COMPLEX CIRCUITS

(L-21)

As you know, there are circuits that cannot be simplified using equivalent series and parallel combinations. In such cases, Kirchoff's Laws must be used to analyze the situation. This lab will allow you to work with such a circuit.

PROCEDURE--DATA

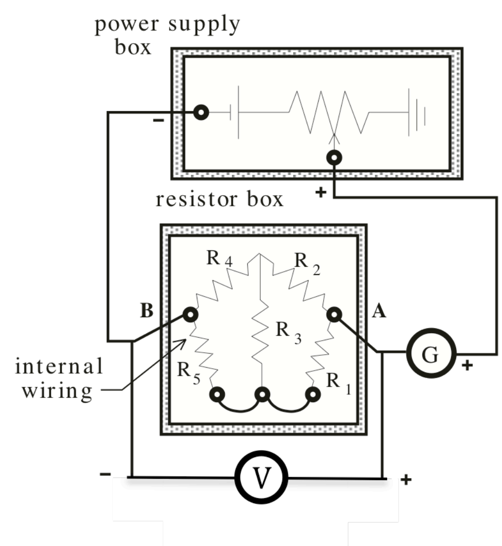
Part A: (the circuit)

a.) Hook up the circuit shown to the right (note that the dark lines are connections you have to make whereas the light lines denote internal wiring).

b.) Using the meters, make whatever data you think is appropriate to determine experimentally the equivalent resistance of the circuit. Notice that although the Galvanometer does not say so, maximum deflection is associated with $5x10^{-4}$ amps.

c.) Use the Impedance Bridge to determine the resistance of the isolated resistors, then hook across resistors R_1, R_3, and R_5 and measure the equivalent resistance of the circuit. Call this R_{imp}

COMPLEX CIRCUIT



CALCULATIONS

Part A: (the *experimental* equivalent resistance of the complex ckt.)

1.) Use the ammeter/voltmeter data you took in *Part b*, determine the experimental equivalent resistance for the circuit. Call this R_{exp} .

2.) Do a % comparison between R_{exp} and the equivalent resistance's actual value (i.e., the Impedance Bridge value R_{imp}). Comment.

Part B: (the *theoretical* equivalent resistance of the complex ckt.)

3.) Draw the circuit *full page*. On the drawing, put in the resistance values along with their algebraic symbols and assuming the battery voltage is the variable V_o. Calling the current from the battery i_o, define all the currents needed in the circuit using node equations to simplify (you should be able to reduce the number of unknowns from six to three with the node equations). Identify three loops (one of these must include the power supply).

4.) Using numerical values of all resistors (instead of using the general variable form--R_1, R_2, etc.):

a.) Write out your three LOOP EQUATIONS. Assume the battery voltage for this is 1 volt.

b.) Put the LOOP EQUATIONS into DETERMINATE FORM.

c.) Use what you know about matrix manipulation on your TI-85 to determine the theoretical current being drawn from the battery.

d.) Use your solution from *Part 4c* to determine the theoretical equivalent resistance of the circuit. Call this R_{theo}.

e.) Do a % comparison between R_{theo} and your IMPEDANCE BRIDGE value R_{imp}. Comment.

QUESTIONS

I.) When you measured the Impedance Bridge value for R_3, you had the external wires between R_1, R_3 and R_5 shown in the sketch at the top of the previous page disconnected. How would the Impedance Bridge value have changed is you hadn't disconnected those wires before making that measurement (i.e., gone up, down or stayed the same), and if there was a difference from what you actually measured, explain why the difference would have arisen.