Ryerson University

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

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

| Lab #: | 3 | Lab Title: | Nodal & Mesh |
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| **Section #:** | 11 |
| **Submission date and time:** | 3/2/2023 - 17:00 |
| **Due date and time:** | 3/2/2023 - 17:00 |

**Document submission for Part II:**

- A completed and signed "COVER PAGE – **Part II**" has to be included with your submission, a copy of which is available on D2L. The report will not be graded if the signed cover page is not included.
- Scan your completed pages of **Section 5.0** and **Section 6.0** (via a scanner or phone images), together with any required In-Lab Oscilloscope screen-shot images.
- Collate and create a .pdf or .docx file of the above, and upload it via D2L **by 11.59 p.m. on the same day** your lab is scheduled. ***Late submissions will not be graded.***

**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.*

# 5.0 IN-LAB Experiment: IMPEMENTATION & MEASUREMENTS

## (a) *Circuit Reference Node*

1. Implement the circuit in **Figure 2.0a** on your breadboard using the resistor values as shown. Set the input D.C. source, **E** = **15V** on the power-supply and select node "**d**" as a *reference* node to which "COM" terminal of the DMM in the Voltmeter setting is connected to allow for direct measurement of the *unreferenced* voltage nodes.

2. With the "-" (or the reference) terminal of the DMM Voltmeter connected to the selected *reference* node, directly measure the voltages at nodes "**a**", "**b**", "**c**" and "**d**" (i.e. $\mathbf{V_a}$, $\mathbf{V_b}$, $\mathbf{V_c}$ and $\mathbf{V_d}$, respectively). Use the DMM Voltmeter to directly measure the voltage across resistors, $\mathbf{R_1}$ (=$\mathbf{V_{ab}}$), $\mathbf{R_2}$ (=$\mathbf{V_{bc}}$) and $\mathbf{R_3}$ (=$\mathbf{V_{cd}}$). Measure the current, **I** using the DMM set up as an Ammeter. From the above measured node voltages ($\mathbf{V_a}$, $\mathbf{V_b}$, $\mathbf{V_c}$ and $\mathbf{V_d}$), calculate the voltages $\mathbf{V_{ab}}$, $\mathbf{V_{bc}}$ and $\mathbf{V_{cd}}$. Record all your results in the below **Table 4.0**.

3. **Relocate** the circuit reference ground at node "**c**" shown in **Figure 2.0b**. Repeat **steps 1** and **2** above.

4. Turn OFF the Power Supply.

| | | Using *Reference* Node "**d**" | Using *Reference* Node "**c**" |
|---|---|---|---|
| **I** (mA) | Measured value => | 2.35 mA | 2.32 mA |
| $\mathbf{V_a}$ (Volts) | Measured value => | 14.99 v | 7.56 v |
| $\mathbf{V_b}$ (Volts) | Measured value => | 12.59 v | 5.08 v |
| $\mathbf{V_c}$ (Volts) | Measured value => | 7.78 v | 0 |
| $\mathbf{V_d}$ (Volts) | Measured value => | 0 | -7.5 v |
| $\mathbf{V_{ab}}$ (Volts) | Measured value => | 2.35 v | 2.35 v |
| | Calculated value => | 2.31 v | 2.31 v |
| $\mathbf{V_{bc}}$ (Volts) | Measured value => | 5.10 v | 5.10 v |
| | Calculated value => | 5.08 v | 5.08 v |
| $\mathbf{V_{cd}}$ (Volts) | Measured value => | 7.78 v | 7.785 v |
| | MultiSIM value => | 7.62 v | 7.62 v |

**Table 4.0:** Experimental results of the Figure 2.0 circuits

## (b) *Nodal and Mesh Analysis*

1. Implement the circuit in **Figure 3.0** on your breadboard using the resistor values as shown. Set the input D.C. source, **E** = **15V** on the power-supply.

2. ***Nodal Analysis***: Refer to the circuit of **Figure 3.0a**. Use node "**d**" as the ground *reference* node, and measure the node voltages $\mathbf{V_a}$, $\mathbf{V_b}$ and $\mathbf{V_c}$ with respect to this reference ground. Then measure the branch voltage, $V_X$ across resistor, $\mathbf{R_3}$ and the branch current, $I_X$ through resistor, $\mathbf{R_2}$.

3. ***Mesh Analysis***: Measure the branch currents $I_1$, $I_2$, $I_3$ and $I_X$, and then use these measured branch currents to determine the values of the mesh currents, $I_A$, $I_B$ and $I_C$ and the branch voltage, $V_X$. Record all your results in below **Table 5.0**.

4. Turn OFF the Power Supply

| | | ***Nodal*** Analysis | ***Mesh*** Analysis |
|---|---|---|---|
| $\mathbf{V_a}$ (Volts) | Measured value => | 14.99 v | |
| $\mathbf{V_b}$ (Volts) | Measured value => | 8.65 v | |
| $\mathbf{V_c}$ (Volts) | Measured value => | 7.60 v | |
| $I_A$ (mA) | Calculated value => | | 2.89 mA |
| $I_B$ (mA) | Calculated value => | | 2.25 mA |
| $I_C$ (mA) | Calculated value => | | 7.42 mA |
| $I_X$ (mA) | Measured value => | 2.7 mA | 2.65 mA |
| $V_X$ (Volts) | Measured value => | 7.4 mA | 7.39 mA |
| $I_1$ (mA) | Measured value => | | 2.9 mA |
| $I_2$ (mA) | Measured value => | | 2.26 mA |
| $I_3$ (mA) | Measured value => | | 7.4 mA |

**Table 5.0:** Experimental results of the Figure 3.0 circuits