

# Electric Circuits I

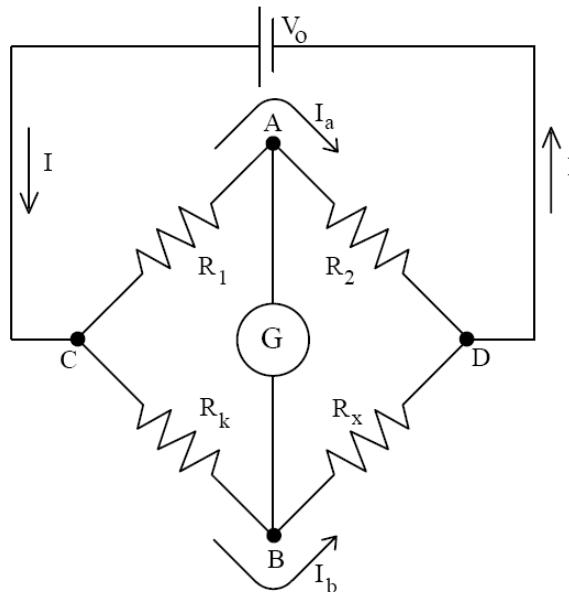
## Laboratory 3: Wheatstone Bridge

### 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”.



## LABORATORY PROCEDURE:

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

$$V = 10 \text{ V}_{\text{DC}}, \quad R_1 = 1 \text{ k}\Omega, \quad R_2 = 10 \text{ k}\Omega,$$

2. You will use a decade resistance box for  $R_k$  and you will be provided with a resistor of unknown value,  $R_x$ .
3. Using this circuit, find the value of  $R_k$  that makes  $V_{AB}$  zero. Determine the value of the "unknown" resistor.
4. Measure  $R_x$  using a DMM.
5. Compare the measured value to what you determined using the Wheatstone Bridge. If there is a large discrepancy, recheck all measurements.
6. Get another  $R_x$  which has the same theoretical resistance (same color code) and repeat Steps 3-4.
7. Compare the value measured to what you determined using the Wheatstone Bridge in Step 6. If there is a large discrepancy, recheck all measurements.
8. Compare the values from Steps 5 and 7. If they are different, explain.
9. 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.

## Pre-Lab:

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.