CS 3651 Skill Demo 6: Powering Your Circuit

NAME____________________  GTID____________________

Goals:
Know how to choose appropriate resistors for “dummy loads” to approximate a circuit.
Understand how to use a linear regulator
Understand how to use a full-wave rectifier to convert AC to DC
Use an oscilloscope to see the “ripple” from a full-wave rectifier
Understand the role of capacitors to reduce the ripple.

Tools/supplies:
Teensy
laptop and mini USB cable (maybe)
breadboard
5V 7805 (or similar) linear regulator
AC to AC Transformer
diodes (rectifier type)
capacitors
resistors

Background:
All videos from Skill Demos 1-5
CS 3651 - APIA - full wave rectifier - Part 1/2
CS 3651 - APIA - full wave rectifier - Part 2/2
CS 3651 - APIA - using an oscilloscope
Internal Resistance
How to test the internal resistance of a battery

Relevant section of book (Practical Electronics for Inventors 2000 edition):

Motivation:
Now that you've learned how to make basic circuits, it is time to cut the cord – the USB cord to your computer that is! The following skill demo will show that you know how to power your circuits using batteries or AC wall current (using a step-down AC transformer).
1) Using a linear regulator, convert 9VDC from your battery to 5VDC. Use an appropriate resistance and wattage resistor as a “dummy load” to make sure that your circuit is working correctly. Show your circuit working to an instructor.

Resistance: _______________ Wattage: _______________

Initials_________________ Date__________________ Time_________________

2) Re-program your Arduino to flash its on-board LED (the Blink example program). UNPLUG THE USB CABLE from the laptop. Use your linear regulator to power your Arduino by connecting the 5V out from the regulator to Vcc on your Arduino and the common line on the regulator to the ground on your Arduino. Please double check your work before attaching your battery to the circuit!!!!

Use your multimeter to determine the max current your Arduino is taking while it is running the Blink program. REMEMBER THAT YOU PUT YOUR AMMETER IN SERIES with the circuit to measure current. What is the maximum power that your Arduino is taking? Find/make a new “dummy load” resistor that you can use to simulate the load of the Arduino.

Max Current:_______________ Max Power:_______________ Dummy Load Resistor:_________

Initials_________________ Date__________________ Time_________________
3) Create a half-wave (one diode) and a full-wave rectifier circuit. Use one of the 12 or 24VAC power supplies and the oscilloscopes in the lab to demonstrate that your circuit works correctly.

Draw the input wave form (include a 0V line, maximums, and minimums for all these drawings):

Draw the output wave form using the half-wave rectifier:

Draw the output wave form using the full-wave rectifier:

Initials_________________ Date_________________
Time___________________
4) Put your dummy load resistor in the circuit (is it rated for the new wattage?). Try different capacitor values to help reduce the ripple in the circuit. Some capacitors, especially the larger ones like electrolytics, have a polarity. Make sure to put them in the right way or else they might “blow up.” Try to get your ripple <1.0V. What size capacitor did you have to use? What is the output DC voltage of the circuit?

Draw the output wave form with the dummy load resistor:

Capacitor size:____________________ DC output voltage: ________________

Take out your dummy load and put a larger resistor (less load) in. What happens to the ripple? What happens when there is no load?

Draw the output wave form with the larger resistor:

Draw the output wave form without the dummy load resistor:

Initials_________________ Date__________________ Time________________
5) Hook up your linear regulator to the circuit to convert your DC voltage to 5VDC. Use your dummy load to emulate your Arduino on the 5VDC side. Construct the circuit so that your ripple on the 5VDC side is <0.5V. Show the instructor your circuit working and its output waveform (with the dummy load!) on the oscilloscope.

Draw the output wave form:

Initials_________________ Date__________________ Time_________________

6) Use your circuit to power your Arduino.