Sekolah Pendidikan Profesional dan Pendidikan Berterusan (SPACE)

# JABATAN KEJURUTERAAN ELEKTRIK
# PUSAT PENGAJIAN DIPLOMA (PPD), SPACE
# UNIVERSITI TEKNOLOGI MALAYSIA
# KUALA LUMPUR

## DDWE 1711 ELECTRICAL ENGINEERING LABORATORY 1

## (CIRCUIT THEORY 1)

## EXPERIMENT 3
## THE SUPERPOSITION AND THEVENIN'S THEOREM

| | |
|---|---|
| **Group members** | **1.** |
| | **2.** |
| | **3.** |
| | **4.** |
| | **5.** |
| **Lecturer** | **:** |
| **Date** | **:** |

| No. | PO | CO | Student Marks | Marks |
|---|---|---|---|---|
| 1 | PO1 | CO1 | | 35% |
| 2 | PO2 | CO4 | | 40% |
| 3 | PO8 | CO5 | | 10% |
| | | Total Marks | | /85% |

**EXPERIMENT 1 : THE SUPERPOSITION THEOREM & THEVENIN'S THEOREM'**

**OBJECTIVES**

After doing this experiment; you will be able to:

1. construct a circuit with two voltage sources.
2. apply and verify the superposition theorem to linear circuits.
3. change a linear resistive network into all equivalent Thevenin circuit.
4. prove the equivalency of the resistive network with the Thevenin circuit.

**APPARATUS**

1. DC power supplies
2. Multimeter
3. Voltmeter
4. Ammeter (mA)
5. Decade resistance box

**COMPONENTS**

Resistors 1 kΩ, 2.2 kΩ, 3.3 kΩ, 3.9 kΩ, 6.8 kΩ.

**INSTRUCTION**

Show all calculations in the spaces provided in the Report Sheet.

**PROCEDURE**

**PART 1 : THE SUPERPOSITION THEOREM**

**A : MEASUREMENT OF CURRENTS AND VOLTAGE IN CIRCUIT WITH TWO SOURCES**

1. Obtain resistors listed in Table 1. Measure each resistor and record the measured values in Table l.
2. Connect the circuit shown in Figure 1.

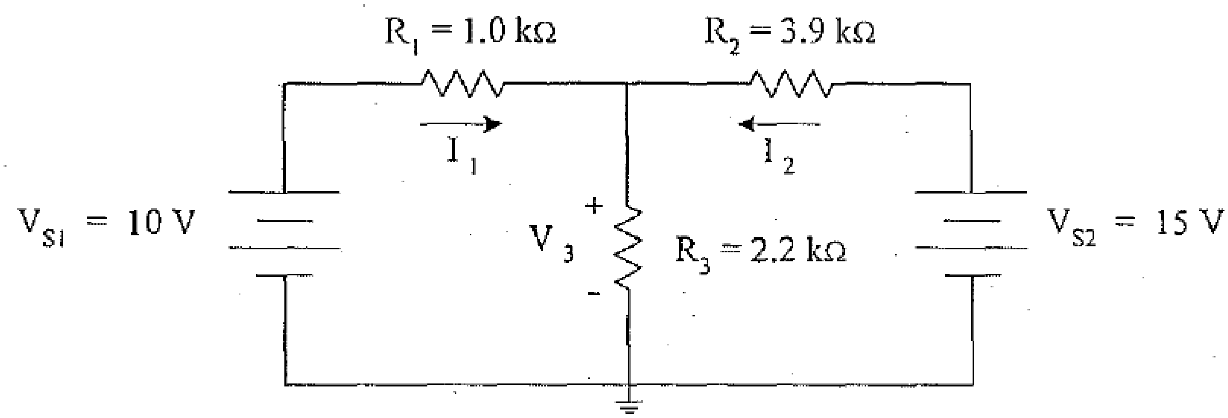


**Figure 1**

3. Switch on the power supplies. Measure the voltages across the power supplies using voltmeter. Adjust the voltage of the power supplies to the required values.
4. Use the ammeter to measure the currents, $I_1$ and $1_2$. Record the values in Table 2. (**Note:** Ammeter must be placed in **series** with the branch to be measured.)
5. Use the voltmeter to measure the voltage $V_3$ . Record the value in Table 2.

**B : APPLYING THE SUPERPOSITION THEOREM**

1. Use the same circuit as in Figure 1. Switch off the power supplies and remove the 15 V voltage source.
2. The 10 V, voltage source is made ACTIVE by replacing the 15 V voltage source with a jumper between the points labeled C and D, as shown in Figure 2.

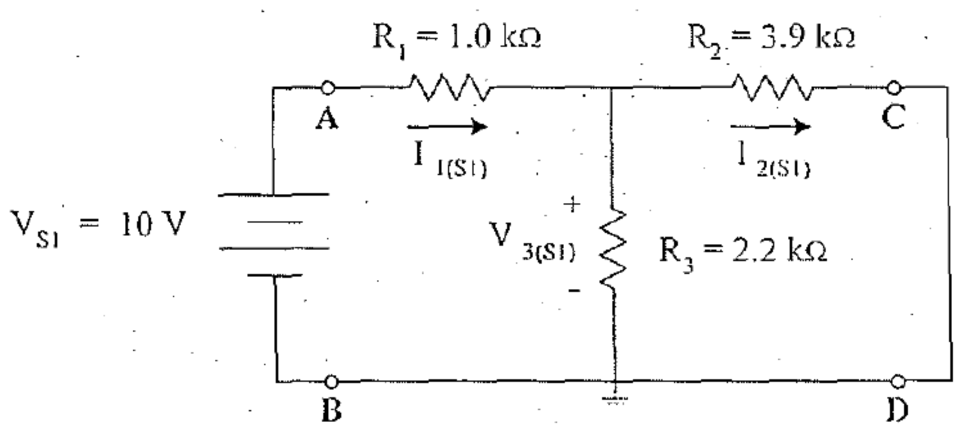


**Figure 2**

3. Switch on the 10 V voltage source.

4. Use the ammeter to measure the currents, $I_{1(SI)}$ and $I_{2(SI)}$. Record the values in Table 3.
5. Use the voltmeter to measure the voltage $V_{S(SI)}$. Record the value in Table 3.
6. Switch off the power supply.
7. Connect the circuit as shown in Figure 3. The 15 V voltage source is made ACTIVE by replacing the 10 V voltage source with a jumper between the points labeled A and B.

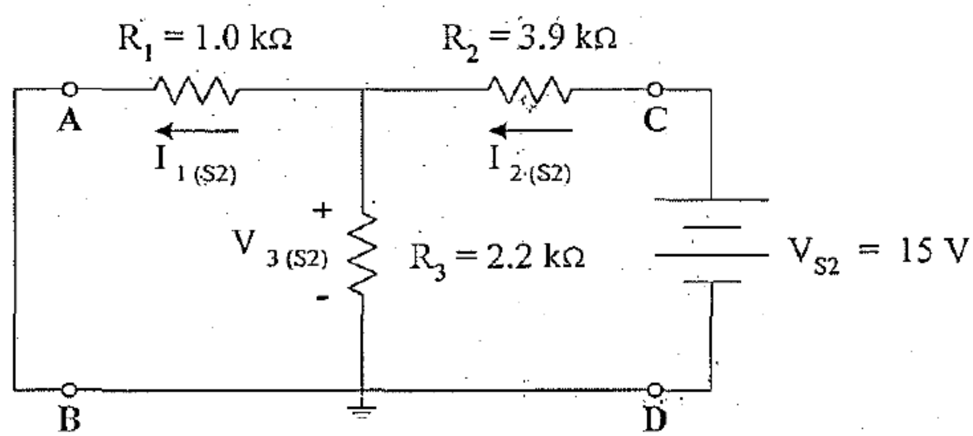


**Figure 3**

8. Switch on the 15 V, voltage source.
9. Use the ammeter to measure the currents, $I_{1(S2)}$ and $I_{2(S2)}$ Record the values in Table 3.
10. Use the voltmeter to measure the voltage $V_{3(S2)}$. Record the value in Table 3.
11. Calculate the algebraic sum of currents $I_1$, $I_2$ and voltage $V_3$ in Table 3. Pay attention the direction of the currents. **Current in the same directions are added and currents in the opposite directions arc subtracted.**

## PART 2 : THE THEVENIN'S THEOREM

### A : LINEAR RESISTIVE NETWORK

1. Obtain resistors listed in Table 4. Measure each resistor and record the measured values in Table 4.
2. Connect the circuit shown in Figure 4.

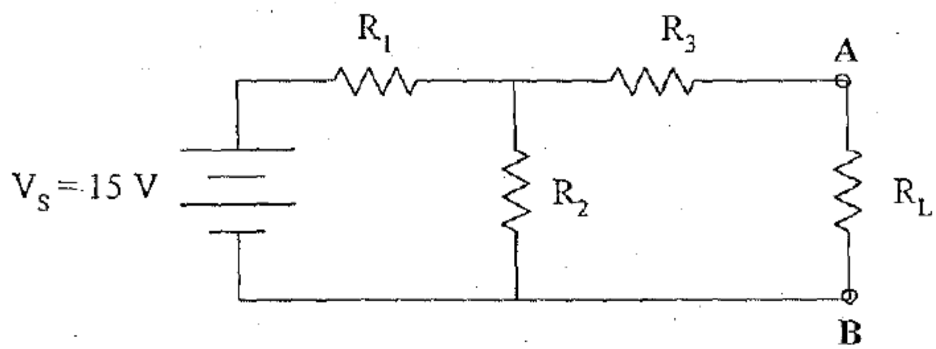


**Figure 4**

3. Switch on the power supply.
4. Use an ammeter to measure the current, $I_L$, flowing through the load resistor $R_L$. Record the value in Table 5.

### B : THE THEVENIN'S THEOREM

1. Use the same circuit with the load resistor removed as shown in Figure 5.

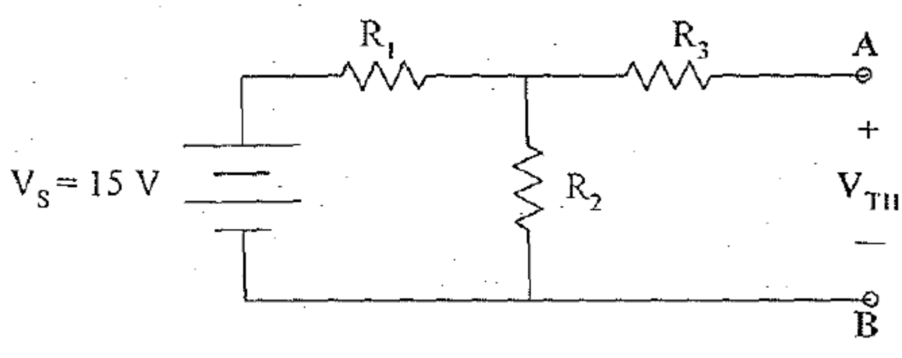


**Figure 5**

2. Measure the Thevenin equivalent voltage, $V_{TH}$ across terminal A-B of Figure 5. Record the value in Table 6.
3. Disconnect the 15 V voltage source and replace it with a jumper (short circuit) as shown in Figure 6.

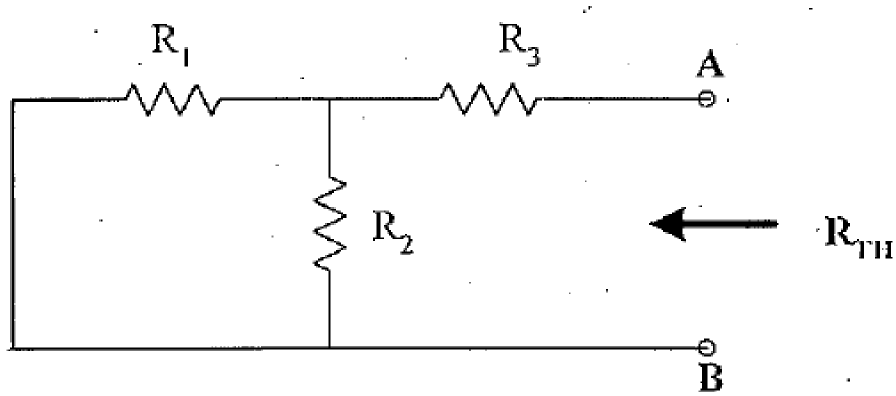


**Figure 6**

4. Measure the Thevenin equivalent resistance, $R_{TH}$ looking from terminal A-B. Record the value in Table 6.
5. Draw the Thevenin equivalent circuit in the space provided in the report sheet:

**C : THE THEVENIN EQUIVALENT CIRCUIT**

1. Construct the Thevenin equivalent circuit obtained in Part B. Use the decade resistance box for the measured Thevenin equivalent resistance. The decade resistance box may not be accurate. Use your multimeter to set the resistance to the exact value.
2. Connect the load resistor $R_L$ across the output terminal A-B.
3. Measure the current h flowing through the load resistor $R_L$. Record the value in Table 7.

**RESULT AND REPORT**

**PART 1: SUPERPOSITION THEOREM**

**A : MEASUREMENT OF CURRENTS AND VOLTAGE IN CIRCUIT WITH TWO SOURCES**

**Table 1 (Step 1)**

| Resistor | Listed Value(kΩ) | Measured Value (kΩ) |
|---|---|---|
| $R_1$ | 1.0 | |
| $R_2$ | 3.9 | |
| $R_3$ | 2.2 | |

| PO1 | CO1 | ......... /2m |
|---|---|---|

**Table 2 (Step 4 - 5)**

| Value | Measured Value |
|---|---|
| $I_1$ (mA) | |
| $I_2$ (mA) | |
| $V_3$ (V) | |

| PO1 | CO1 | ......... /2m |
|---|---|---|

**B : APPLYING THE SUPERI>OSITION THEOREM**

**Table 3 (Steps 4 - 5, Step 9 - 10, Step 11)**

| $V_{S1}$ active | | $V_{S2}$ active | | Algebraic Sum | |
|---|---|---|---|---|---|
| $I_{1(S1)}$ | | $I_{1(S2)}$ | | $I_1=I_{1(S1)} + I_{1(S2)}$ | |
| $I_{2(S1)}$ | | $I_{2(S2)}$ | | $I_2=I_{2(S1)} + I_{2(S2)}$ | |
| $V_{3(S1)}$ | | $V_{3(S2)}$ | | $V_3=V_{3(S1)} + V_{3(S2)}$ | |

| PO1 | CO1 | ......... /3m |
|---|---|---|

**CONCLUSIONS:**

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| PO1 | CO1 | ......... /5m |
|---|---|---|

**PART 2: THE THEVENIN'S THEOREM**

**A : LINEAR RESISTIVE NETWORK**

**Table 4 (Step 1)**

| Resistor | Listed Value(kΩ) | Measured Value (kΩ) |
|---|---|---|
| $R_1$ | 3.3 | |
| $R_2$ | 6.8 | |
| $R_3$ | 1.0 | |
| $R_L$ | 2.2 | |

| PO1 | CO1 | ......... /2m |
|---|---|---|

**Table 5 (Step 4)**

| | |
|---|---|
| $I_L$ (mA) | |

| PO1 | CO1 | ......... /2m |
|---|---|---|

**B : THE THEVENIN'S THEOREM**

**Table 6 (Step 2 & Step 4)**

| | |
|---|---|
| $V_{TH}$ (V) | |
| $R_{TH}$ (kΩ) | |

| PO1 | CO1 | ......... /2m |
|---|---|---|

**The Thevenin equivalent circuit (Step 5)**

| PO1 | CO1 | ......... /5m |
|---|---|---|

**C: THE THEVENIN EQUIVALENT CIRCUIT**

**Table 7 (Step 3)**

| $I_L$ (mA) | |
|---|---|

| PO1 | CO1 | ......... /2m |
|---|---|---|

**Comments on load current measured in Part 2A (Table 5) with the value obtained in Part 2C (Table 7)**

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| PO1 | CO1 | ......... /5m |
|---|---|---|

**CONCLUSIONS:**

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| PO1 | CO1 | ......... /5m |
|---|---|---|

## Guideline for ethic rubric (PO8):

| ETHIC AND PROFESSIONAL MORAL ( 100 marks) | | | | | |
|---|---|---|---|---|---|
| **Scale :** | **1 (5marks)** | **2 (10marks)** | **3 (15marks)** | **4 (20marks)** | **5 (25marks)** |
| **Criteria**<br>✓ **Understand the economic, environmental and socio-cultural impacts of professional practice** | **Very Poor** | **Poor** | **Moderate** | **Good** | **Excellent** |
| **A. Professional Practice (Punctuality/Follow the Rules)** | Tidak menepati/ Tidak Mematuhi | Kurang menepati/ Kurang mematuhi | Adakala menepati / Adakala mematuhi | Menepati / Mematuhi | Sentiasa menepati / Sentiasa mematuhi |
| **B. Ethical Behavior (Trustworthy / Respectfulness)** | Tidak mengamalkan | Kurang mengamalkan | Adakala mengamalkan | Mengamalkan | Sentiasa mengamalkan |
| **C. Social Cultural ( Racial Harmony)** | Tidak mengamalkan | Kurang mengamalkan | Adakala mengamalkan | Mengamalkan | Sentiasa mengamalkan |
| **D. Sahsiah Rupa Diri** | Tidak menepati | Kurang menepati | Adakala menepati | Menepati | Sentiasa menepati |

| PO8 | CO5 | ……… /10% |
|---|---|---|

## Guideline of practical skill rubric (PO2) :

| Practical skill ( 100 marks) | | | | | | |
|---|---|---|---|---|---|---|
| **Scale :** | **1 (5marks)** | **2 (10marks)** | **3 (15marks)** | **4 (20marks)** | **5 (25marks)** | **Marks** |
| **Criteria**<br>✓ **Demonstrate the practical skill** | **Very Poor** | **Poor** | **Moderate** | **Good** | **Excellent** | |
| **A. Circuit assembly/construction** | 5 | 10 | 15 | 20 | 25 | |
| **B. Using appropriate measurement equipment and technique** | 5 | 10 | 15 | 20 | 25 | |
| **C. Troubleshooting skill and technique** | 5 | 10 | 15 | 20 | 25 | |
| **D. Follow lab regulation** | 5 | 10 | 15 | 20 | 25 | |
| | | | | | **Total marks** | |

| PO2 | CO4 | ……… /40% |
|---|---|---|