ECE 204 AC CIRCUITS

Lab # 4 Superposition, Nodal & Mesh Analysis

The objectives of this laboratory are to predict nodal voltages and mesh currents in the phasor domain and to confirm the predictions with direct phasor measurements.

1.0 PRE-LAB

1.1 Read the complete laboratory procedure and be ready to apply it to your work. If you do not understand anything in the lab procedure, go and ask your instructor — don't wait until the lab has started; remember, the instructor has to deal with fifteen groups and you will be "waiting in line". Note that "waiting in line" is not a valid excuse for failing to finish the lab. You are expected to "budget your time" in lab and not waste it socializing.

1.2 Re-draw Figure 1 in the phasor domain, based on a frequency of 1.5 kHz.

1.3 Apply Nodal Analysis to Figure 1 and make predictions for the nodal voltages, then determine the superposition components for the left and right Function Generators (AWG1 & AWG2). Also determine the Mesh Currents for both sources active and fill in the blank items in tables 1 & 2. Make the predictions phasor quantities, with peak magnitudes and angles in degrees with respect to the reference node.

Table 1—Ideal Predictions for Nodal Voltages

Item	Total	AWG1	AWG2
V_1			
V_2			
V_3			

Table 2—Ideal Predictions for Mesh Currents

Item	Prediction (mA)
I_1	
I_2	
I_3	

1.4 Confirm the nodal voltages by adding the superposition components.

1.5 Submit a photocopy of the pre-lab at the ***start of the lecture preceding this lab.***

1.6 Follow the instructions for keeping lab notebooks (Lab B) in the course webpage.

2.0 LAB PROCEDURE

2.1 Measure Component Values

Measure the nominal values of each individual component shown in Figure 1, using one of the R, L, C meters at the front of lab and re-do the predictions in the pre-lab with the new nominal values.

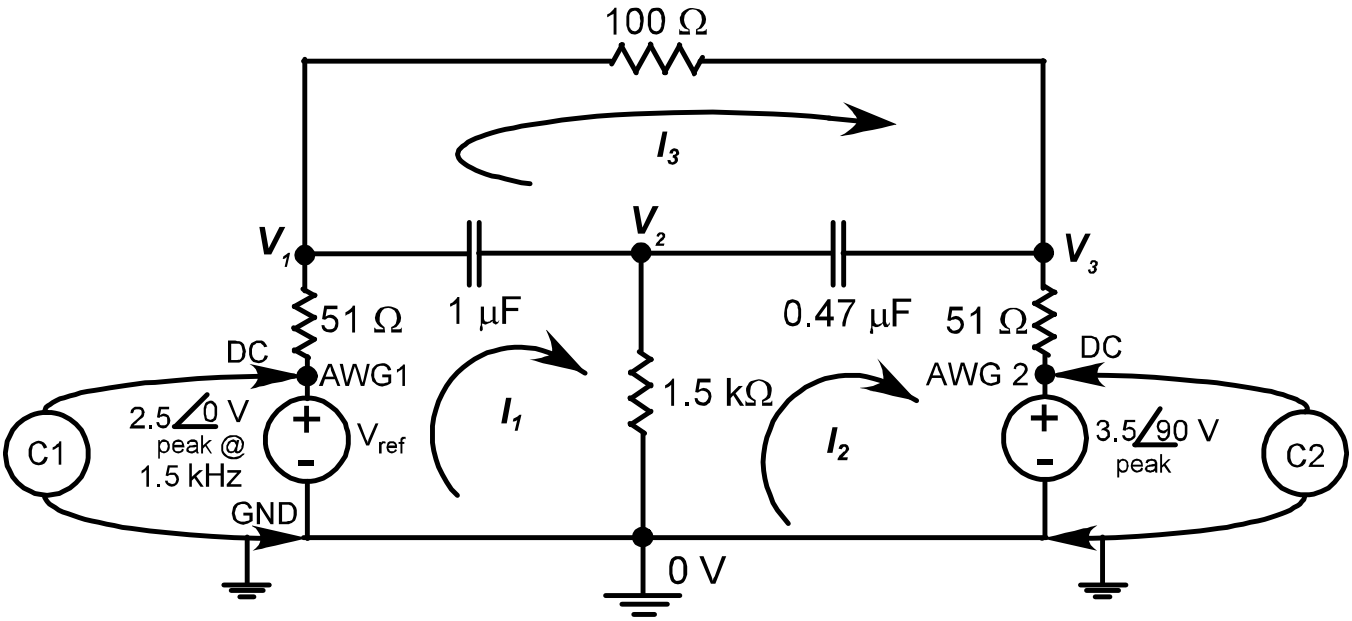
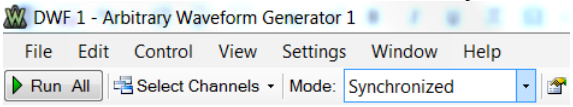


Figure 1—Circuit Diagram for *Nodal & Mesh Analysis*

2.2 Measure Node Voltages with Both Sources Active

Set the left FG (AWG1) to 2.5 V_{peak} at 1.5 kHz, zero phase shift and connect it directly to C1 of the oscilloscope and trigger off AWG1. Then set the right FG (AWG2) to 3.5 V_{peak} at 1.5 kHz, 90^0 phase shift. Be sure the "Mode" is set to "Synchronized" as shown:



Determine the nodal voltages that were predicted in Table 1 by moving C2 around the circuit. Use these nodal voltages and Ohm's Law to calculate the mesh currents in Table 2.

2.3 Measure Node Voltages using Superposition

Re-configure the circuit with only one FG active and the other FG de-activated. When you deactivate the FG you need to replace it with a short-circuit. Use C2 to measure the nodal voltages due to ***one source acting alone***, and then repeat this to measure the nodal voltages due to the ***other source acting alone***. The oscilloscope should be triggered off AWG1 even when it is disconnected from the circuit. Apply superposition to determine the nodal voltages that were predicted in Table 1.

Compute the percent error of the magnitude for each item in Tables 1 & 2 and state the angle errors in degrees. When considering the comparison of the phase offset, you need to recognize that the reference point of your analysis is zero degrees.

2.4 Completion

The lab-work is finished now make sure your lab notebook is properly completed by following the format of Lab B. Be sure to write a conclusion that shows what you have learned from doing the lab.