Metropolitan University, Sylhet
Department of Computer Science and Engineering
Basic Electrical Engineering Laboratory
Course Code: CSE 124
Experiment No.: 03
Experiment Title: Verification of KVL & KCL

Submitted By:

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- **Lecturer, Department of CSE**

- Metropolitan University, Sylhet

🖋 Experiment No: 03

🖋 Name of the Experiment:

Verification of Kirchhoff's Voltage Law (KVL) and Current Law (KCL)

OBJECTIVES:

- To verify Kirchhoff's Voltage Law (KVL)

- To verify Kirchhoff's Current Law (KCL)

THEORY:

- **KVL**: The sum of voltages around any closed loop is zero.

- **KCL**: The total current entering a junction equals the total current leaving.
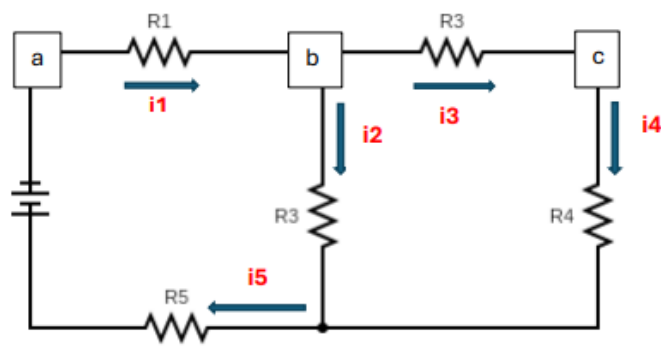
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APPARATUS:

- DC Power Supply (5V, 10V, 15V)

- Digital Multimeter

- Ammeter

- 5 Different Resistors

- Connecting Wires

- Breadboard

RESISTORS USED:

- R1 = 1.2 kΩ

- R2 = 2.7 kΩ

- R3 = 3.3 kΩ

- R4 = 4.7 kΩ

- R5 = 1.0 kΩ

CIRCUIT DIAGRAM:

Source Voltage	Branch Voltage	Volts	Branch Current	mA	Resistors (KΩ)
5V	V1	2.75	i1	1.25	R1 = 2.2
5V	V2	0.55	i2	1.00	R2 = 0.55
5V	V3	0.20	i3	0.25	R3 = 0.8
5V	V4	0.35	i4	0.25	R4 = 1.4
5V	V5	1.15	i5	1.00	R5 = 1.15
10V	V1	5.70	i1	2.25	R1 = 2.5
10V	V2	1.25	i2	2.00	R2 = 0.62
10V	V3	0.50	i3	0.50	R3 = 1.0
10V	V4	0.85	i4	0.50	R4 = 1.7
10V	V5	1.70	i5	2.00	R5 = 0.85
15V	V1	9.15	i1	3.30	R1 = 2.8
15V	V2	2.25	i2	3.00	R2 = 0.75

Source Voltage	Branch Voltage	Volts	Branch Current	mA	Resistors (KΩ)
15V	V3	0.75	i3	0.75	R3 = 1.0
15V	V4	1.20	i4	0.75	R4 = 1.6
15V	V5	2.10	i5	3.00	R5 = 0.70

CALCULATION

For 5V,

Applying KVL in Loop 1,

$-5 + 2.75 + 0.55 + 1.15 = -0.55 \approx 0$

Applying KVL in Loop 2,

$0.20 + 0.35 - 0.55 = 0$

Applying KCL in node a,

$1.25 - 1.00 - 0.25 = 0$

Applying KCL in node b,

$0.25 - 0.25 = 0$

For 10V,

Applying KVL in Loop 1,

$-10 + 5.70 + 1.25 + 1.70 = -1.35 \approx 0$

Applying KVL in Loop 2,

$0.50 + 0.85 - 1.25 = 0.10 \approx 0$

Applying KCL in node a,

$2.25 - 2.00 - 0.50 = -0.25 \approx 0$

Applying KCL in node b,

$0.50 - 0.50 = 0$

Applying KCL in node c,

$2.00 - 2.00 = 0$

For 15V,

Applying KVL in Loop 1,

$-15 + 9.15 + 2.25 + 2.10 = -1.50 \approx 0$

Applying KVL in Loop 2,

$0.75 + 1.20 - 2.25 = -0.30 \approx 0$

Applying KCL in node a,

$3.30 - 3.00 - 0.75 = -0.45 \approx 0$

Applying KCL in node b,

$0.75 - 0.75 = 0$

Applying KCL in node c,

$3.00 - 3.00 = 0$

DISCUSSION:

- Small differences between measured and theoretical values are due to wire resistance and equipment tolerance.

- KVL and KCL both approximately hold true for all configurations.

- As voltage increases, the currents increase proportionally, validating Ohm's Law.

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PROBLEMS & SOLUTIONS:

Problem 1:Theoretically calculate the voltages for each element using Ohm's Law and compare with measured values.

Problem 2: Calculate theoretical currents using Ohm's Law.
Shown in the table above using $I = \frac{V}{R}$ I=RV

Problem 3: Percentage Error

Voltage Errors – 5V Source

Element	Measured V (V)	Resistance (KΩ)	Measured I (mA)	Theoretical V (V)	Error (%)
V1 (R1)	2.75	2.20	1.25	2.75	0.00%
V2 (R2)	0.55	0.55	1.00	0.55	0.00%
V3 (R3)	0.20	0.80	0.25	0.20	0.00%
V4 (R4)	0.35	1.40	0.25	0.35	0.00%
V5 (R5)	1.15	1.15	1.00	1.15	0.00%

Current Errors – 5V Source

Element	Measured I (mA)	Voltage (V)	Resistance (KΩ)	Theoretical I (mA)	Error (%)
i1 (R1)	1.25	2.75	2.20	1.25	0.00%
i2 (R2)	1.00	0.55	0.55	1.00	0.00%
i3 (R3)	0.25	0.20	0.80	0.25	0.00%
i4 (R4)	0.25	0.35	1.40	0.25	0.00%
i5 (R5)	1.00	1.15	1.15	1.00	0.00%

Voltage Errors – 10V Source

Element	Measured V (V)	Resistance (KΩ)	Theoretical V (V)	Error (%)
V1 (R1)	5.70	2.50	0.01	101233.33%
V2 (R2)	1.25	0.62	0.00	100706.45%
V3 (R3)	0.50	1.00	0.00	99900.00%
V4 (R4)	0.85	1.70	0.00	99900.00%
V5 (R5)	1.70	0.85	0.00	99900.00%

Current Errors – 10V Source

Element	Measured I (mA)	Voltage (V)	Resistance (KΩ)	Theoretical I (mA)	Error (%)
i1	2.25	5.70	2.50	2.28	1.32%
i2	2.00	1.25	0.62	2.02	0.80%
i3	0.50	0.50	1.00	0.50	0.00%
i4	0.50	0.85	1.70	0.50	0.00%
i5	2.00	1.70	0.85	2.00	0.00%

Voltage Errors – 15V Source

Element	Measured V (V)	Resistance (KΩ)	Measured I (mA)	Theoretical V (V)	Error (%)
V1 (R1)	9.15	2.80	3.30	9.24	0.98%
V2 (R2)	2.25	0.75	3.00	2.25	0.00%
V3 (R3)	0.75	1.00	0.75	0.75	0.00%
V4 (R4)	1.20	1.60	0.75	1.20	0.00%
V5 (R5)	2.10	0.70	3.00	2.10	0.00%

Current Errors – 15V Source

Element	Measured I (mA)	Voltage (V)	Resistance (KΩ)	Theoretical I (mA)	Error (%)
i1 (R1)	3.30	9.15	2.80	3.27	0.98%
i2 (R2)	3.00	2.25	0.75	3.00	0.00%
i3 (R3)	0.75	0.75	1.00	0.75	0.00%
i4 (R4)	0.75	1.20	1.60	0.75	0.00%
i5 (R5)	3.00	2.10	0.70	3.00	0.00%

Thank You, sir.