Experiment 4

Passive RLC Filters

EGT 243 - AC Circuit Analysis

Johnny Rivera & Mason Milburn

Northern Kentucky University
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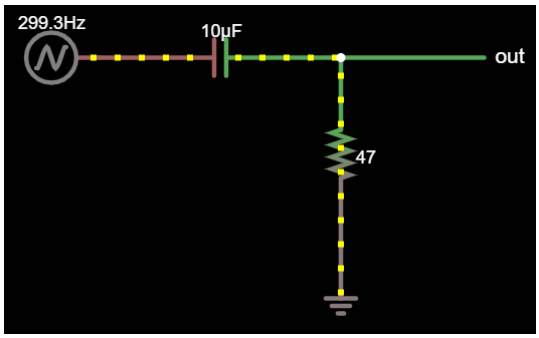
Introduction

The purposes of this experiment are as follows: allow students to build a physical circuit using multiple different components, build familiarity with lab equipment and the mentioned components, and utilize the learned formulae to compute theoretical circuit values, then test those values against real-world models.

Required Components

- 220Ω Resistor, 47Ω Resistor, 10uF Capacitor, 4.7mH Inductor
- Breadboard with Jumper Wires
- Function Generator
- Oscilloscope

Schematic Design



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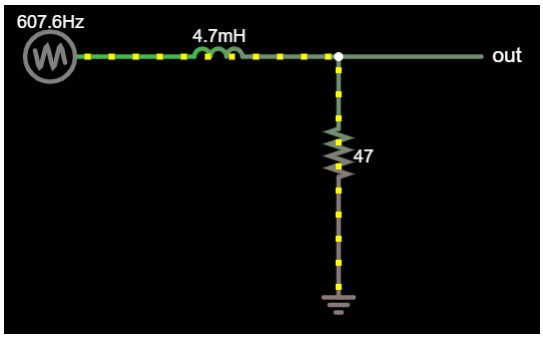

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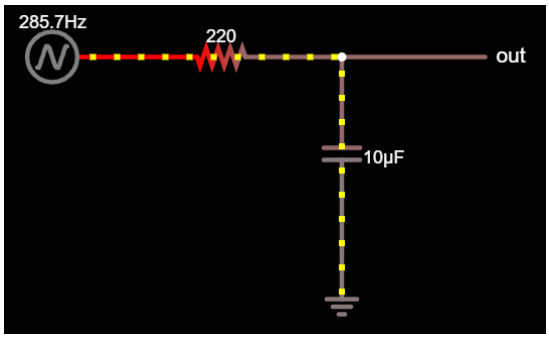

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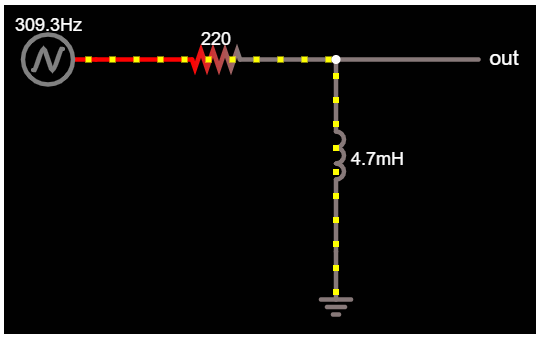

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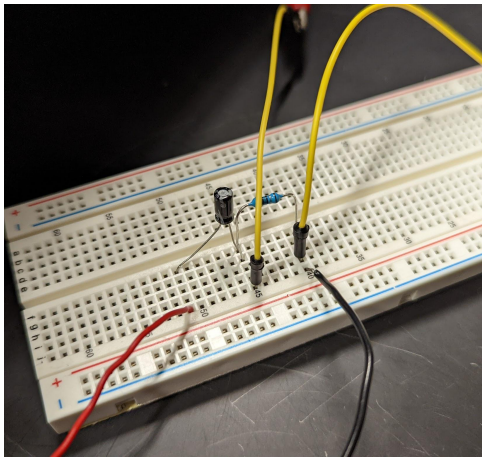
Component Layout



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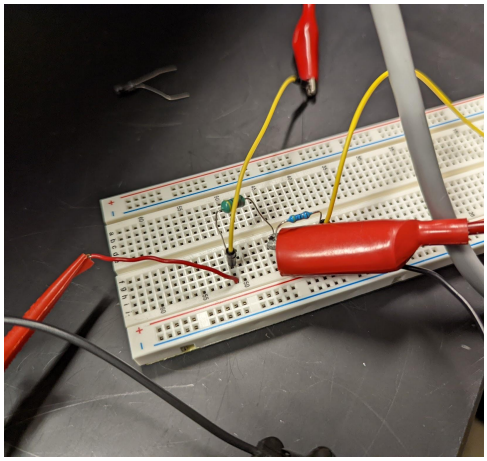

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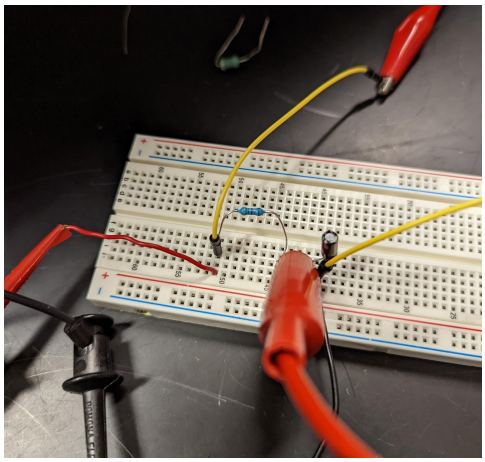

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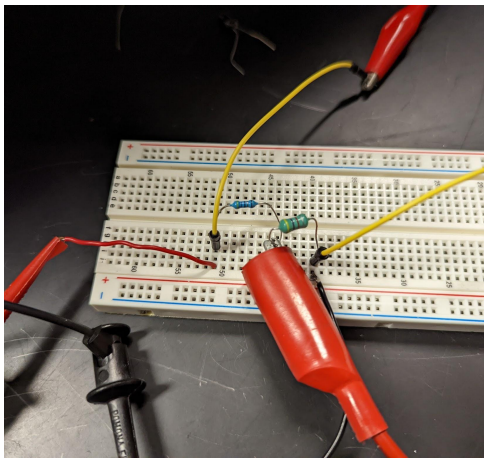


^ *Used in part 4*

Procedure

Part 1:

1. Build the given circuit with a 47Ω resistor and 10uF capacitor.
2. Connect the function generator to the circuit input.
3. Connect the oscilloscope channel 1 to the input and channel 2 to the output of the filter.
4. Adjust the function gen. frequency to a higher and lower range to see the impact on the output.
5. Take photos at each frequency range.

Part 2:

1. Build the given circuit with a 47Ω resistor and 4.7mH inductor.
2. Connect the function generator to the circuit input.
3. Connect the oscilloscope channel 1 to the input and channel 2 to the output of the filter.
4. Adjust the function gen. frequency to a higher and lower range to see the impact on the output.
5. Take photos at each frequency range.

Part 3:

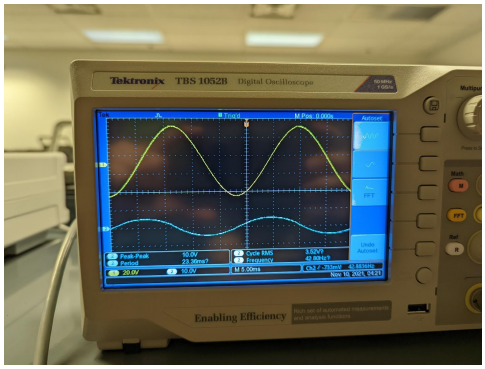
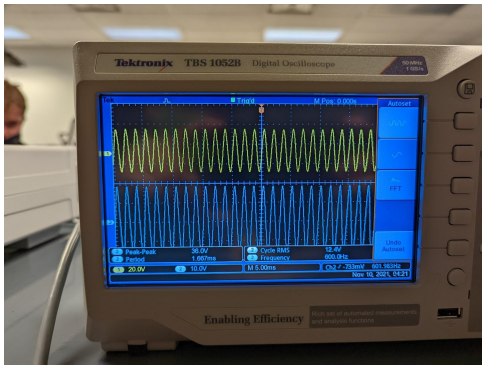
1. Build the given circuit with a 220Ω resistor and 10uF capacitor.
2. Connect the function generator to the circuit input.
3. Connect the oscilloscope channel 1 to the input and channel 2 to the output of the filter.
4. Adjust the function gen. frequency to a higher and lower range to see the impact on the output.
5. Take photos at each frequency range.

Part 4:

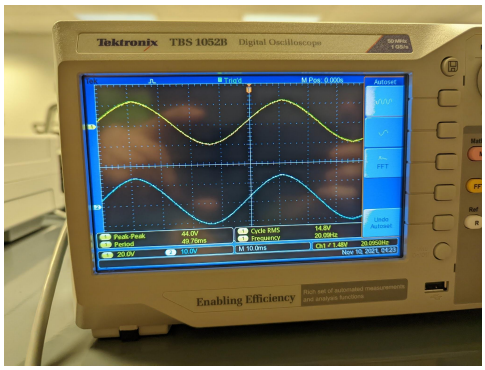
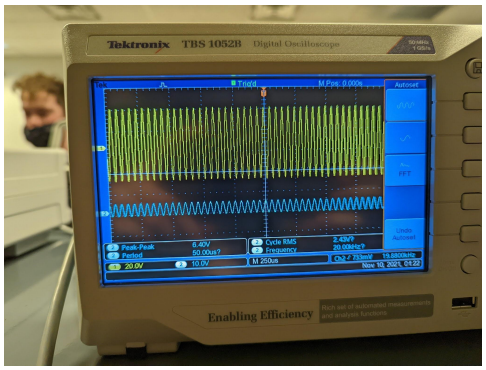
1. Build the given circuit with a 220Ω resistor and 4.7mH inductor.
2. Connect the function generator to the circuit input.
3. Connect the oscilloscope channel 1 to the input and channel 2 to the output of the filter.
4. Adjust the function gen. frequency to a higher and lower range to see the impact on the output.
5. Take photos at each frequency range.

Experimental Results

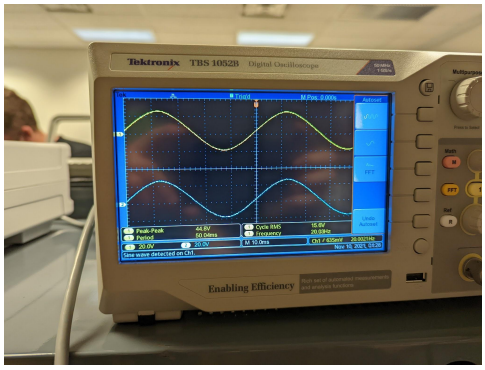
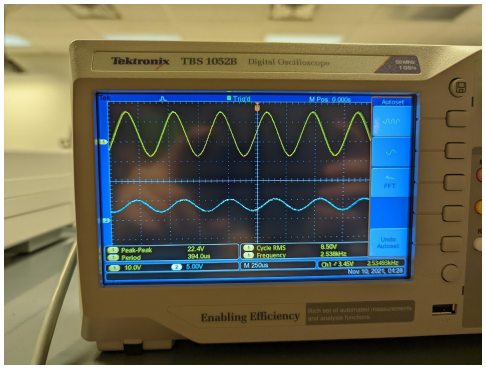
Part 1: High-pass filter (RC)

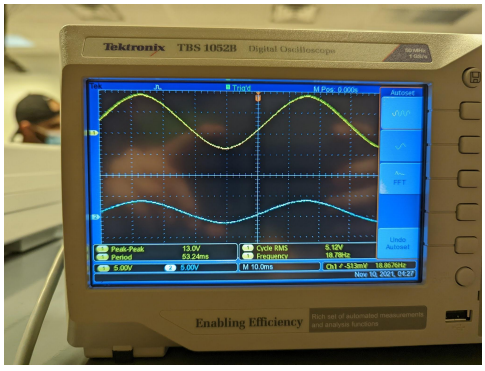
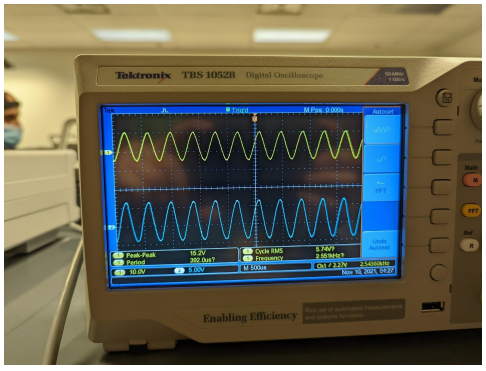
Part 2: Low-pass filter (RL)

Part 3: Low-pass filter (RC)

Part 4: High-pass filter (RL)

Discussion

The RC high pass filter circuit was able to clearly demonstrate to us that it allows high frequency to go through while filtering out the low frequencies. The RL low pass filter was able to demonstrate to us that it allows low frequencies while filtering high frequencies. The alternate forms of these circuits are shown in part 3 and 4 where it switches the states of filtering by reordering the circuit (inductor/capacitor first). One adjustment to possibly see the distinct differences more clearly would be to use the correct inductors/capacitors as we had to improvise given the available components.

Conclusion

In conclusion, through the use of an oscilloscope, function generator, and built circuits, we were able to test different forms of RCL filters. The importance of the capacitor/inductor's position was shown by the various types of filters they would produce. One adjustment to the experiment to possibly see the distinct differences more clearly would be to use the correct inductors/capacitors. We had to change the values of those said parts as we had to improvise given the components provided to us by the instructor. Overall we were able to learn a lot about RCL filters through experimentation and observation.

References

Principles of Electric Circuits: Conventional Current Version, 10th Edition, Thomas L. Floyd, Pearson, 2019. (ISBN-13: 9780134879482)

Appendices

1A. Ohm's Law - a law stating that electric current is proportional to voltage and inversely proportional to resistance. (Oxford Languages, 2021)
1B. Breadboard - a construction base for practicing electronic circuits.
1C. Falsad Online Circuit Simulator: https://www.falstad.com/circuit/