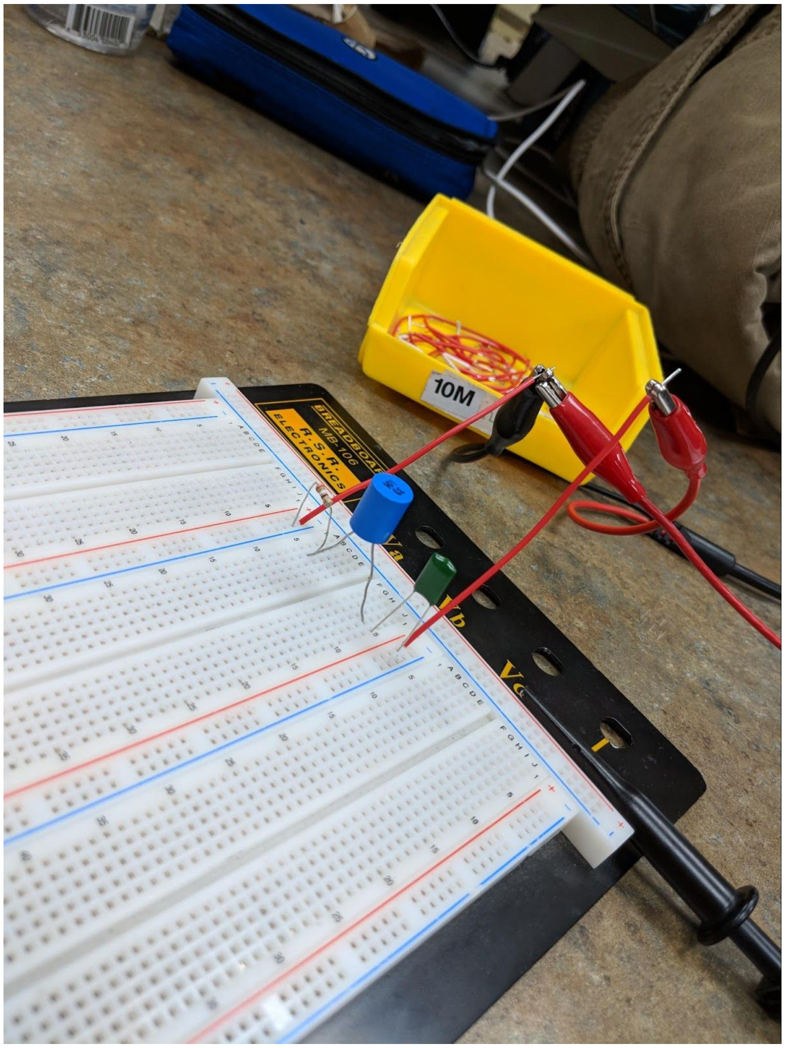
Lab 49



By:Thomas Buckley,Aidan O'Leary,Joshua Pinoos, Zachary Welch

The week of February 12th to 16th 2018

Lab 49

Objective:

The objectives of the lab are to observe a series AC RLC circuit operating at frequencies that will cause the circuit to act inductively or capacitively, find the phase shift between the applied voltage and circuit current, individual voltage drops, and the value of circuit current, and observe changes in circuit characteristics as components or frequency varies.

Materials:

Oscilloscope

100mH and 33 mH inductors

.022uf Capacitor

390 ohm and 1.8k ohm resistors

Procedure:

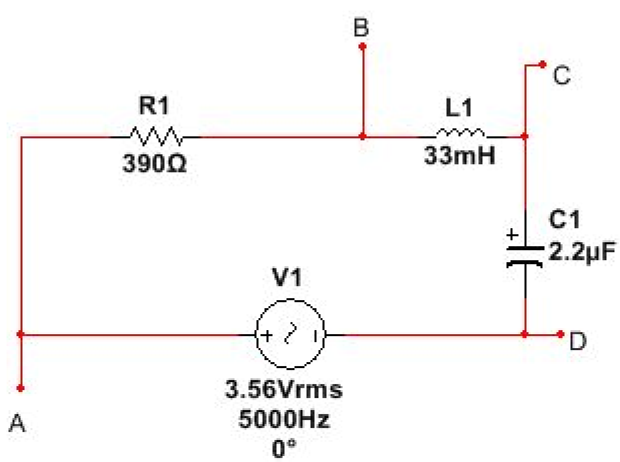
First the actual values of the resisters were measured with a ohm meter as shown in figure 1.

Figure 1

Actual (S)	Actual (R)	Stated
390 Ω	390.4 Ω	390 Ω
1.8k Ω	1.792k Ω	1.8k Ω

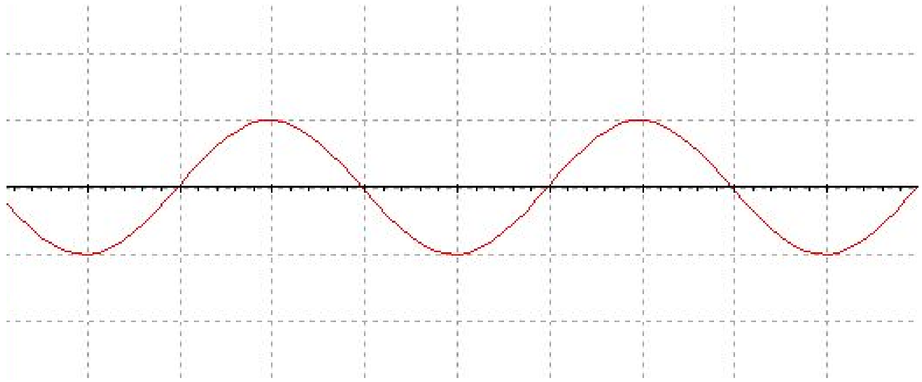
Then a circuit was built as shown in figure 2.

Figure 2



Then the external trigger was set to a standard 5 volt peak wave by attaching both the ext. Trigger and ch. 1 to point A as shown in figure 3.

Figure 3



Then the voltage peak and phase shift on each component was measured as shown figure 4.

Figure 4

	V (Sim)	V(Real)	Phase Angle (S)		Real
Cap	13 V	12.6 V	-57.5		-56
Induct.	10.5 V	9.5 V	135		135
Resistor	3.5 V	3.4 V	In phase		In phase

Then frequency was raised to about 5.9 khz and certain values were monitored for change as shown in figure 5.

Figure 5

As frequency rises:

Net reactiance	Increases
Phase shift	Increases
Current	Decreaes
R Voltage	Decreaes

As frequency falls:

Net reactiance	Decreases
Phase shift	Decreases
Current	Increases
R Voltage	Increases

Then a second circuit was built as shown in figure 6 and both phase angle and voltage was measured in figure 7.

Figure 6

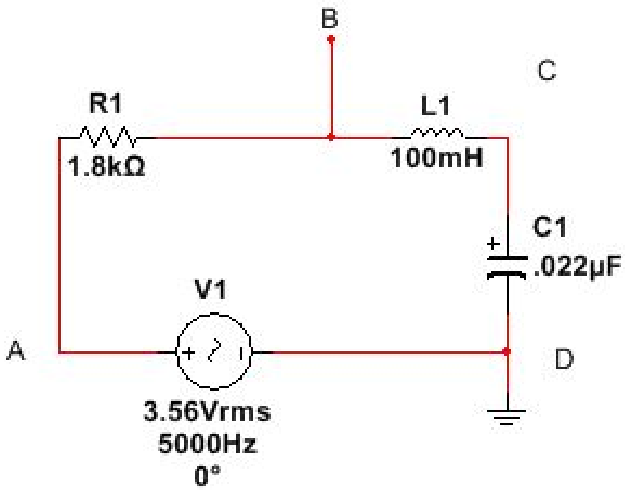


Figure 7

	V (Sim)	V(Real)	Phase Angle (S)		Real
Cap	2.9 V	3 V	-34		-37
Induct.	3.2 V	3.3V	128		130
Resistor	3.5 V	3.5 V	In phase		In phase

Observations:

Circuit 1

1. Capacitively
2. Largest reactance determines phase angle
3. I_t= 8.835 mA
4. X_c=1446 Ω,X_L=1036 Ω
5. Z_t= 565Ω
6. V_c=12.7 V,V_L=9.16 V

Circuit 2

7. Inductively
8. The inductor value is greater than the capacitor value
9. I_t= 2.02 mA
10. X_c=1446 Ω,X_L=3141.59 Ω
11. Z_t= 2472.27Ω
12. V_L=6.35 V,V_c=2.9 V
13. F decrease

Net reactiance		Increases
Phase shift		Increases
Current		Decreaes
R Voltage		Decreaes

14. The circuit changed in accordance with the chart.

15.

Net reactiance	Decreases
Phase shift	Decreases
Current	Increases
R Voltage	Increases

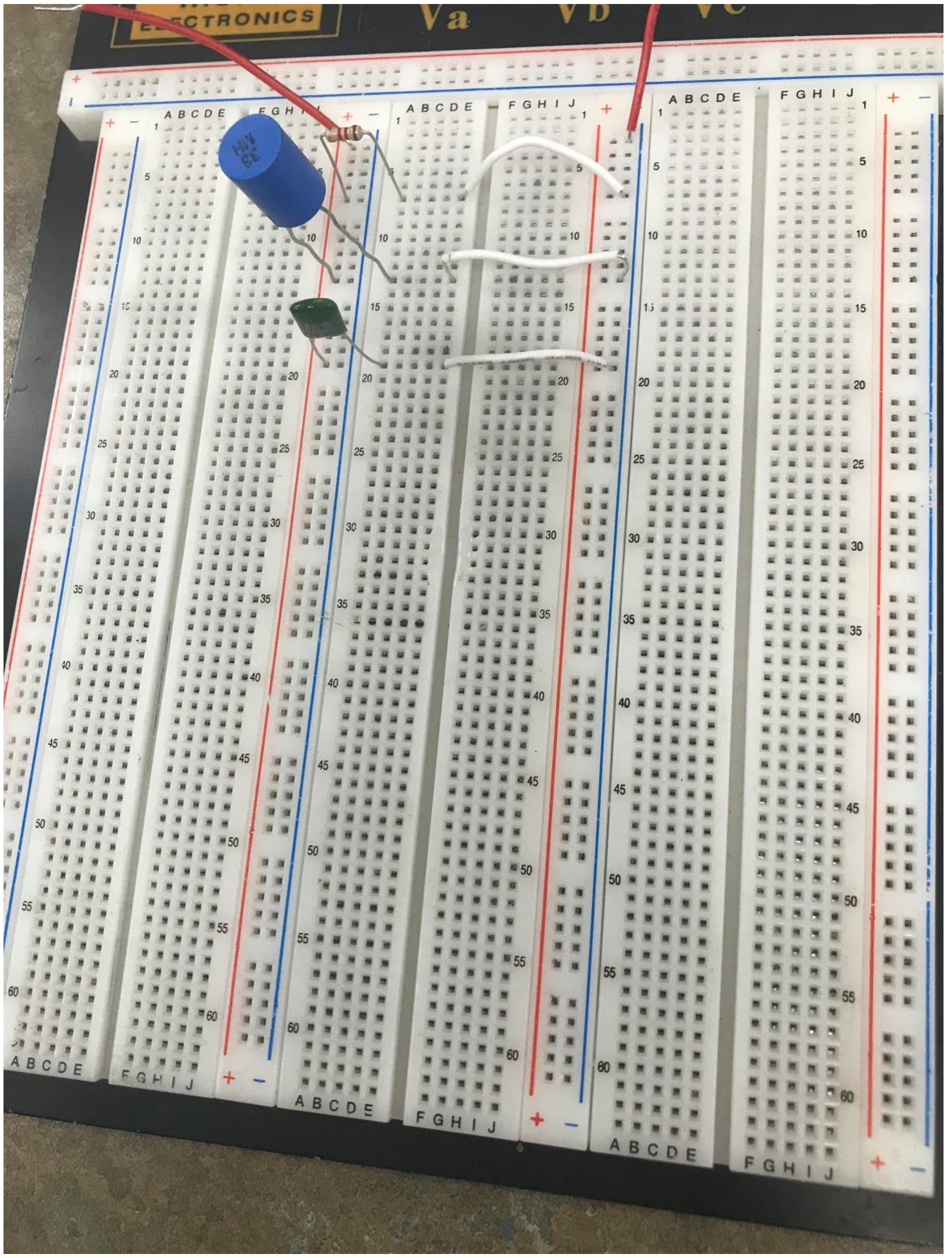
F increase

16. The circuit changed in accordance with the chart.

Discussion: The sim values may be different due to human error and being held in a perfect scenario with rounding of values contributing for inaccuracy.

Conclusion: In a RLC circuit current and resistor voltage increase while net reactance and the phase shift decreases when frequency decreases and when it increases the opposite happens. A RLC circuit will act inductively if the inductor's value is greater than the capacitor value and a RLC circuit will act capacitively if the capacitor value is greater than the inductor's.

Lab 51



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The week of February 12th to 16th 2018

Lab 51

Objectives: Observe the characteristics of a parallel AC RLC Circuit. The following characteristics should be observed: the phase angle of the total circuit current versus the applied voltage, the phase angle of the current through each reactive component versus the voltage across that component, the effect changing the frequency has on the phase angle of total circuit current to applied voltage, the effect changing components has on the total circuit current to applied voltage phase angle. Also practice using the oscilloscopes' external trigger to measure phase angle.

Materials:

- Function generator
- Dual trace oscilloscope
- 100 mH inductor
- 33 mH inductor
- 0.0022 µF capacitor
- 0.001 µF capacitor
- 2700 Ω resistor
- 220 Ω resistor
- Test leads

Procedure:

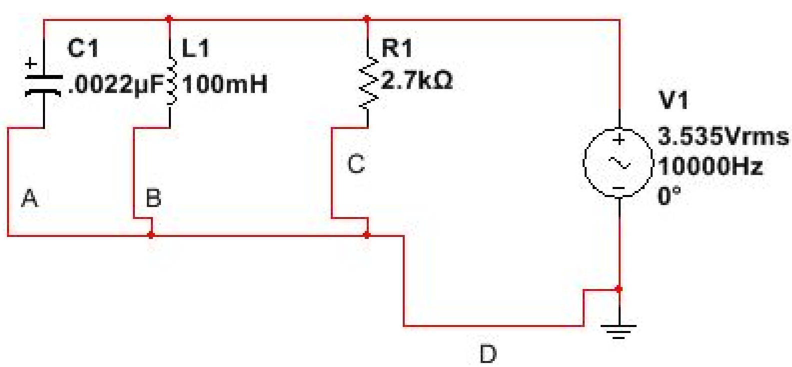
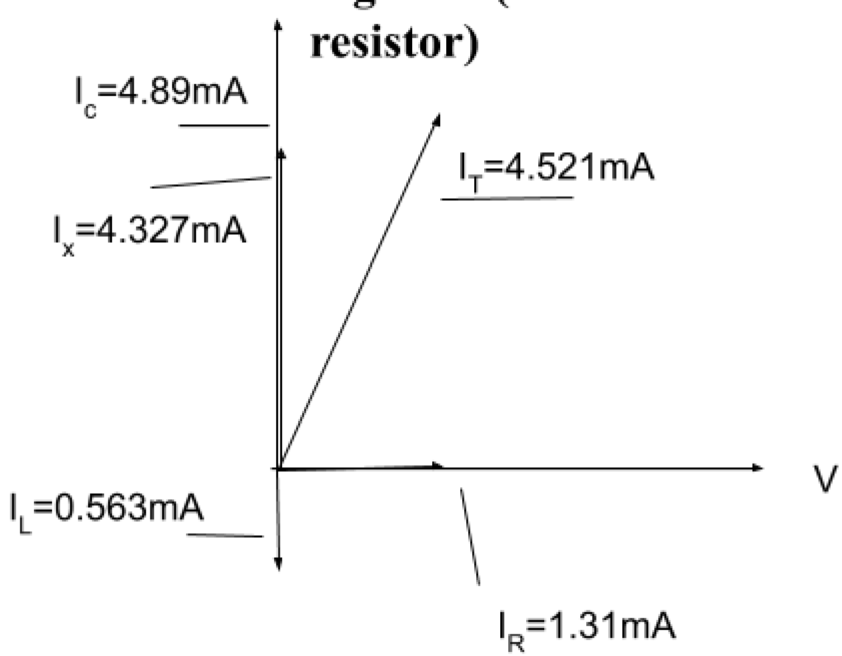


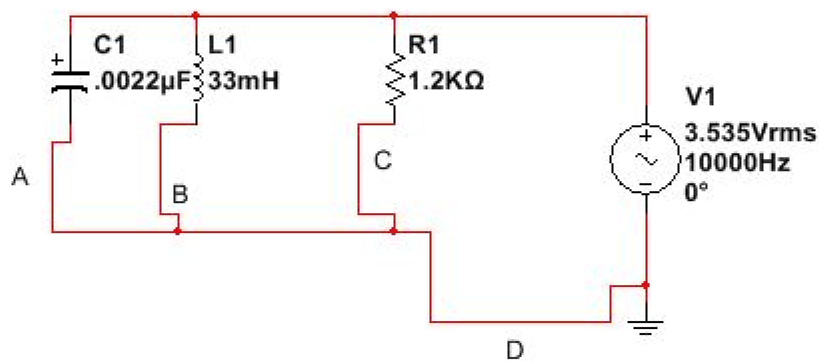
Figure 1

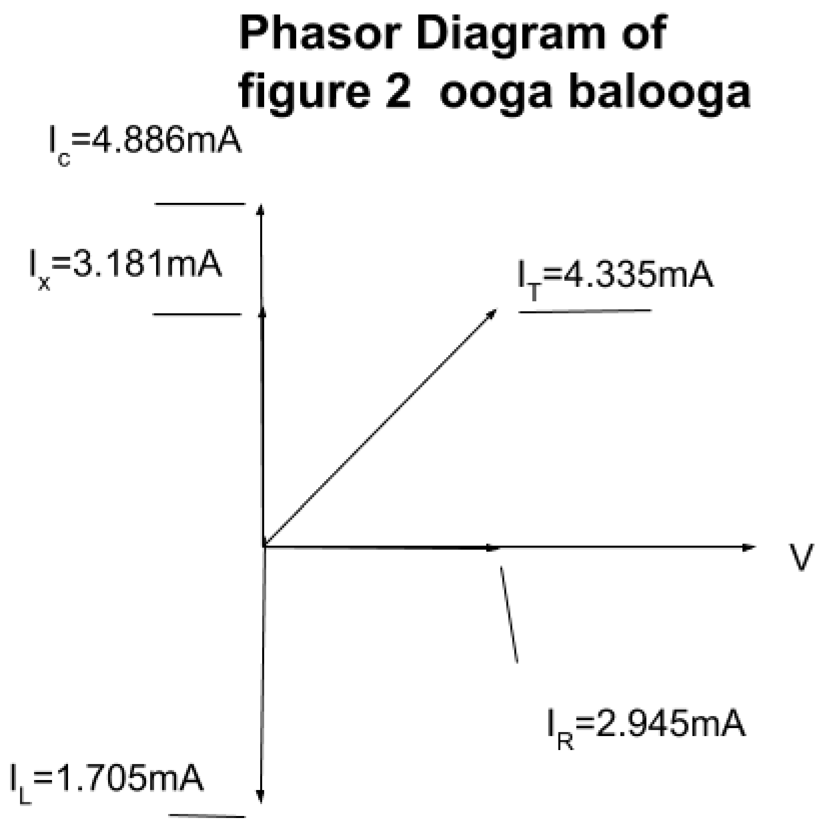
Procedure: First we constructed the circuit shown in figure 1. Then we connected the external trigger of the oscilloscope across the applied voltage and connected channel 2 of the oscilloscope to the applied voltage to measure it and adjusted the amplitude of the wave until only one cycle was shown. Next we replaced jumper A with a 220 Ω resistor and measured the voltage between the 0.0022 µF capacitor and 220 Ω resistor. We found the voltage on the breadboard to be 2.4 volts and in multisim it was 2.5 volts. Then we noticed that the phase angle in multisim was 60° and on the breadboard 62.3° and current of the capacitor was lagging the applied voltage on the breadboard and in multisim. Next we reinserted jumper A and replaced jumper B with the 220 Ω resistor and placed channel 1 between the 100 mH inductor and the 220

Ω resistor. Similarly to when the resistor was connected to the capacitor we found the phase angle on multisim to be 90°and on the breadboard to be 90°. We then put jumper B back into place and replaced jumper C with the 220 Ω resistor. We found the phase angle between the current through the 2.7 k resistor and the applied voltage to be 0°on the breadboard and 0° in multisim. Then we replaced jumper C and substituted the 220 Ω resistor for jumper D and found that that the circuit current was leading the applied voltage and that the circuit was acting capacitively. Next we adjusted the frequency down to 4 KHz and we found that the total circuit current to applied voltage phase angle increased and that the circuit continued to act capacitively. Then we constructed the circuit in figure 2 and made a phasor diagram to help find the phase angle of the circuit current to the applied voltage being 50° in multisim and 47.21 °on the breadboard. Next we replaced jumper A with the 220 Ω resistor and found the phase angle to be 11.2° on the breadboard and 12° in multisim. Then we slowly adjusted the frequency to 15 KHz and noticed that the circuit was acting capacitively but the phase angle progressively decreased . After that we set the frequency of the function generator back to 10 KHz and replaced the 0.0022 µF capacitor with a 0.001 µF capacitor, after we replaced the capacitor we found that the phase angle is smaller, the current is leading, and the circuit is acting inductively. Then we removed the 1200 Ω resistor which caused the current to lead the applied voltage more and the voltage peak rose from 4 volts to 4.8 volts. Lastly we replaced the 1200 Ω resistor with a 120 Ω resistor and noticed that when the 120 Ω resistor was add the current and the applied voltage were in phase.

Phasor Diagram of Figure 1 (without 220 Ω resistor)







Discussion: We originally started the lab with a 0.0022 µF capacitor so instead of a 0.0047 µFcapacitor so rather than restarting the lab we continued it with a 0.0022 µF capacitor.

Conclusion: In a parallel AC RLC circuit current phasors are used to find the phase angle between the applied voltage and total circuit current. Current through an in inductor will lag behind voltage applied to it and current through a capacitor will lead ahead of voltage applied. As the frequency of a parallel AC RLC circuit decreases the phase angle of total circuit current to applied voltage will increase and the circuit will act capacitively. When the frequency of a parallel AC RLC circuit increases the phase angle between the total circuit current and applied voltage will decrease and circuit will begin to act inductively. Replacing resistors in a parallel AC RLC circuit will result in changes to the phase angle. If the resistors are smaller in value the phase angle will increase. If the resistors are higher in value the phase angle will decrease. The external trigger of an oscilloscope can be attached to a voltage source as a trigger source to help measure values in a parallel AC RLC circuit.