \mathbf{V}_3 + \mathbf{V}_4$.

e) Compare the phasor diagrams with the time-domain signals in Figures 1-4. You should be able to see how the phase differences in the phasor diagrams are related to the time-shifts in the sinusoids.
(You don't have to explain anything for this part.)

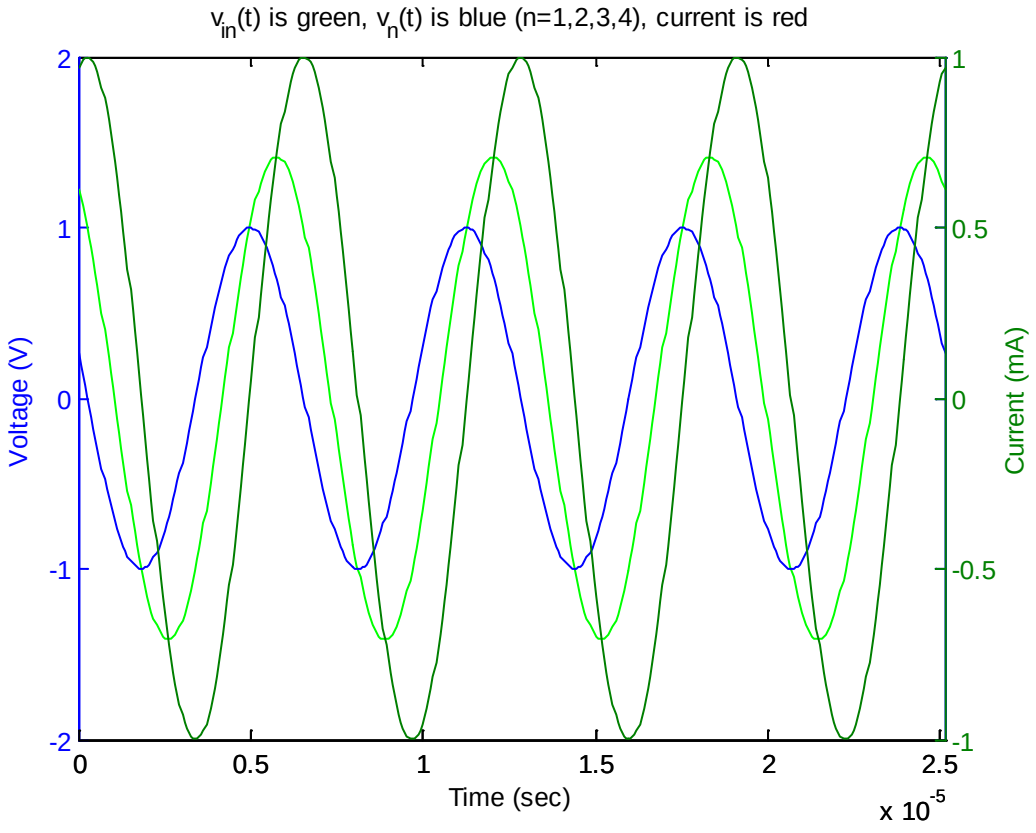


Figure 1

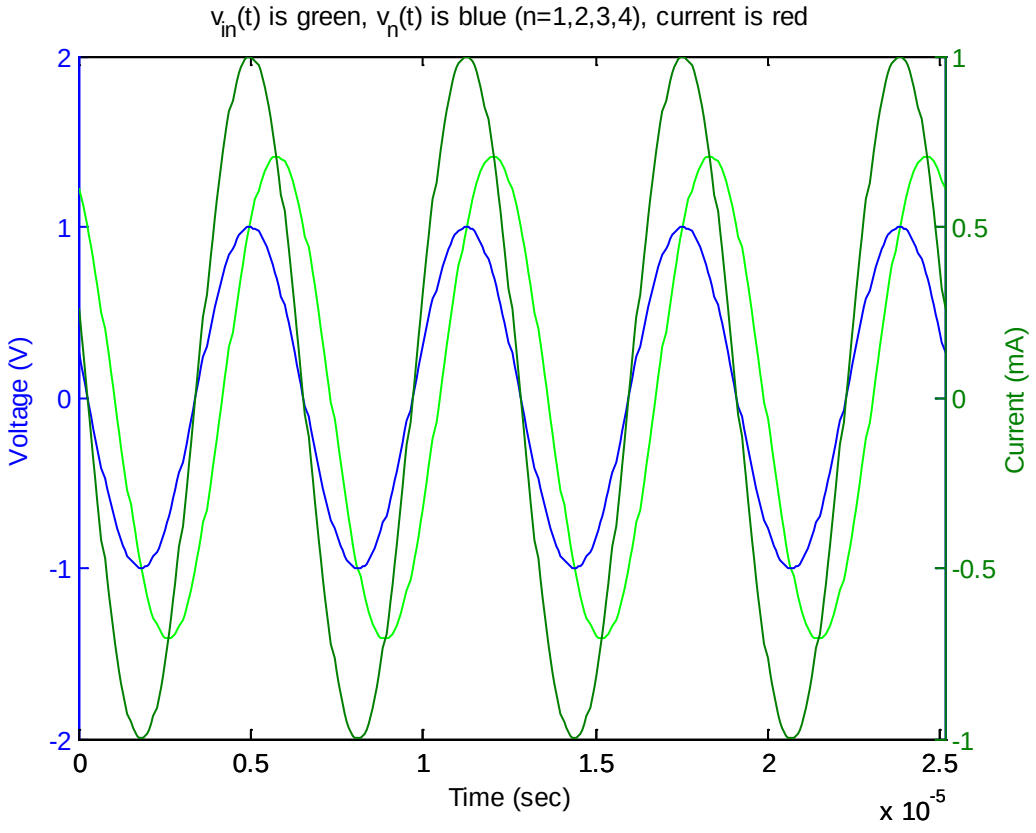


Figure 2

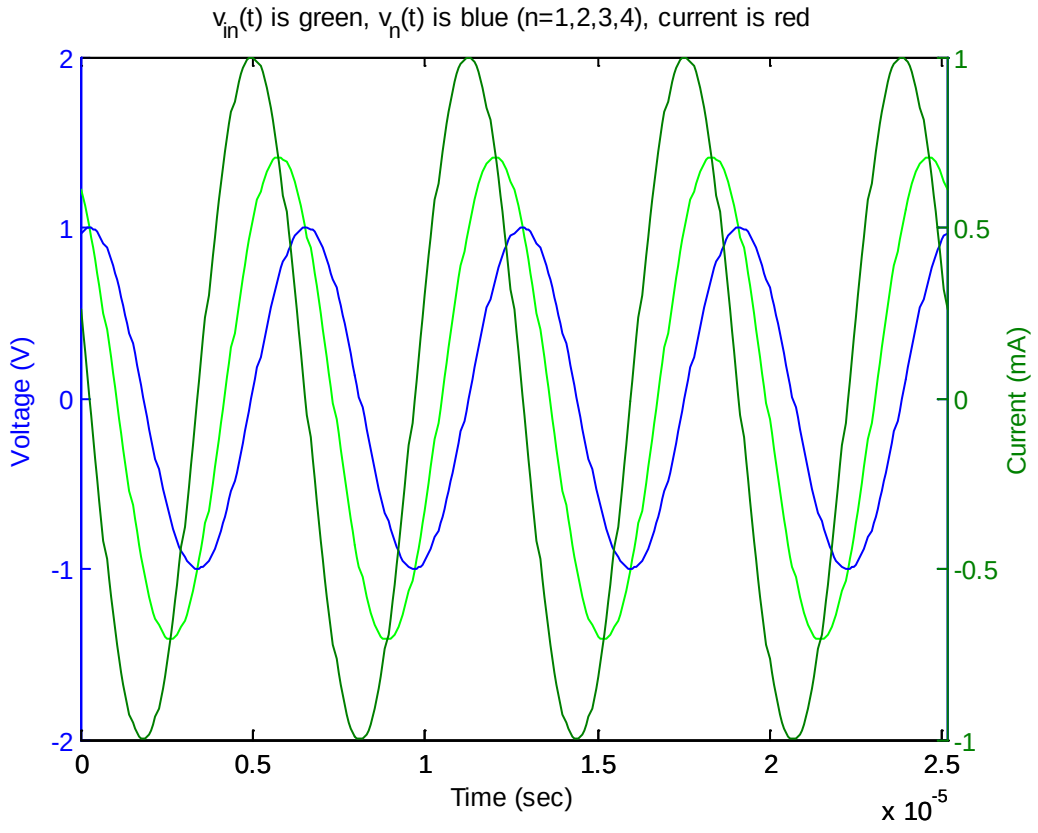


Figure 3

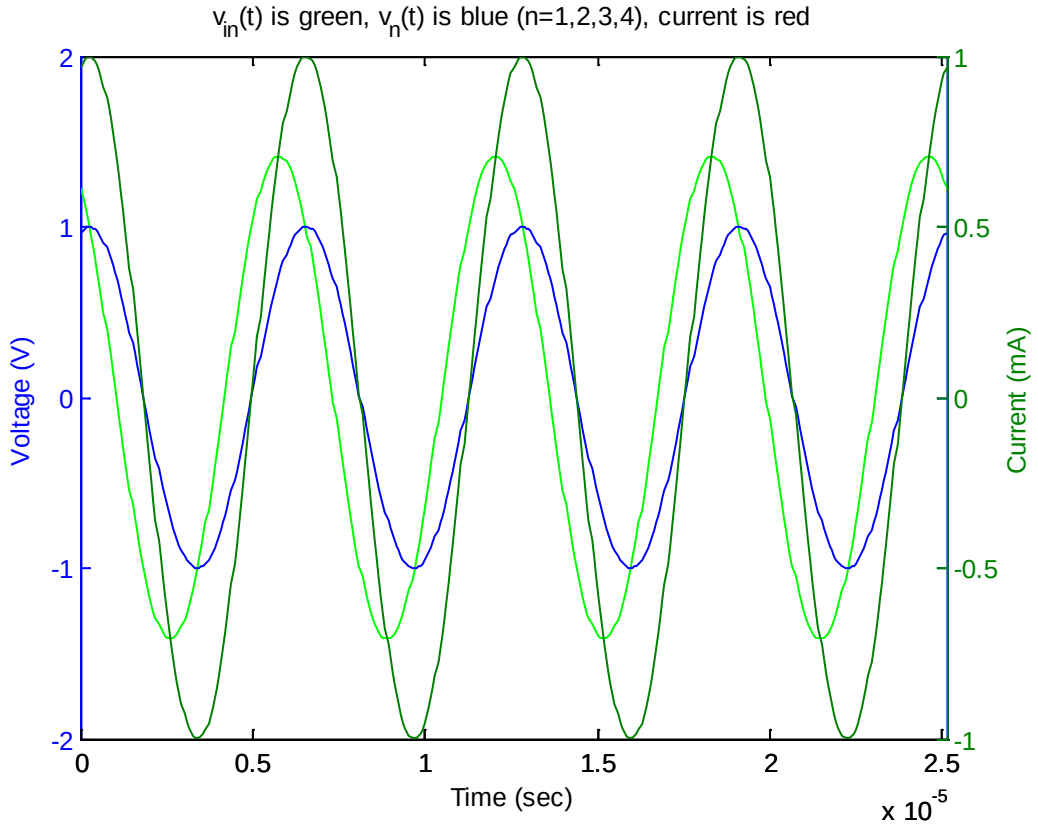
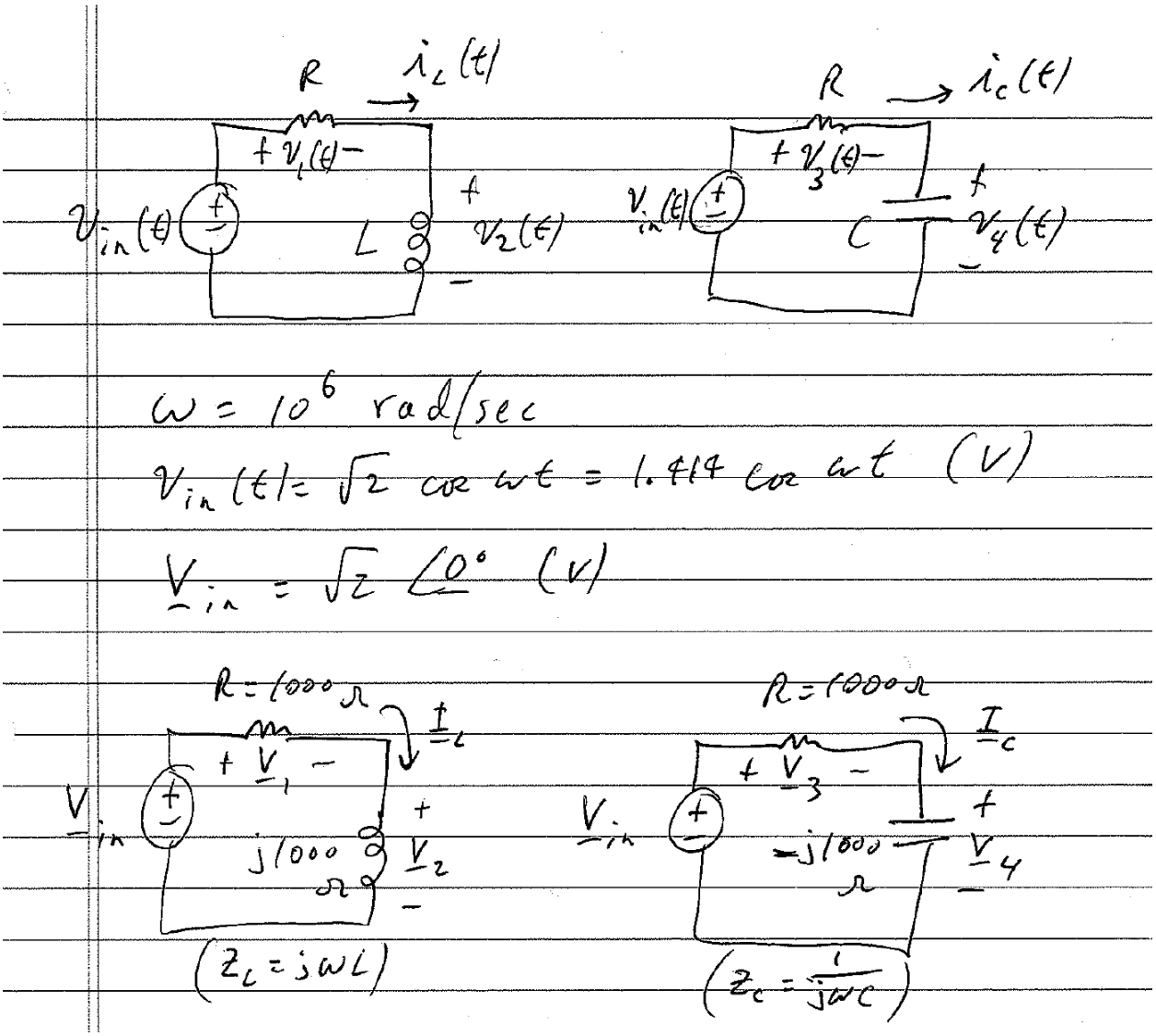


Figure 4

RL and RC Circuits:



$\omega = 10^6$ rad/sec

$v_{in}(t) = \sqrt{2} \cos \omega t = 1.414 \cos \omega t$ (V)

$\underline{V}_{in} = \sqrt{2} \angle 0°$ (V)