Electric Circuits I

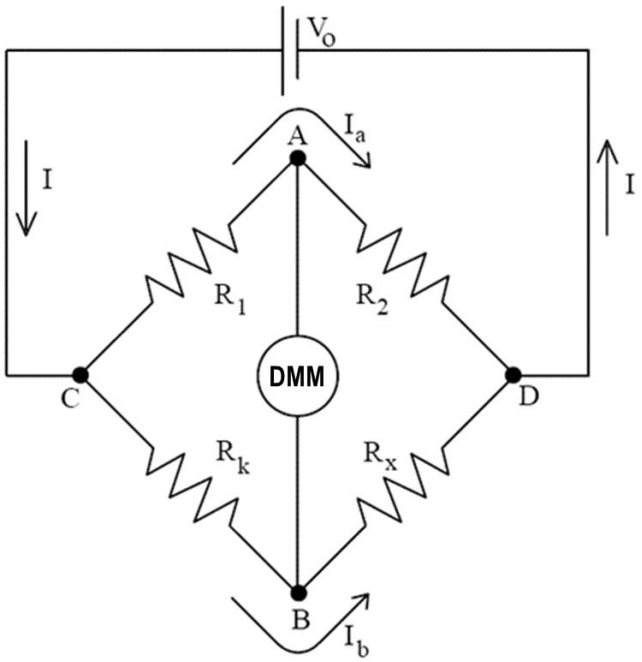
Laboratory 3: Wheatstone Bridge

Objective:

To experimentally verify the operation of a typical bridge circuit to measure the resistance of an unknown resistor.

BACKGROUND & THEORY

The circuit diagram of a Wheatstone bridge is shown in the figure below. The resistor R_k is known, and the two resistors R_1 and R_2 have a known ratio R_2/R_1, although their individual values may not be known. The unknown resistor is R_x. A DMM measures the voltage difference V_{AB} between nodes A and B. Either the known resistor R_k or the ratio R_2/R_1 is adjusted until the voltage difference V_{AB} is zero and no current flows through G. When $V_{AB} = 0$, the bridge is said to be "balanced".



PRELAB:

Answer the following questions and complete the derivations **prior to coming to the lab**.

- On which circuit laws is the operation of this bridge based?
- Derive the Wheatstone bridge expression, $R_x/R_k = R_2/R_1$.
- Derive expressions for the total power delivered by the voltage source and the power absorbed by each resistor.

LABORATORY PROCEDURE:

1. Build the circuit above using the following specific component values:

   $V = 10\ V_{DC}$, $R_1 = 2.2\ k\Omega$, $R_2 = 5.6\ k\Omega$,

3. You will use a decade resistance box for R_k and you will be provided with a resistor of unknown value, R_x.

4. Using this circuit, find the value of R_k that makes VAB zero. Determine the value of the "unknown" resistor.

5. Measure R_x using a DMM.

6. Compare the measured value to what you determined using the Wheatstone Bridge. If there is a large discrepancy, recheck all measurements.

7. Get another R_x which has the same theoretical resistance (same color code) and repeat Steps 3-4.

8. Compare the value measured to what you determined using the Wheatstone Bridge in Step 6. If there is a large discrepancy, recheck all measurements.

9. Compare the values from Steps 5 and 7. If they are different, explain.

10. Calculate the total power delivered by the voltage source and the power absorbed by each resistor, using the expressions derived in the pre-lab.

Laboratory Report:

Include the measurements, computations, and answers to questions from the laboratory procedure. Clearly label all steps.