EET 1150

1. LAB NUMBER: 4

2. TITLE: Parallel AC Circuit Analysis

3. OBJECTIVES:

After completing this lab, the student will be able to:

1. measure the amplitude and phase of a voltage drop across a component,
2. verify Kirchhoff's Current Law,
3. verify Current Divider Rule.

4. EQUIPMENT:

METEX MS-9150 Generator
Oscilloscope
Experimenter board
Multisim software

5. COMPONENTS:

3 - 10 Ω ½ watt 5% Resistor
1 - 560 Ω ½ watt 5% Resistor
1 - 33 nF Capacitor
1 - 15 mH Inductor

6. TEXT REFERENCE:

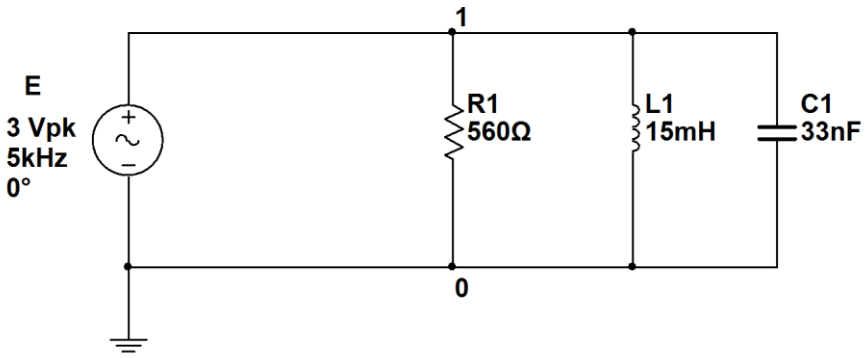
Circuit Analysis: Theory and Practice (5^{th} Edition):
A.H. Robbins and W.C. Miller

Section 18.4: AC Parallel Circuits
Section 18.5: Kirchhoff's Current Law and the Current Divider Rule

7. PRE-LAB ASSIGMENT:

Study Fig. 1 which shows a parallel circuit with three components. Do the following calculations:

Figure 1:



a) Calculate the reactances of L1 and C1 at 5000Hz then determine the total impedance Zt as seen by the source. Record your result in Table 1.

Table 1:

R1	X_{L1}	X_{C1}	Zt
Ω< °	Ω< °	Ω< °	Ω< °

b) Convert the source voltage E to phasor form (with angle 0°) then calculate the total current It and three component currents using Ohm's Law (as the components all have the same voltage E across them):

$$I = E / Z$$

Record your results in Table 2.

Table 2:

It	I_{R1}	I_{L1}	I_{C1}
mA< °	mA< °	mA< °	mA< °

c) Using the value of It above, re-calculate the component currents using the Current Divider Rule:

$$I_x = \frac{Z_t}{Z_x} I_t$$

Record your results in Table 3

Table 3:

.

I_{R1}	I_{L1}	I_{C1}
mA< °	mA< °	mA< °

d) Compare Table 2 to Table 3. Is the Voltage Divider Rule accurate?

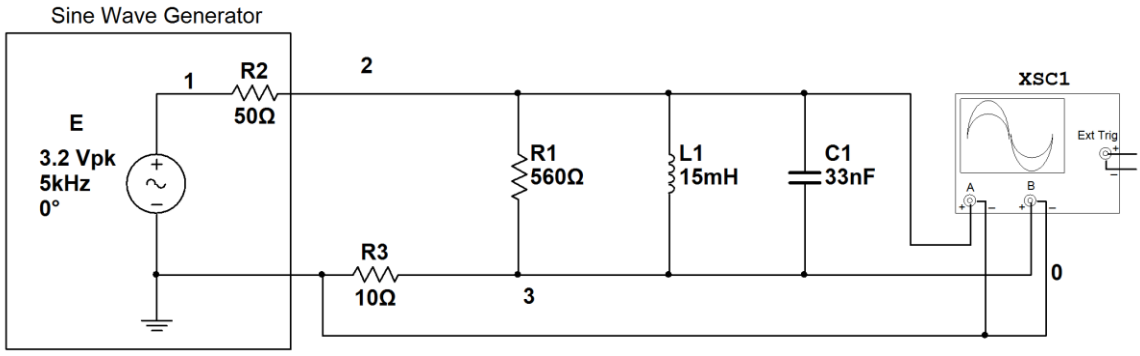
e) At Node 1 of Fig. 1, It flows into this node and the three component currents (branch currents) flow out of the node. Calculate the sum of the three component currents and compare it to It to verify Kirchhoff's Curent Law.

8. MEASUREMENTS:

A – Measurement of Total Current It:

a) Build the circuit of Fig. 2., which has a sense 10 Ω resistor to measure total current It (method used in Lab 2).

Figure 2:



b) CH1 measure the output of the Sine Wave Generator (METEX). Increase the output until CH1 reads 3V peak at 5kHz (there is some loss over R2).

c) CH2 reads the voltage and phase of the voltage across R3, which will give you the total current It flowing out of Node 3. Note carefully that all the ground clips of the oscilloscope are to be connected to the ground clip from the METEX (Node 0). Record your result in Table 4.

Table 4:

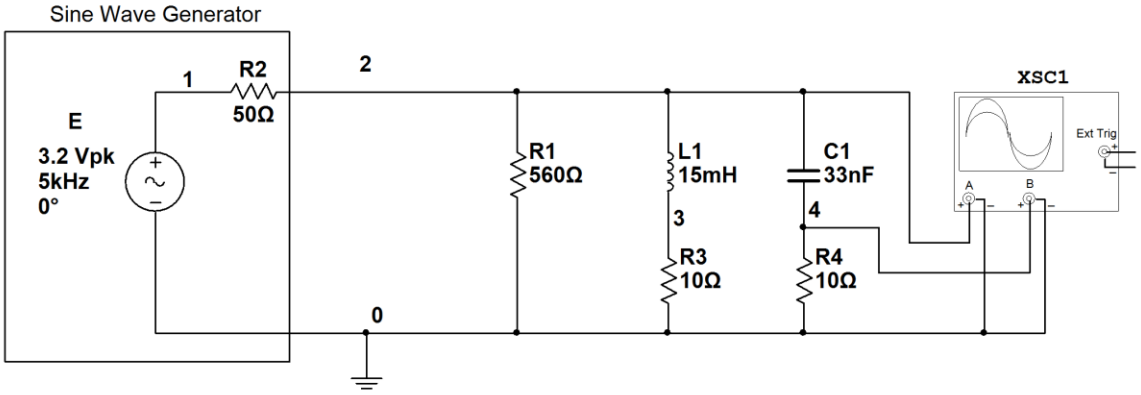
It
mA< °

d) Compare Table 4 to the calculated It in Table 2.

B – Measurements of Branch Currents:

e) Move R3 to L1 and add another sense resistor R4 to C1 as in Fig. 3. The current through L1 will be calculated by Vr3 and that through C1 will be determined by Vr4. CH2 will be moved from point "4" to point "3" to measure the amplitudes and phases of these two currents. The current through R1 is determined from the phasor E and Ohm's Law.

Figure 3:



f) Make sure that CH1 reads 3 V peak at point "2" then determine the amplitudes and phases of the three currents and record them in Table 5.

Table 5:

V_{R1}	V_{R3}	V_{R4}
2.12 V< 0°	V< °	V< °
I_{R1}	I_{L1}	I_{C1}
mA< °	mA< °	mA< °

g) Compare Table 5 to Table 3 and Table 2.

C – Multisim Simulations:

h) Create a Multisim circuit for Fig. 3. Set the oscilloscope for Horizontal rate at 20 μsec/div, Vertical A at 1V/div and Vertical B at 50mV/div. Set trigger to Channel A, positive slope and Normal mode. Capture the voltages at point "3" and "4" (magnitude and phase). Print the simulations for your report.

9. LAB REPORT REQUIREMENT:

Your team's Lab Report should contain the followings:

A Cover Page with Lab Number, Lab Title, Team members' Names and Date.
An Introductory Page with list of Equipment and Components used.

Result Pages with:

A – Measurement of Total Current It:

Procedure:

(Summarize the main activities that your team did (past tense) in this section).

Results:

Show a copy of Table 4.

Discussions:

1) Answer 8(d).
2) Discuss any factors that cause the differences in results.

B – Measurements of Branch Currents:

Procedure:

(Summarize the main activities that your team did (past tense) in this section).

Results:

Show a copy of Table 5.

Discussions:

1) Answer 8(g), compare also with Multisim results.
2) Do the differences affect your team's conclusions on Kirchhoff's Current Law and the Voltage Divider Rule (7d-e)?

C – Conclusions:

1) Is Kirchhoff's Current Law valid? Explain your answer.
2) Is the Current Divider Rule accurate? Explain your answer.
3) Are all the Lab objectives met? Explain if some are not.

Appendix:

Attach all Multisim simulations and Pre-Lab calculations.