Spring 2023

EEE/ETE 141L

Electrical Circuits-I Lab (Sec-19)

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Instructor: Md. Rabiul Karim Khan

Lab Report 05: Verification of Superposition Theorem.

Date of Performance:
02 April 2023

Date of Submission:
09 April 2023

Group no.: 05

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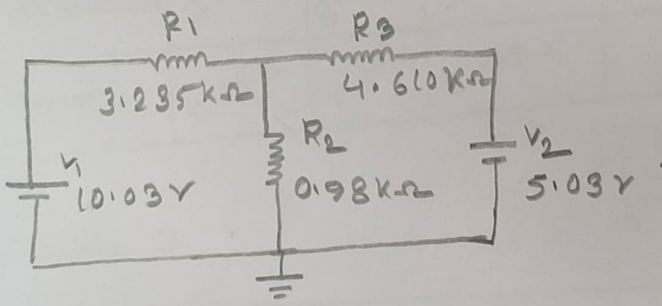
Experiment Name:- Verification of Superposition Theorem.

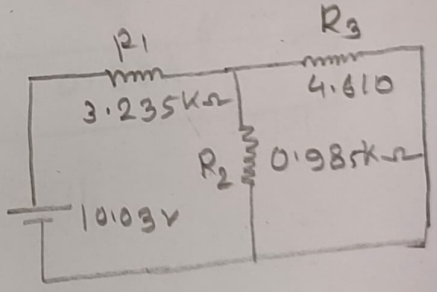
Objectives:- To verify Superposition Theorem.

Apparatus:-

→ Breadboard
→ Resistors (1x 3.3kΩ, 1x 4.7kΩ, 1x 1kΩ)
→ Digital multimeter
→ De power supply
→ wire.

Circuit Diagram:-





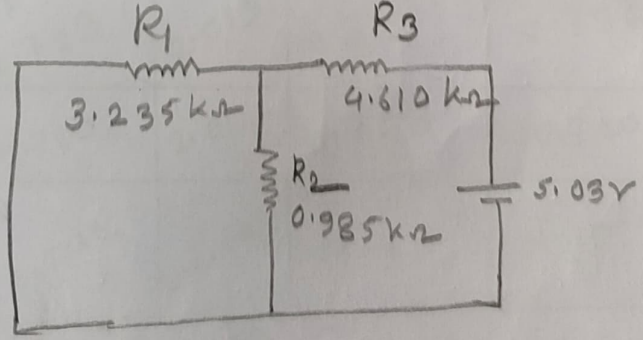


Table 1:

	I_1	I'_1	I''_1	$I'_1 + I''_1$
measured Data	2.780	2.040	0.740	2.780
Theoritical Data	2.761	2.043	0.719	2.762
Error	0.69%	0.15%	2.92%	0.65%

Table 2

	VR_1	$V'R_1$	$V''R_1$	$V'R_1 + V''R_1$
measured	7.300	8.010	-0.722	7.288
Theoritical	7.311	8.018	-0.708	7.310
Error	0.15%	0.10%	1.98%	0.304

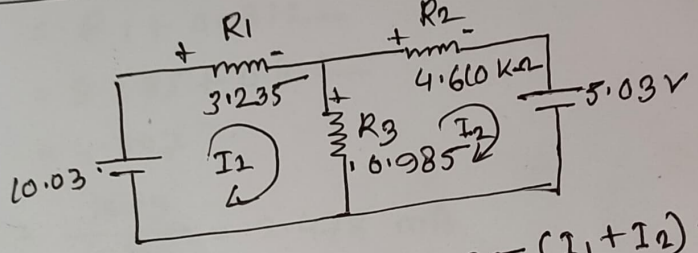
Table 3

	VR_2	$V'R_2$	$V''R_2$	$V'R_2 + V''R_2$
measured	2.728	2.013	0.723	2.736
Theoretical	2.720	2.012	0.708	2.720
Error	0.29%	0.054%	2.12%	0.59%

Table-4

	V_{R_3}	V'_{R_3}	V''_{R_3}	$V'_{R_3} + V''_{R_3}$
measured	2.375	-2.014	4.410	2.396
Theoretical	2.310	-2.012	~~2.910~~ 4.322	2.310
Error	2.81%	0.10%	2.04%	3.72%

From circuit 1:-



loop1 $10.03 - 3.25 I_1 - 0.985 (I_1 + I_2) = 0$

$\Rightarrow 10.03 - 3.25 I_1 - 0.985 I_1 - 0.985 I_1 = 0$

$\Rightarrow -4.22 I_1 - 0.985 I_1 = 10.03$

$4.22 I_1 + 0.985 I_1 = 10.03 \ldots (i)$.

loop 2: $5.03 - 4.610 I_1 - 0.985 (I_1 + I_2) = 0$

$\Rightarrow 5.03 - 4.610 I_1 - 0.985 I_1 - 0.985 I_2 = 0$

$0.985 I_1 + 5.595 I_1 = 5.03 \ldots (ii)$

Using calculator

$I_1 = 2.260 mA$

$I_2 = 0.501 mA$

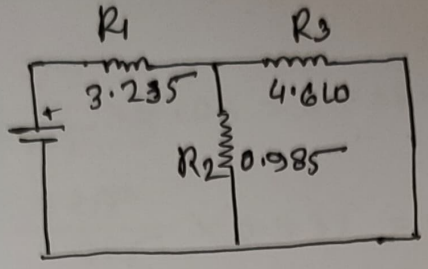
$I_{R_1} = (2.260 + 0.501) mA = 2.761 mA$

$V_{R_1} = 2.260 \times 3.235 = 7.34 V$

$V_{R_2} = 2.761 \times 0.985 = 2.720 V$

$V_{R_3} = 0.501 \times 4.610 = 2.310 V$

circuit 2:-



$$R_T = R_1 + (R_2 \| R_3)$$

$$= R_1 + \left(\left(\frac{1}{0.985} + \frac{1}{4.610}\right)^{-1}\right)$$

$$= R_1 + 0.812$$

$$= 3.235 + 0.812$$

$$= 4.047$$

$$I_S = \frac{10.03}{4.047} = 2.478 \text{ mA}$$

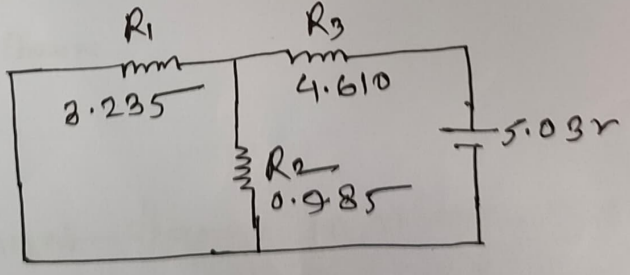
$$V_{R_1} = \frac{3.235}{4.047} \times 10.03 = 8.018 \text{ V}$$

$$V_{R_2} = \frac{0.812}{4.047} \times 10.03 = 2.012 \text{ V}$$

$$V_{R_3} = -V_{R_1} = -2.012 \text{ V}$$

$$I'_1 = \frac{0.812}{0.985} \times 2.478 = 2.043 \text{ mA}.$$

Circuit 3:



$$R_T = R_3 + (R_1 \| R_2)$$

$$= R_3 + \left(\left(\frac{1}{3.235} + \frac{1}{0.985}\right)^{-1}\right)$$

$$= R_3 + 0.755$$

$$= 4.610 + 0.755$$

$$= 5.365 \text{ k}\Omega$$

$I_5 = \frac{5.03}{5.365} = 0.938\,mA$ $V''R_3 = \frac{4.610}{5.365} \times 5.03 = 4.322V$

$V'R_2 = \frac{0.755}{5.365} \times 5.03 = 0.708V$ $V_{R_1}' = -V_{R_1}'' = -0.708V$

$I_1' = \frac{0.755}{0.985} \times 0.933 = 0.719\,mA.$

Errors:

$I_2 = \left| \frac{2.76 - 2.780}{2.761} \right| \times 100$ $V_{R_1} = \left| \frac{7.311 - 7.369}{7.311} \right| \times 100$

$= 0.69\%$ $= 0.15\%$

$V_{R_2} = \left| \frac{2.720 - 2.728}{2.720} \right| \times 100$ $V_{R_3} = \left| \frac{2.310 - 2.375}{2.310} \right| \times 100$

$= 0.29\%$ $= 2.81$

Result Analysis:- we measured the current I2 whe two source were coonted and when only one source was coonted at a time. After meanuring we found value I2 is the same as the algebraic I'_2 and I''_2. That means our circuit Superposition theore.

Question:

① The current through on voltage across any element of network is equal to the algebraic sum of the current on voltage produced independently by each source.

② Already showed in Data Table section.

08. In our expriment circuit we found I_2 was 2.78 mA when two source were connected. we found I_2' of 2.04 we removed the second source. After reconnecting the second source and removing the first source. we find 2.04 + 0.74 = 2.78 mA.

V_{R_1}

$V_{R_1}' + V_{R_1}'' = 8.01v (-0.722V) = 7.288\ v = V_{R_1}$

V_{R_2}

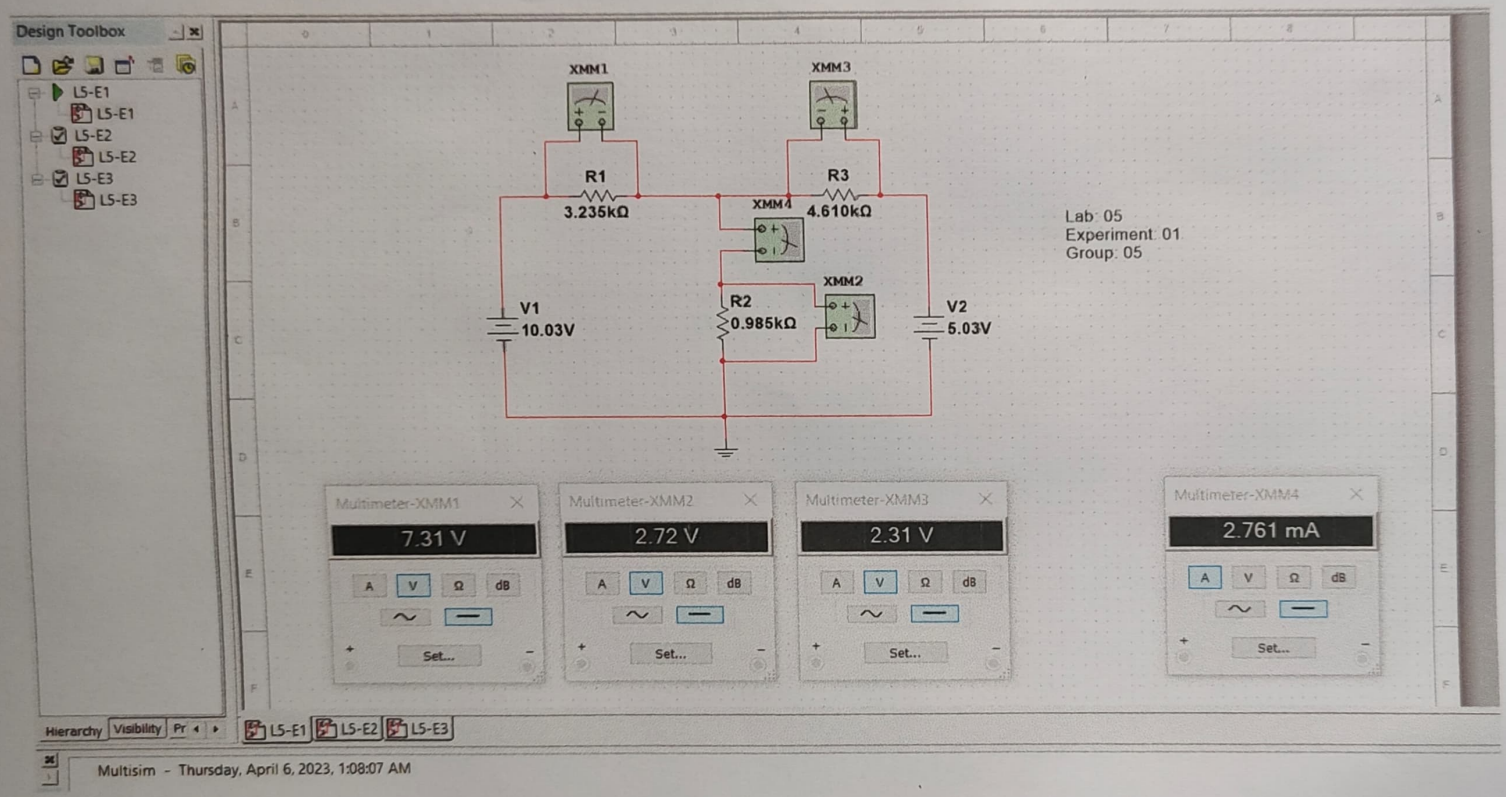
$V_{R_2}' + V_{R_2}'' = 2.013v + 0.723v = 2.736v = 0.728v = V_{R_2}$

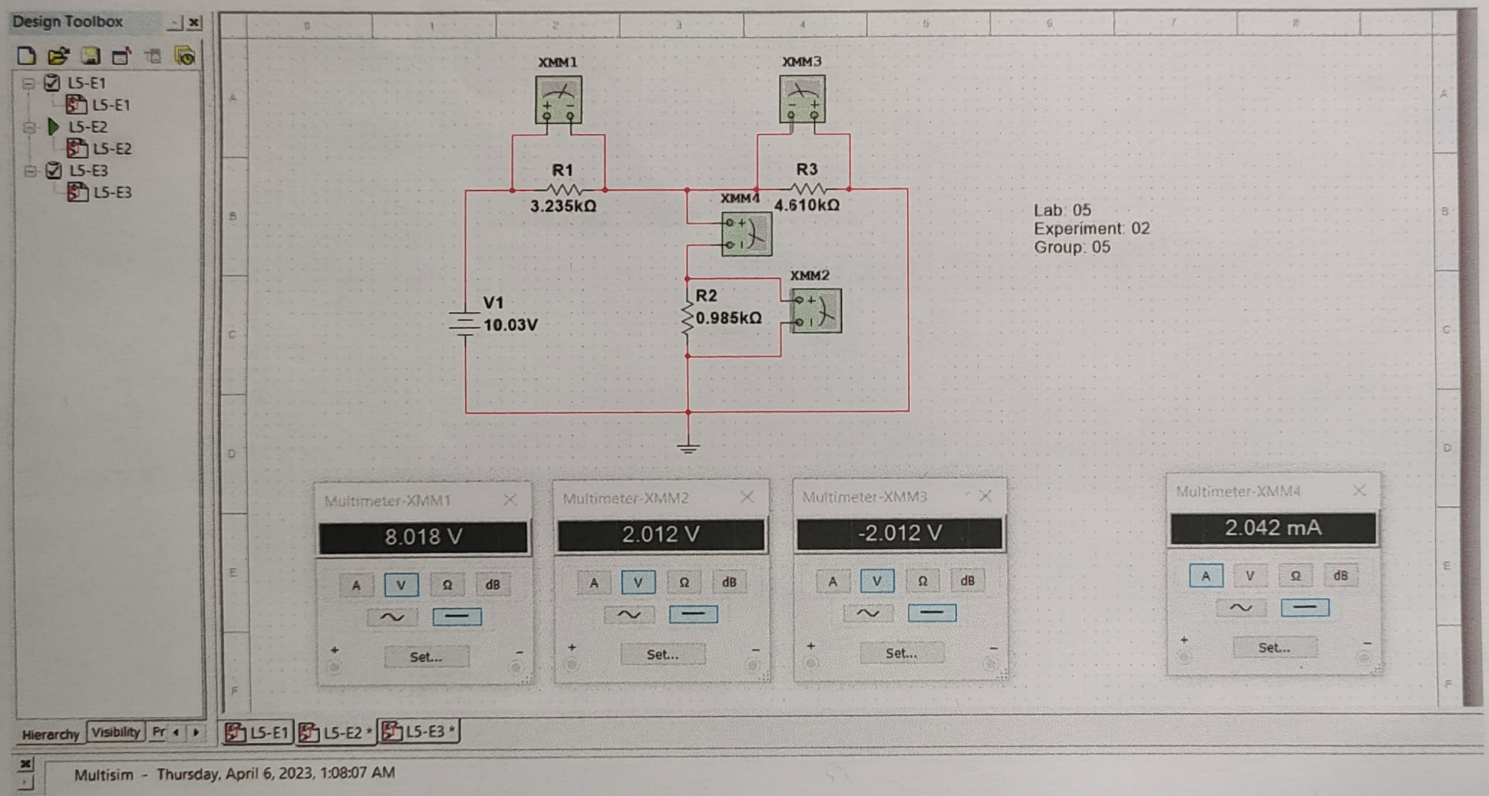
V_{R_3}

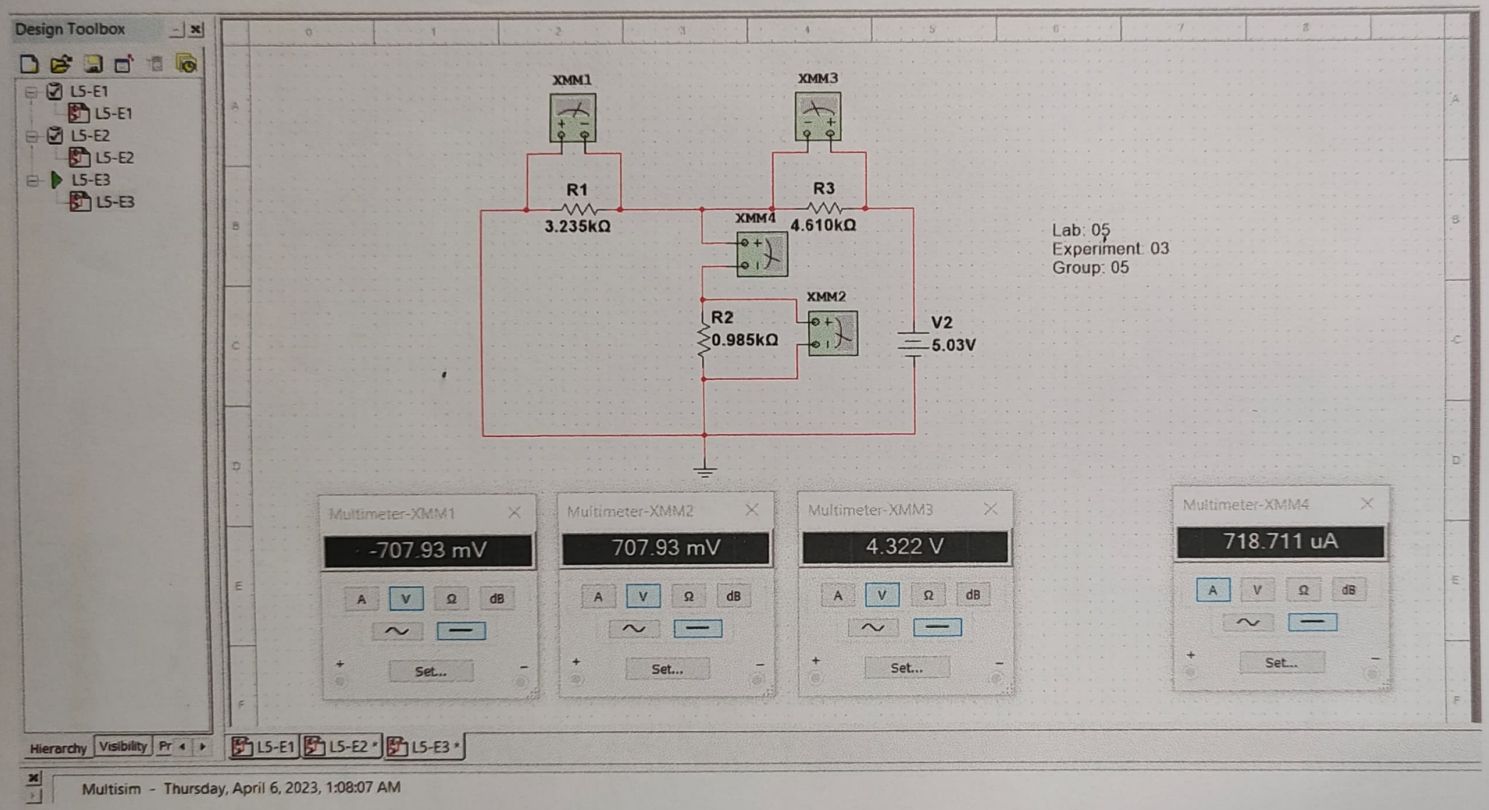
$V_{R_3}' + V_{R_3}'' = -2.014 + 4.410V = 2.396v = 2.375 = V_{R_3}$

04. Already showed in Data Table.

Discussion:- After completing this experiment we sucessfully verify the superposition Theorem. That means ca now find a solution for a current or voltage using only one source at a time. we need to combine the result to find the final solution. In this experiment we don't face any severe dibficulty we encounted a problem with De power supply it was continously. Finlly we completed the experiment with in the time.


Design Toolbox
L5-E1
L5-E1
L5-E2
L5-E2
L5-E3
L5-E3
XMM1
XMM3
R1
3.235kΩ
R3
4.610kΩ
XMM4
XMM2
R2
0.985kΩ
V1
10.03V
V2
5.03V
Lab: 05
Experiment: 01
Group: 05
Multimeter-XMM1
7.31 V
Multimeter-XMM2
2.72 V
Multimeter-XMM3
2.31 V
Multimeter-XMM4
2.761 mA
A
V
Ω
dB
Set...
Hierarchy
Visibility
L5-E1
L5-E2
L5-E3
Multisim - Thursday, April 6, 2023, 1:08:07 AM


Design Toolbox
L5-E1
L5-E1
L5-E2
L5-E2
L5-E3
L5-E3
XMM1
XMM3
R1
3.235kΩ
R3
4.610kΩ
XMM4
XMM2
V1
10.03V
R2
0.985kΩ
Lab: 05
Experiment: 02
Group: 05
Multimeter-XMM1
8.018 V
Multimeter-XMM2
2.012 V
Multimeter-XMM3
-2.012 V
Multimeter-XMM4
2.042 mA
A
V
Ω
dB
Set...
Hierarchy
Visibility
L5-E1
L5-E2 *
L5-E3 *
Multisim - Thursday, April 6, 2023, 1:08:07 AM


Design Toolbox
L5-E1
L5-E1
L5-E2
L5-E2
L5-E3
L5-E3
XMM1
XMM3
R1
3.235kΩ
R3
4.610kΩ
XMM4
XMM2
R2
0.985kΩ
V2
5.03V
Lab: 05
Experiment: 03
Group: 05
Multimeter-XMM1
-707.93 mV
Multimeter-XMM2
707.93 mV
Multimeter-XMM3
4.322 V
Multimeter-XMM4
718.711 uA
A
V
Ω
dB
Set...
Hierarchy
Visibility
L5-E1
L5-E2 *
L5-E3 *
Multisim - Thursday, April 6, 2023, 1:08:07 AM

NORTH SOUTH UNIVERSITY

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Electrical Circuit I Lab

Lab 5: Verification of Superposition Theorem

Objective:

- To verify Superposition Theorem.

List of Equipment

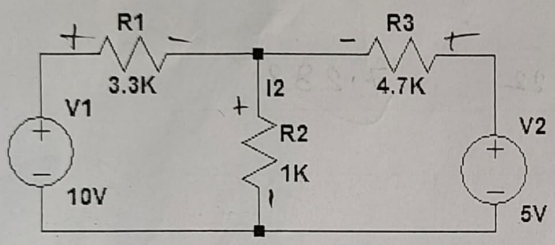
- Trainer Board
- DMM
- 1 x 3.3kΩ resistor
- 1 x 4.7kΩ resistor
- 1 x 1KΩ resistor

$R_1 = 3.235\ k\Omega$

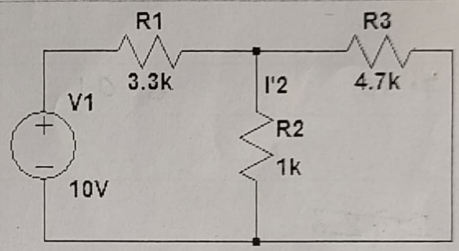
$R_2 = 0.985\ k\Omega$

$R_3 = 4.610\ k\Omega$

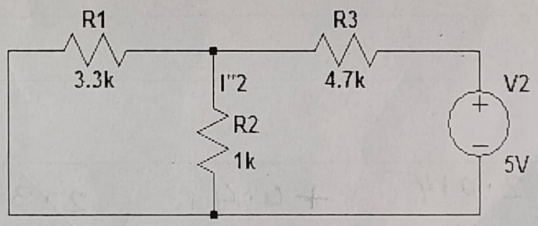
Circuit Diagram



Circuit 1



Circuit 2



Circuit 3

Procedure:

1. Set up Circuit 1.
2. Mark the polarities of each resistor.
3. With both the voltage source connected to the circuit, measure I_2 , V_{R1}, V_{R2}, V_{R3} and record the values in appropriate tables.
4. Setup Circuit 2. Measure and record $I'_2, V'_{R1}, V'_{R2}, V'_{R3}$.
5. Setup Circuit 3. Measure and record $I''_2, V''_{R1}, V''_{R2}, V''_{R3}$.

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Electrical Circuit I Lab

Data Collection for Lab 5:

Group No. _____
Instructor's Signature _____

Table 1:

I_2	I'2	I"2	I'2 + I"2
2·78	2·04	0·74	2·04 + 0·74 = 2·78

Table 2:

V_{R1}	V'_{R1}	V''_{R1}	$V'_{R1} + V''_{R1}$
7·30	8·01	-0·722	7·288

Table 3:

V_{R2} ~~2·728~~	V'_{R2}	V''_{R2}	$V'_{R2} + V''_{R2}$
2·728	2·013	0·723	2·736

Table 4:

V_{R3}	V'_{R3}	V''_{R3}	$V'_{R3} + V''_{R3}$
2·375	-2·014	+4·41	2·396

Report:

1. What is Superposition Theorem?
2. Theoretically Calculate all values of Table 1 to Table 4. **Show all the steps in details.**
3. Using measured data, show that your circuit followed superposition theorem.
4. Find the % Error between your theoretical and experimental values.

Rabin
02/04/23