Interdisciplinary STEM Teaching & Learning Conference

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Putting Lab into Lecture

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PUTTING LAB INTO LECTURE

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PUTTING LECTURE INTO LAB

Engineering classes at any level are separated into two separate components, lecture and lab. Often these two classes have little to no direct relationship, being taught by two different instructors with different objectives. Students struggle to see the relationship between the theory from lecture and the applications in lab. To bridge the gap, lab must be brought into the lecture. Students must experience the theory by building, measuring, and exploring the concepts. Instructors can bring these experiences into the classroom by breaking labs up into smaller activities that are closely related to the theory. This is not to say that larger labs should be eliminated but augmented with these minilabs embedded in the class. Example applications from electrical engineering courses are to be shared and discussion of how to apply this in various courses.

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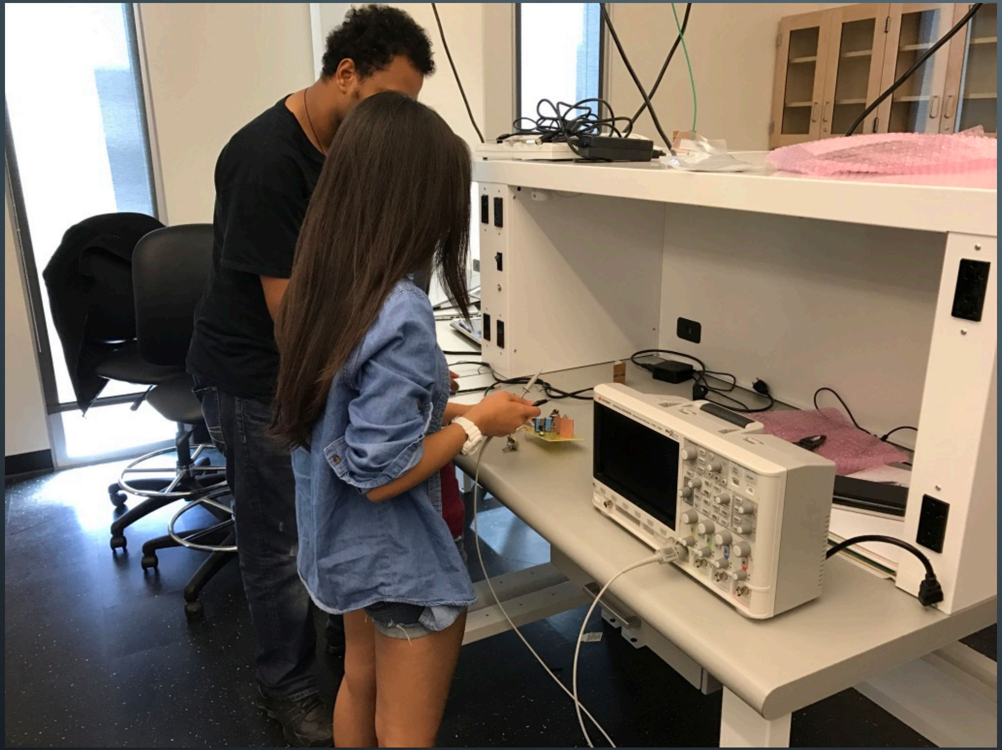
- Engineering Programs
  - Electrical Engineering
  - Mechanical Engineering
  - Biomedical Engineering
- Hands on program

LECTURE AND LAB COMBINATIONS



LECTURE AND LAB COMBINATION

- UNV 112
  - Time

LECTURE NEEDS SOME LAB

- How do we add activities to the class that will augment the lecture and the lab?

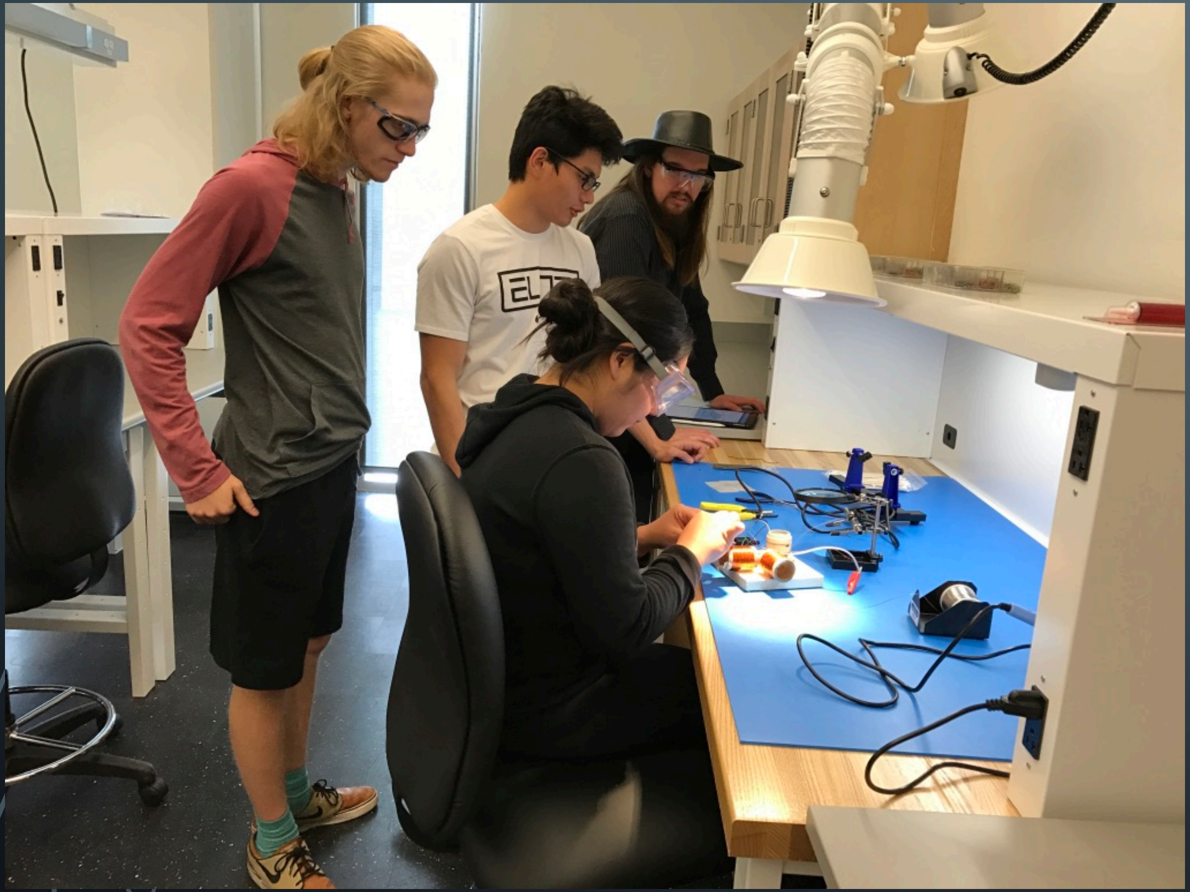
HOW DO WE ADD THE LAB INTO A CLASSROOM

- Have class in the lab

HOW DO WE ADD THE LAB INTO A CLASSROOM

- Make labs shorter

HOW DO WE ADD THE LAB INTO A CLASSROOM

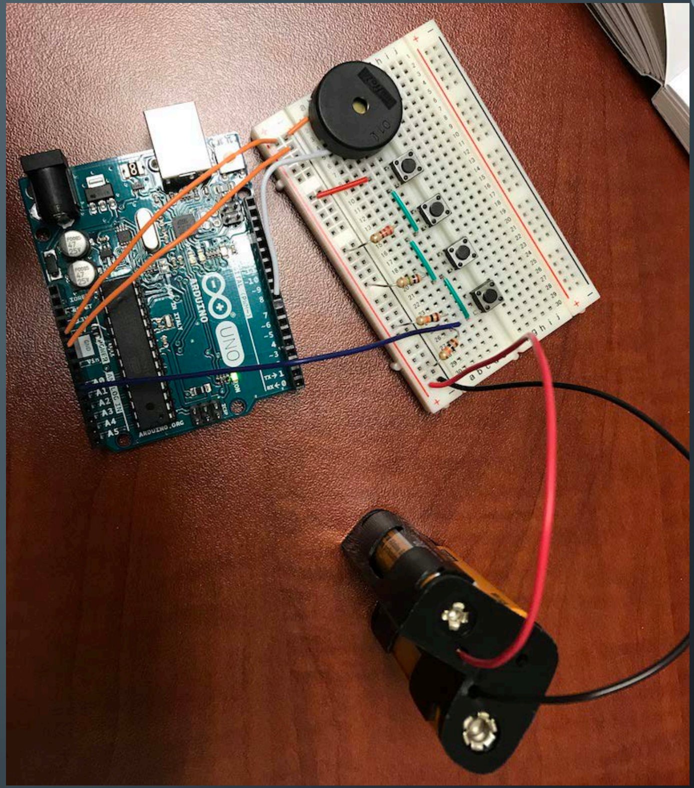


- Find the link between the theory and the lab

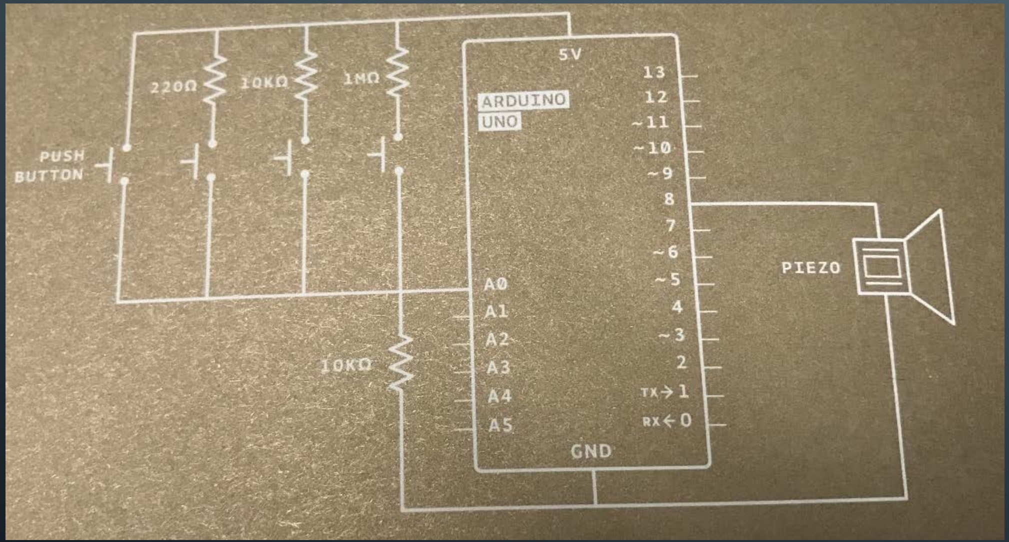
EXAMPLES

EXAMPLE

Microcontroller



Resistor Ladder

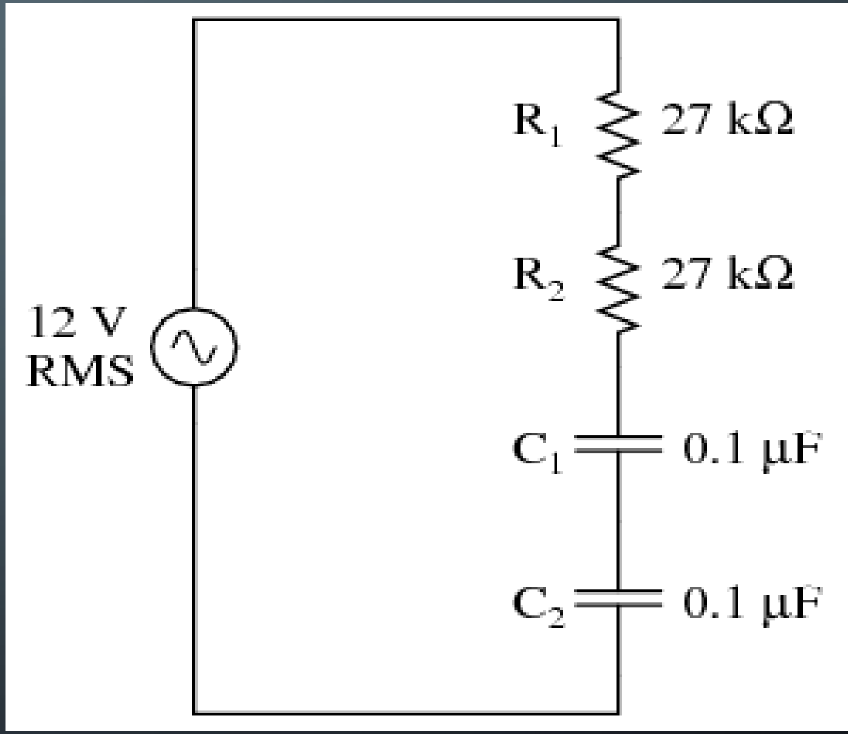


1. Explain how resistors in a resistor ladder are connected?
2. When might a resistor ladder be useful (practical application)?
3. Find the resistance that is passed to the input pin when each combination of buttons is pushed. (show your work)

EXAMPLE

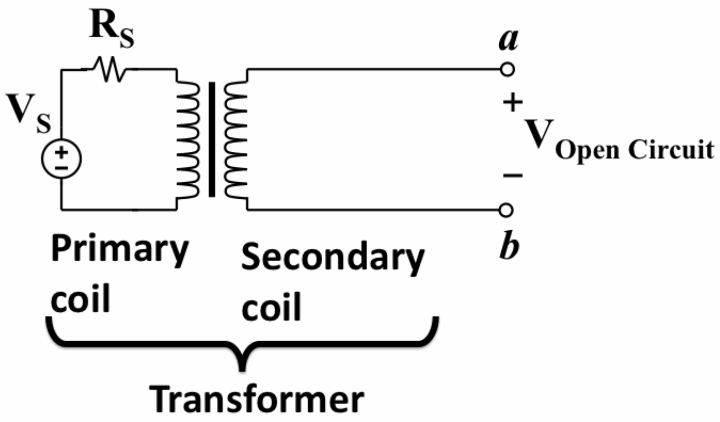
PHASE SHIFT

- Measure voltage drops across each component.
- Measure the voltage supply.
- Add the voltage drops and compare to the total voltage supply.
- Take phase angles into consideration do the voltage drops add to total supply voltage?
- Measure the voltage drop across both resistors and compare to the sum of the voltage drops across each resistor. Are both the resistors' voltage drop waveforms in-phase with each other?
- Measure the voltage drop across both capacitors at once and compare it to the sum of the voltage drop across each capacitor. Are both the capacitors' voltage drop waveforms in-phase with each other?
- Given the power supply frequency is 60Hz (the standard household power frequency in the United States), calculate the impedance for all components.
- Determine the voltage drops using Ohn's law. Do the polar magnitudes of the results closely agree with the readings from the voltmeter?

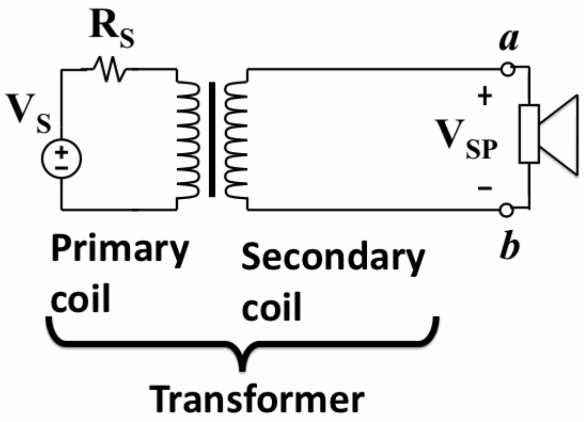


EXAMPLE ~ AC POWER

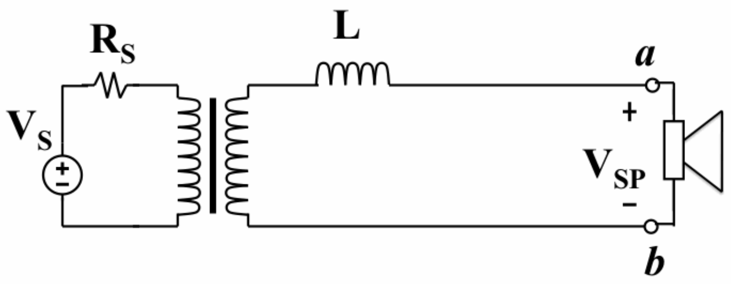
Circuit #0 (without load)



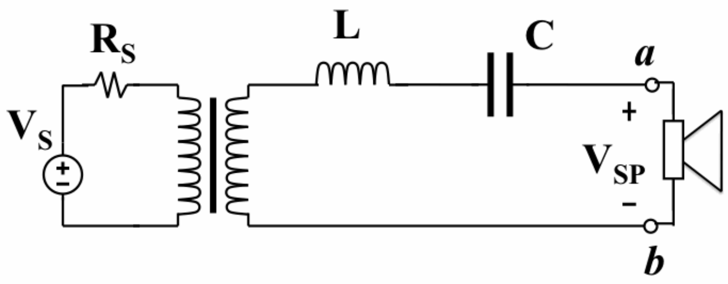
Circuit #1: Speaker as the load



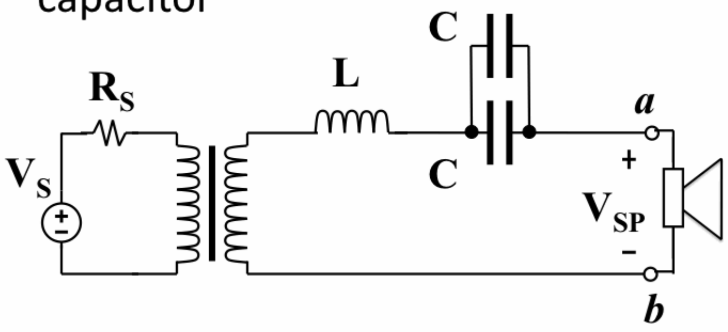
Circuit #2: Speaker as the load, inductor as a model for transmission line



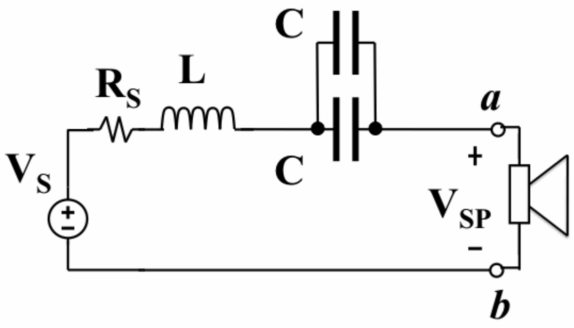
Circuit #3: Speaker as the load, L as a transmission line, C as a compensating capacitor



Circuit #4: Same as circuit #3, with a doubled compensating capacitor



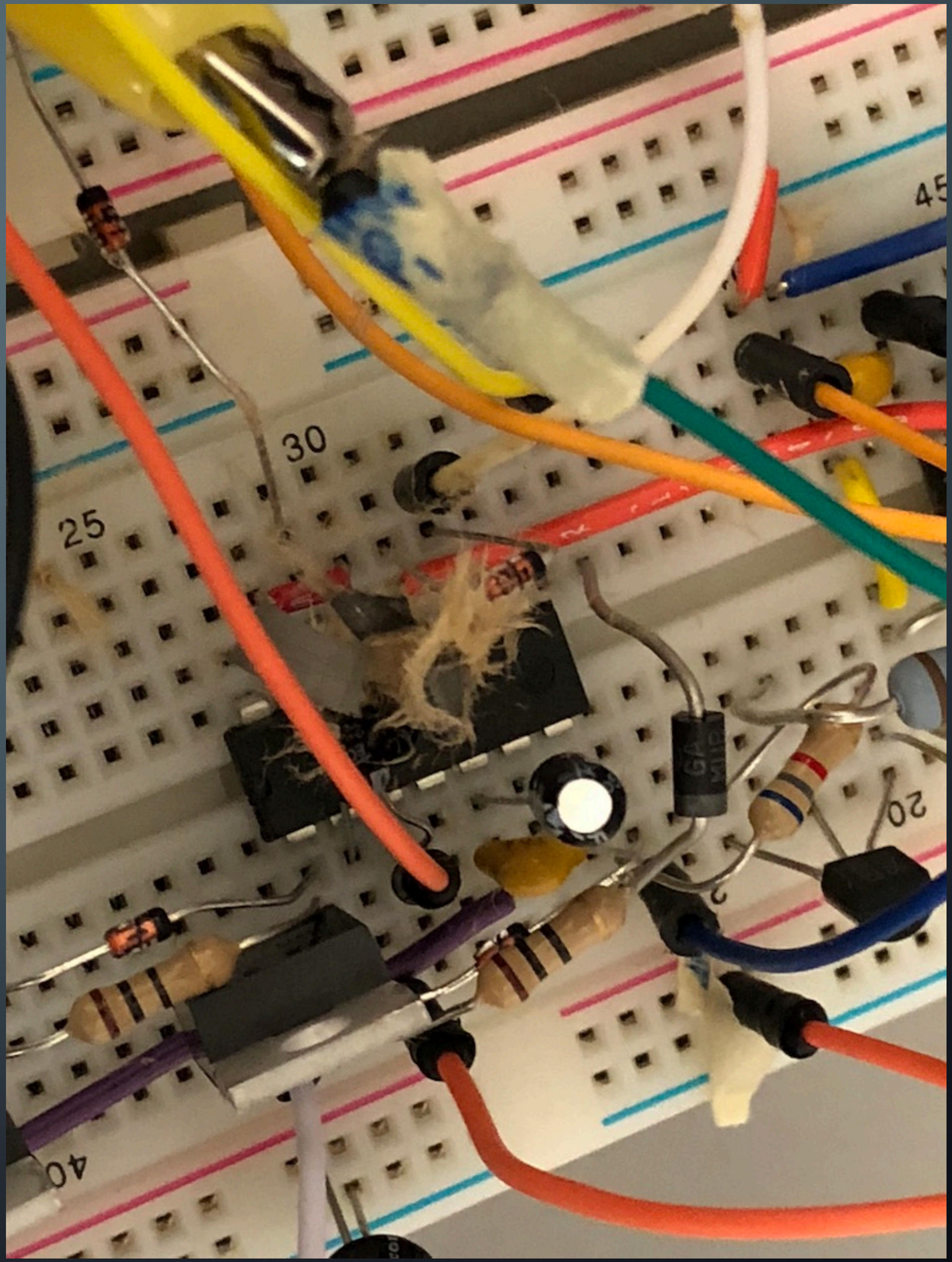
Explorations: No transformer, doubled compensating capacitor



HOW TO APPLY THIS

- Think outside the box
- Use the resources that have been created in the past
  - Take a look at the lab companions for your textbooks
  - Free online resources
    - instructables.com
- Start small

STUDENTS STILL DON'T LISTEN



QUESTIONS

THANK YOU!