Experiment 3

**Submission Template**

# The following should be included in your experimental checklist. Everything should be labeled and easy to find. Credit will be deducted for poor labeling or unclear presentation. ALL PLOTS SHOULD INDICATE WHICH TRACE CORRESPONDS TO THE SIGNAL AT WHICH POINT AND ALL KEY FEATURES SHOULD BE LABELED.

**Hand written schematics are required for physically built circuits, ONLY!!!**

# Part A – (12 pts)

1. What value did you calculate for the resistance of the inductors? How did this compare to the measured resistance? (4 pt)

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1. Based on your RL circuit analysis of the cutoff frequency, what inductance did you experimentally determine for each inductor? How do your values compare to the calculated value? How do these compare to the measured L using the RLC meter. (8 pt)

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# Part B – (30 points)

B.1 Include the following plots (both coils):

1. M2K/Analog Discovery plots of the input voltage, the current through resistor R and LC voltage of the RLC circuit. (4 pt)
2. Air coil
3. Ferrite coil
4. *LTspice* plot of the transient response of your RLC circuit with the values of L and R that produce results close to those observed in the experiment. Plot the same parameters as above. (4 pt)
   1. Air coil
   2. Ferrite coil

B.2 Answer the following questions (for both coils):

1. What amplitude did set for the function generator and what was the current through R? (2 pt)

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1. What are the measured values for the capacitance of your capacitor C and the resistance of your resistor R? (2 pt)

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1. What are your best estimates for Lest for both coils from part A? That is, what are the values closest to what you measured with the impedance bridge? (2 pt)

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1. What did you calculate for the expected resonant frequencies of your two circuits? (Please show what values you substituted into the equation.) (2 pt)

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1. At what frequencies did you actually measure the resonances of your circuits? (2 pt)

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1. What values did you get for Lest using the measured resonant frequency? (Please show what values you substituted into the equation.) (4 pt)

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1. What values of L did you get when you adjusted your *LTspice* circuits to match the experimental response of the circuit you built? (4 pt)

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1. List all values you have found for both inductors. Based on these what do you think is the best estimate and why? Include the RLC meter measurement. (4 pt)

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# Part C – (16 points)

C.1 Include the following plots (both coils):

1. *LTspice* plot of the initial 3 traces of the ratios for the transformer when L1 = 4mH and L2 = 1mH.
2. *LTspice* plot of the three ratios that prove the transformer works at 1kHz and up. (2 pt)
3. *LTspice* plot of the three ratios that prove the transformer works at 100Hz and up. (2 pt)

C.2 Answer the following questions (for both coils):

1. In what frequency range did the original transformer function as it should? (2 pt)

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1. Use your output traces and the three design criteria equations to describe how you know these values satisfy the criteria for an ideal transformer. (2 pt)

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1. What are the values of L1 and L2 you chose to obtain correct transformer operation for the range of 1kHz and up? (2 pt)

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1. What are the values of L1 and L2 you chose to obtain correct transformer operation for the range of 100Hz and up? (2 pt)

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1. What design advantages exist for circuits that are to work at higher frequencies rather than at lower frequencies? (2 pt)

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# Part D – (14 points)

D.1 Include the following plots:

1. M2K/Analog Discovery plot with the input and output currents of your transformers. This is determined by the voltage across R1 and Rload. (4 pt)

D.2 Answer the following questions:

1. What is the inductance of your secondary coil? (2 pt)

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1. What is the value of *a* for your transformer? (2 pt)

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1. List the ratio of the secondary (load side) current to the primary (source side) current in your transformer at the frequencies requested. (3 pt)

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1. At what frequency did your transformers work as expected? How do you know this? To answer this question, you will need to analyze the voltages observed and show how closely they satisfy the basic formulas for the transformer. (3 pt)

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**Other (8 points)**

1. Are all plots and figures included, labeled and are they placed in a logical order. Can they be fully understood without reading the associated text? (8 pt)

**List group member *responsibilities (0 to -4 pts)*.**

Note that this is a list of *responsibilities*, not a list of what each partner did. It is very important that you divide the responsibility for each aspect of the experiment so that it is clear who will make sure that it is completed. Responsibilities include, but are not limited to, reading the full write up before the first class; collecting all information and writing the report; building circuits and collecting data (i.e. doing the experiment); setting up and running the simulations; comparing the theory, experiment and simulation to develop the practical model of whatever system is being addressed, etc.

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**Summary/Overview** (0 to -10 pts) There are two parts to this section, both of which require revisiting everything done on this experiment and addressing broad issues. Grading for this section works a bit differently in that the overall report grade will be reduced if the responses are not satisfactory.

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***Experiment 3***

***Checklist w/ Signatures for Main Concepts***

INSERT SIGNED COPY OF CHECKLIST BELOW (OR ADD SCANNED PDF VERSION)



***Experiment 3***

***Hand Drawn Schematics***

INSERT HAND DRAWN SCHEMATICS FOR ALL CIRCUITS BUILT