Experiment #3  Direct Currents

About this experiment

This experiment is composed of three parts.
1. **In part 1**, you will learn how to use ADC to acquire the I-V curve of a resistance and some other nonlinear elements.
2. **In part 2**, we will only cover 2.1, and 2.2, and they will make you know how to measure the conductivity of a material.
3. **In part 3**, we will only conduct some sub-experiments.

Some requirements on Lab Report

1. **This is about the I-V relation for some elements:**
   1. Use the ADC to acquire the signal on a resistance, then measure the two resistance you used. In your lab report draw the curve, and then verify Ohm’s Law.
   2. Use the ADC to acquire the I-V curve of a zener diode, then draw the I-V curve in Excel. Then use the ADC to get the I-V curve of a light bulb, draw the I-V curve and indicating its sweeping direction.
   3. Set up the transistor circuit. Get the I-V curve, say $I_c$ VS $V_{ce}$ for the case $I_b=0.01, 0.02, 0.03, 0.04mA$, plot all the I-V curve in a same figure. Then find out the relation between $I_c$ and $I_b$, and thus the amplification factor of the transistor by linear fitting.
2. In part 2, you should include these in your lab report:
   1. Measure the resistance of the copper wire using the multimeter, then use the data provided in the lab manual to calculate the conductivity of copper, compare with the theoretical value.
   2. Connect a known resistor in series with the parallel-wire electrodes, and measure the voltages on both of them. From the resistor calculate what the current is, and then calculate the resistance between these two electrodes, and thus calculate the conductivity of water.
3. In part 3, you should include these in your lab report:
   1. Setup a potentiometer and measure the output voltage at different angles (every 10°), then list all your data in a table, and draw a figure to show the relation between the output voltage and the angle. Calculate the parameter $\eta=\Delta V/\Delta \alpha$ by fitting your curve.
   2. Measure resistance of each resistor, and the equivalent resistance, then verify the relation about the equivalent resistance.
   3. Measure the resistance of one resistor and the equivalent input resistance. Compare with theoretical value. Then measure the voltage drop at each element of the chain, draw a figure $\ln V_i/VS i$, then compare with theory by linear fitting.
   4. Setup a bridge circuit, and balance it. Use this circuit to measure the resistance of the thermistor at room temperature. Use the relationship between temperature and resistance, which could be found in part 1.4, to calculate the room temperature.
   5. Measure the open-loop voltage of a battery, then apply a load resistance $R_l$ and measure the
voltage across it. Calculate the internal resistance of the battery.

Problems

1. Sketch a figure to show the I-V curve for an ideal diode. Is it possible that an ideal diode is also a flashing diode? Why?
2. Sketch the I-V curve of a bulb when the scanning frequency is too high, say about 1 KHz.
3. Google the conductivity of pure water, why is it different from the value you got from lab?

Other requirements on Lab Report

1. In your lab report, try to derive all the equations used in your analysis part.
2. When reporting a data, do not forget its unit.
3. Error estimation and propagation are not required. However, percentage difference has to be calculated while verifying equations; and you should discuss the origin of errors.