Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

ELE 202
Electric Circuit Analysis
LAB COVER PAGE for Part I submission.

Lab #:	1	**Lab Title:**	Introduction to Basic Lab Equipment, Tools, & DC Measurements

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Section #:	5
Submission date and time:	18 / 5 / 2023 - 10:00
Due date and time:	18 / 5 / 2023 - 10:00

Document submission for Part I:

- A completed and signed "COVER PAGE – **Part I**" has to be included with your submission. The report will not be graded if the signed cover page is not included.
- Your completed handwritten pages of **Section 4.0** should be scanned (via a scanner or phone images), together with the required MultiSIM images. **Note:** *MultiSIM results must be generated using the Department's licensed version of MultiSIM, and the captured screenshots should show your name (at the center-top) and the timestamp (at the bottom-right corner of your screen).*
- Collate and create a ***.pdf*** or ***.docx*** file of the above, and upload it via D2L **any time prior to the start of your scheduled lab**. Upload instructions are provided on D2L.

Zero marks will be assigned for the entire lab if this Part I is not submitted prior to your scheduled lab.

**By signing above, you attest that you have contributed to this submission and confirm that all work you have contributed to this submission is your own work. Any suspicion of copying or plagiarism in this work will result in an investigation of Academic Misconduct and may result in a "0" on the work, an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: www.ryerson.ca/senate/current/pol60.pdf.*

2.0 OBJECTIVES

- To introduce use of MultiSIM circuit simulation tool for capturing and analyzing circuits,
- To familiarize with the operation of basic electrical equipment such as a DC Power Supply (PS) and Digital Multimeter (DMM).
- To construct and test basic electrical circuits using a Breadboard device,
- To properly use a Digital Multimeter (DMM) to measure DC voltage, current and resistance.
- To learn the Standard Resistor Color-Code scheme necessary to read resistor values and tolerances.

3.0 REQUIRED LAB EQUIPMENT & PARTS

- Digital Multimeter (DMM) and Power Supply (PS)
- ELE202 Lab Kit: various components, breadboard, wires and jumpers.

4.0 PRE-LAB: ASSIGNMENT

(a) Use the Standard Resistor Colour-Code Chart in **Figure 1.0f** to: **(i)** determine the numerical value, tolerance and acceptable resistance range for each colour-coded resistor listed in **Table 1.0a**, and **(ii)** identify the corresponding 4-band colour codes of each resistor value listed in **Table 1.0b**. (Note: 1 kΩ = 1x10^{3}Ω = 1000 Ω)

Lab workspace

Resistor	Color of Bands				Color Code Value	Tolerance (%)	Range of Acceptable Values	
	1st band	2nd band	3rd band	4th band			Minimum	Maximum
1	Orange	Orange	Black	Red	33	2	32.34	33.66
2	Green	Violet	Yellow	Gold	570000	5	541500	598500
3	Blue	Red	Red	None	6200	20	4960	7440
4	Yellow	Violet	Orange	Silver	47000	10	42300	51700

Table 1.0a

Resistor Value	Colour of Bands			
	1st band	2nd band	3rd band	4th band
220 Ω ± 5%	Red	Red	Brown	Gold
620 Ω ± 2%	Blue	Red	Brown	Red
5.6 kΩ ± 2%	Green	Blue	Red	Red
470 kΩ ± 5%	Yellow	Violet	Yellow	Gold

Table 1.0b

(b) The simple DC circuit in **Figure 2.0** is powered by a **15 volts** DC battery input-source (**V_I**) which will cause currents to flow through the resistors, **R_1**, **R_2** and **R_3** as illustrated. When current flows through a resistor, it creates a voltage across the resistor as governed by the **Ohm's Law** expression, **$V = I.R$**. The **Kirchhoff's Current Law** (KCL) states that the sum of all currents entering (or leaving) a node is zero. Therefore, $I_1 + (-I_2) + (-I_3) = 0$, resulting in $I_1 = I_2 + I_3$.
Even though the basic circuit laws may not be fully covered in class as yet, you may use the above circuit law expressions to determine the missing values in **Table 2.0**. Show your analysis on the below workspace provided. **Note:** 1 **mA** = $1\text{x}10^{-3}$**A** = 0.001**A**; and 1 **kΩ** = $1\text{x}10^{3}$**Ω** = 1000**Ω**

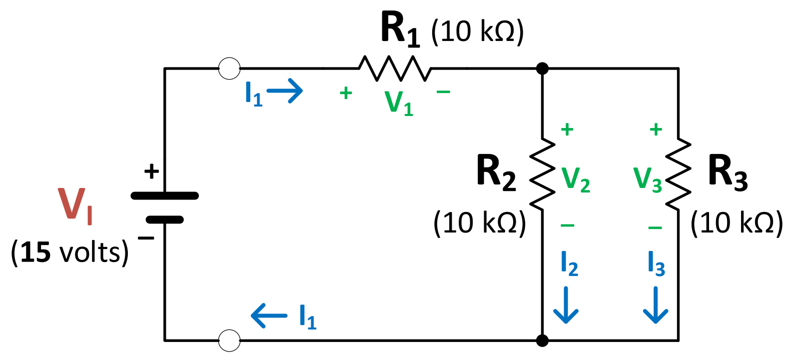

Figure 2.0: Simple D.C. circuit for voltage and current measurements

Pre- Lab workspace

V_1	V_2	V_3	I_1	I_2	I_3
10	5	5 volts	1	**0.5** mA	0.5

Table 2.0

What relationship exists between voltages V_2 and V_3? and between currents, I_2 and I_3? Why?

V2 = I2R2 = 5 v   V3 = I3R3 => I3 = 0.5 mA   I1 = I2 + I3 = 1 mA

Was the voltage relationship $V_I = V_1 + (V_2$ or $V_3)$ established? If so, why would it be the case?

V1 = I1R1 = 10 v

If the resistor, **R_1** is replaced with a wire (i.e. make **R_1** = 0 Ω), intuitively what might the resultant value of the voltage, V_3 be? Explain.

V2 & V3 have same voltages of 5v as they are in parallel circuit I2 and I3 have same current of 0.5 mA as 1 mA of current is split equally due to some resistance and voltages.

(c) The circuit in **Figure 2.1** is a simple voltage-divider configuration that uses two resistors in series to create an output voltage, V_O which is a fraction of the input voltage, V_I. The basic circuit laws dictate that the circuit current, **I** and the resultant voltage division output, V_O of this basic circuit configuration can be expressed as:

$$I = \frac{V_I}{R_X + R_Y} = \frac{V_O}{R_Y} \quad \begin{array}{l} = 15 / (1000+500) \\ = 10\text{^}(-3)\ \text{mA} \end{array} \qquad V_O = \left[\frac{R_Y}{R_Y + R_X}\right] \cdot V_I \quad \begin{array}{l} = 15 * 5000 / 1500 \\ = 5\ \text{v} \end{array}$$

If the input voltage, V_I = **15** volts, and resistors R_X = **10** kΩ and R_Y = **5.0** kΩ, find the values of the output voltage, V_O and the circuit current, **I** by <u>using the above expressions</u>. Record the results in **Table 2.1**.

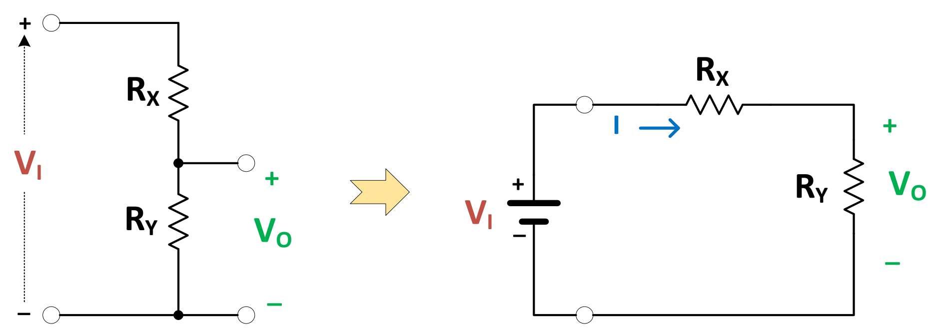

Figure 2.1: Simple voltage-divider circuit

Pre- Lab workspace

V_O	I
5	10^(-3)

Table 2.1

For the resistor values selected for circuits in **Figure 2.0** and **Figure 2.1**, and <u>comparing</u> your results in **Table 2.0** with those in **Table 2.1**, answer the following questions:

(i) Why would the value of $I = I_1$ and $V_O = V_2$ (or V_3)? Explain.

In fig 2.1, the same amount of current flows through the circuit and does not split hence, I & I1, V0, V2 & V3 are equal.

(ii) Would it be reasonable to conclude that resistor, R_Y value chosen must be equivalent to the value of parallel resistors, R_2 and R_3 combined? Why?

Yes