Graphic Era

Deemed to be University

Accredited by NAAC with Grade A+

INDEX

EXP. NO.	DATE	TITLE	PAGE	REMARKS
01	20/02/23	To verify Kirchoff's Voltage Law (KVL) in D.C. circuits.	01-04	[illegible] 27/02/23 X
02	27/02/23	To verify Kirchoff's current law (KCL) in D.C. circuits	05-08	[illegible] 13/03/23 B+
03	13/03/23	To verify superposition theorem for D.C. circuits	09-12	[illegible] 20/03/23 X
04	20/03/23	To verify Thevenin's Theorem for D.C. circuits.	13-16	[illegible] 27/03/23 X+
05	03/04/23	To verify Norton's Theorem for D.C. circuits.	17-20	

Experiment No. - 01

Objective :

To verify Kirchhoff's voltage law (KVL) in D.C. circuits.

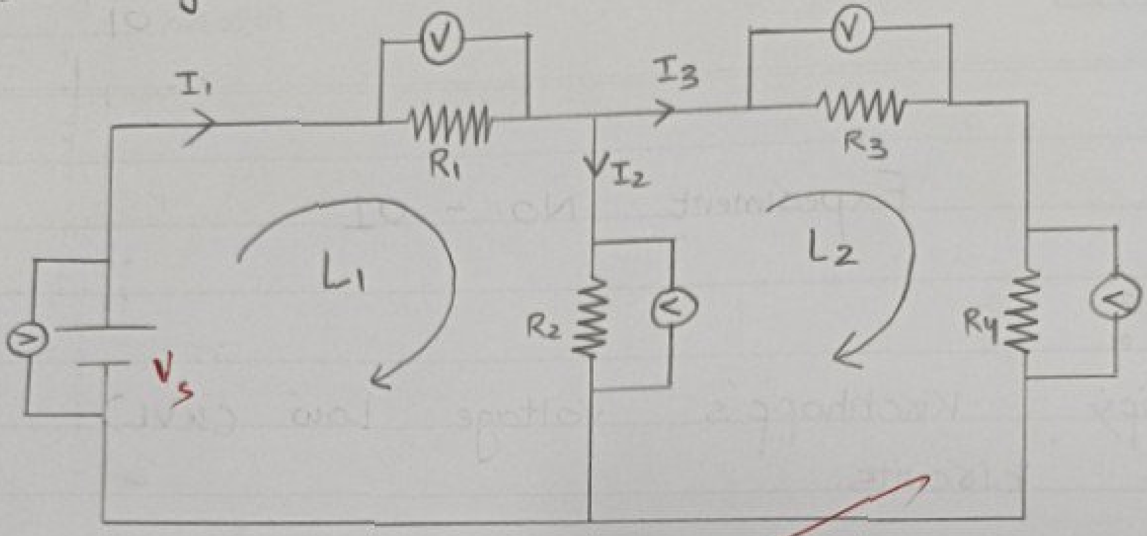
Theory :

Kirchoff's Voltage Law (KVL) : This law states that at any instant (time). The algebraic sum of the voltages taken in the same direction around a loop (closed path) is zero. In other words, the net voltage around a closed circuit is zero. Mathematically it can be expressed as:

$$\Sigma V_K = 0$$

This law is valid regardless of the direction in which loop is considered. It should also be noted that in a circuit, the direction of a loop does not have to be the same as the direction of current. However, the sign convention is very important.

Circuit Diagram:



$R_1 \rightarrow (510 \pm 1\%)\,\Omega$

$R_2 \rightarrow (47 \pm 5\%)\,\Omega$

$R_3 \rightarrow (750 \pm 1\%)\,\Omega$

$R_4 \rightarrow (470 \pm 5\%)\,\Omega$

Date

Apparatus Required :

S.No	Name	Range	Quantity
1.	DC Voltmeter	0-20 V	1
2.	Breadboard	—	1
3.	Connecting Wires	—	4
4.	Carbon Resistors	(47 - 750) Ω	4

Equations :

According to KVL, for the given circuit in Loop 1 :

$V_s - I_1R_1 - I_2R_2 = 0$

OR

$V_s = I_1R_1 + I_2R_2$

OR

$V_s = V_1 + V_2$

Similarly, for Loop 2 :

$I_2R_2 = I_3R_3 + I_3R_4$ OR

$V_2 = V_3 + V_4$

Teacher's Signature

Procedure :

1.) Connect the circuit as shown in circuit diagram.
2.) Switch on the power supply.
3.) Note the Reading of Voltmeter.

Observation Table :

S. No.	V_S (V)	V_1 (V)	V_2 (V)	V_3 (V)	V_4 (V)	$V_S = V_1 + V_2$	$V_2 = V_3 + V_4$
1.	2.00	1.81	0.15	0.09	0.06	1.96	0.15
2.	5.00	4.52	0.40	0.24	0.15	4.92	0.39
3.	10.01	9.07	0.79	0.49	0.30	9.86	0.79
4.	12.01	10.91	0.95	0.59	0.36	11.86	0.95

Result :

The KVL is verified.

Date

Precaution :

1.) All connections should be tight.

2.) Before connecting the instruments check their zero reading.

3.) The terminals of the resistance should be properly connected.

Learning Outcomes :

1.) We learnt to create circuit on breadboard.
2.) We learnt colour coding of different resistors.
3.) We learnt about KVL and verified it.

Applications :

1.) KVL is used to calculate the unknown values of current and voltages in the circuit.
2.) The Wheatstone bridge is an essential application of Kirchoff's Law. It is also used in mesh and node analysis.
3.) KVL helped in analysis and calculation of complex circuits.

Guru

Teacher's Signature 27/02/23

Experiment No. - 02

Objective :

To verify Kirchoff's current Law (KCL) in D.C. circuits.

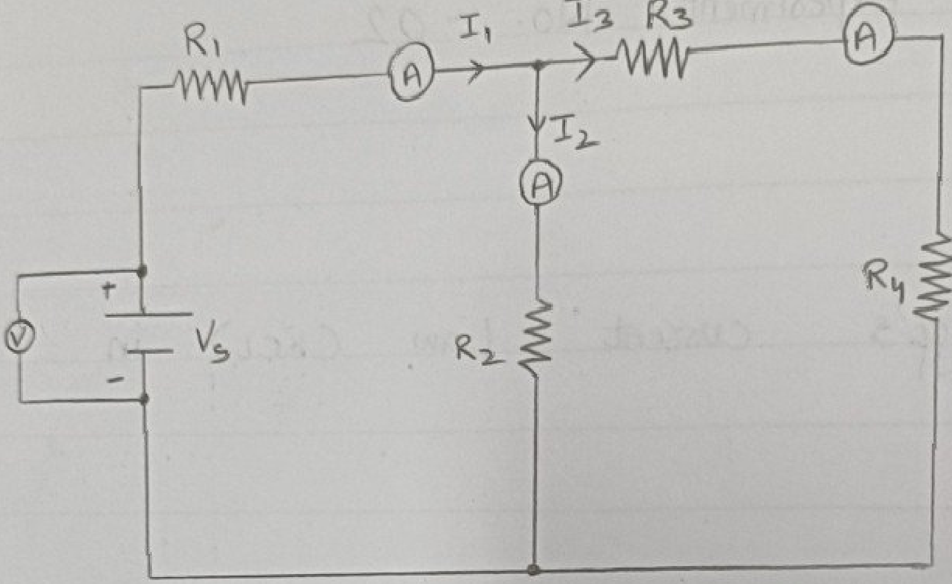
Theory :

Kirchhoff's current Law (KCL) :

This law states that the algebric sum of the currents into a node or a junction at any instant is zero. In other words, the sum of currents entering the node is equal to the sum of currents leaving the node. Mathematically, it can be expressed as

$$\Sigma I_K = 0$$

If the current leaving the node is taken as positive (+ve), then the current entering the node should be taken as negative (-ve) or vice-versa.



Circuit Diagram for Verification of KCL

$R_1 \rightarrow (560 \pm 5\%)\ \Omega$

$R_2 \rightarrow (47 \pm 5\%)\ \Omega$

$R_3 \rightarrow (680 \pm 5\%)\ \Omega$

$R_4 \rightarrow (220 \pm 5\%)\ \Omega$

Apparatus Required :

S.No	Name	Range	Quantity
01.	DC Voltmeter	(0-20) V	1
02.	DC Ammeter	(0-50) mA	1
03.	Breadboard	-	1
04.	connecting Wires	-	6
05.	Carbon Resistors	(47-680) Ω	4

Equations :

According to KCL, for the given circuit at node 'a' :

$$I_1 = I_2 + I_3$$

Procedure :

1.) Connect the circuit as shown in circuit diagram.
2.) Switch on the power supply.
3.) Note the Reading of ammeter.

Observation Table :

S.No	V_s (V)	I_1 (mA)	I_2 (mA)	I_3 (mA)	$I_1 = I_2 + I_3$
01.	2	3.3	3.1	0.1	3.2
02.	5	8.3	7.9	0.3	8.2
03.	8	13.4	12.7	0.6	13.3
04.	12	20.2	19.2	0.9	20.1

Result :

The KCL is verified.

Precaution :

1.) All connections should be tight.
2.) Before connecting the instruments check their zero reading.
3.) The terminals of the resistance should be properly connected.

Learning Outcomes :

1.) We learnt to create circuit on breadboard.

2.) We learnt colour coding of different resistors.
3.) We learnt about KCL and verified it by implementing a circuit.

Applications:

1.) KCL is used to calculate the unknown values of current and voltages in the circuit.
2.) The wheatstone bridge is an essential application of Kirchoff's Law. It is also used in mesh and node analysis.
3.) KCL helped in analysis and calculation of complex circuits.

BT

Rohit Bhatt
13/03/23

Experiment No. - 03

Aim:

To verify superposition theorem for D.C. circuits.

Theory:

In a linear bilateral network containing more than one source, the current flowing through any branch is the algebraic sum of the current flowing through that branch by considering one source at a time and replacing the other sources by their internal resistance.

Apparatus Required:

S. No.	Name	Range	Quantity
01.)	DC Voltmeter	0-20 V	1
02.)	DC Ammeter	0-200 mA	1
03.)	Breadboard	—	1
04.)	Connecting Wires	—	6
05.)	Carbon Resistors.	(270 - 560) Ω	3

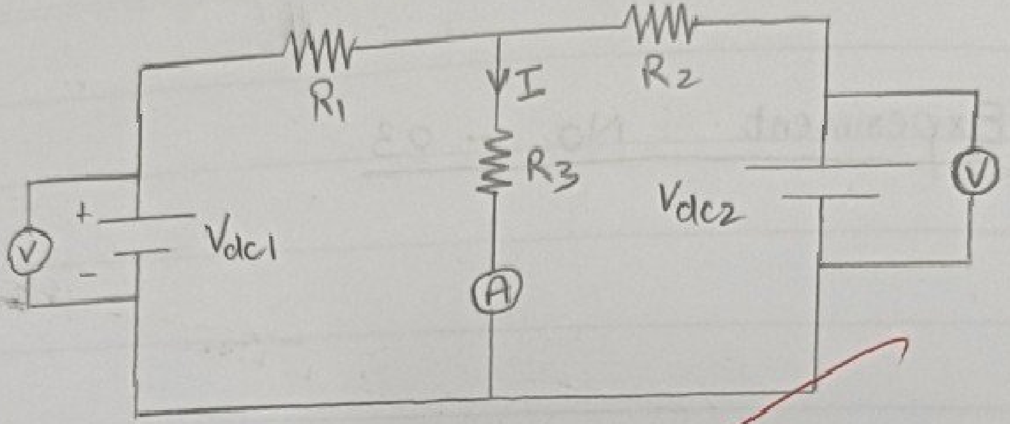


Fig. - 3.1

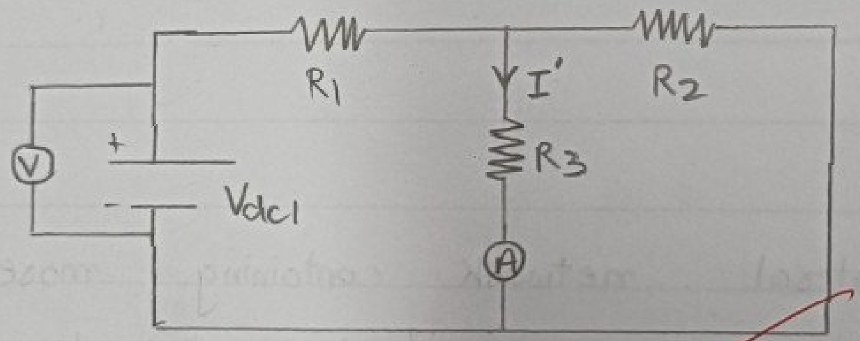
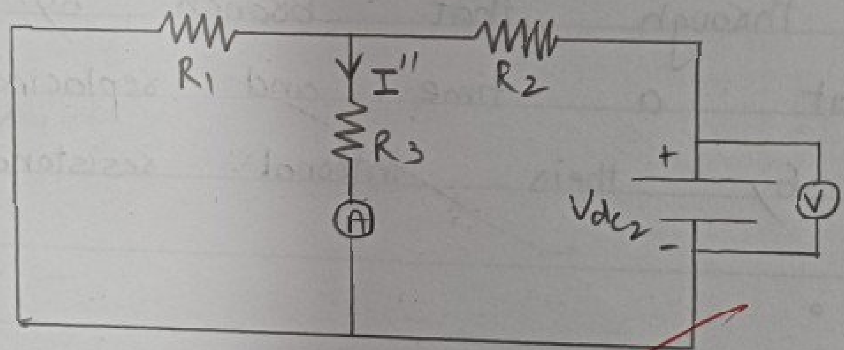


Fig. -3.2



$R_1 \rightarrow 560 \pm 5\%\ \Omega$

$R_2 \rightarrow 330 \pm 5\%\ \Omega$

$R_3 \rightarrow 270 \pm 5\%\ \Omega$

Procedure :

1.) connect the circuit diagram as per the circuit diagram shown in Fig. 3.1.

2.) switch on the DC power supplies (V_1) and (V_2) say 5V and 10V and note down the corresponding ammeter reading I.

3.) Replace the second power supply V_2 by short circuit (Fig. 3.2).

4.) Switch on the power supply V_1 and note down the corresponding ammeter reading 'I''.

5.) Connect the second power supply V_2 and replace V_1 power supply by short circuit (Fig. 3.3).

6.) Switch on the power supply V_2 and note down the corresponding reading I''.

7.) Verify the following condition

$$I = I' + I''$$

Observation Table :

S. No.	Vac1 (V)	Vac2 (V)	Measured Value I (mA)	I' (mA)	I'' (mA)	Calculated Value I = I' + I'' (mA)
01.)	2.01	3.01	5.6	1.6	4.0	5.6
02.)	5.02	7.02	13.3	4.0	9.3	13.3
03.)	7.00	9.02	17.6	5.5	12.0	17.5
04.)	9.02	11.00	21.9	7.2	14.7	21.9

Conclusion :

Hence, superposition theorem for given circuit is verified.

Precaution :

1.) All connections should be tight and perfect.
2.) Connect the DC meters with proper polarity.
3.) Readings must be well within the range of the meters.

Learning Outcomes :

1.) We learnt to create circuit on breadboard.

2.) we learnt colour coding of different resistors.
3.) We learnt about superposition theorem and verified it experimentally.

Applications :

The application of superposition theorem is, we can employ only linear circuits as well as the circuit which has more supplies.

(x)

Chahat Bhatt
20/03/23

Experiment No. - 04

Aim :

To verify Thevenin's theorem for DC circuits.

Theory :

It states that, any two-terminal, linear, bilateral network can be replaced by an equivalent circuit consisting of a voltage source in series with the resistance (impedance) seen from that terminals. The equivalent voltage source, V_{Th} is the open circuit voltage between the terminals and equivalent Resistance, R_{Th} is also the resistance measured by looking back into the network from the open circuit terminals by replacing all the sources by their internal resistances.

Formula :

$$\text{Load current } (I_L) = \frac{V_{Th}}{R_{Th} + R_L}$$

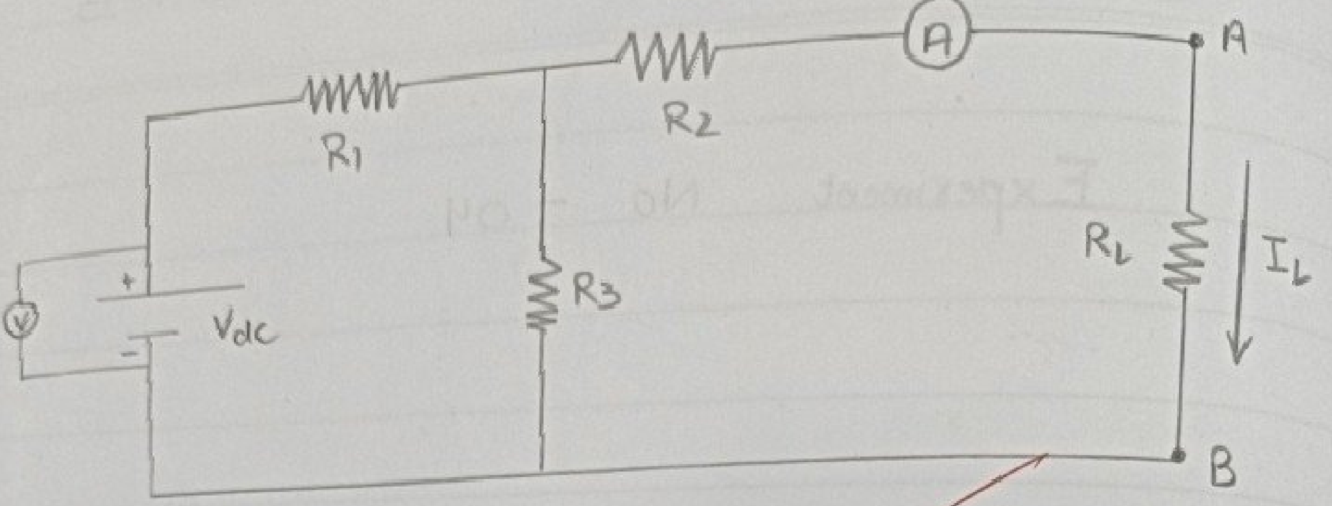


Fig. 4.1 Connection Diagram of Thevenin's Theorem

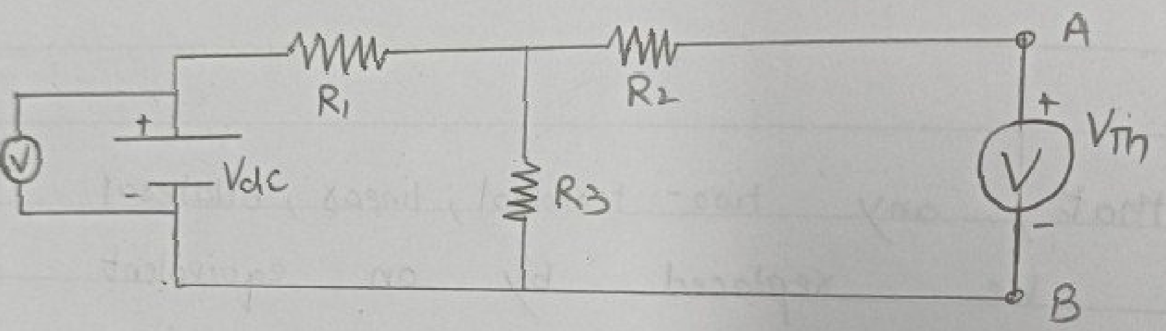


Fig. 4.2 Measurement of V_{Th}

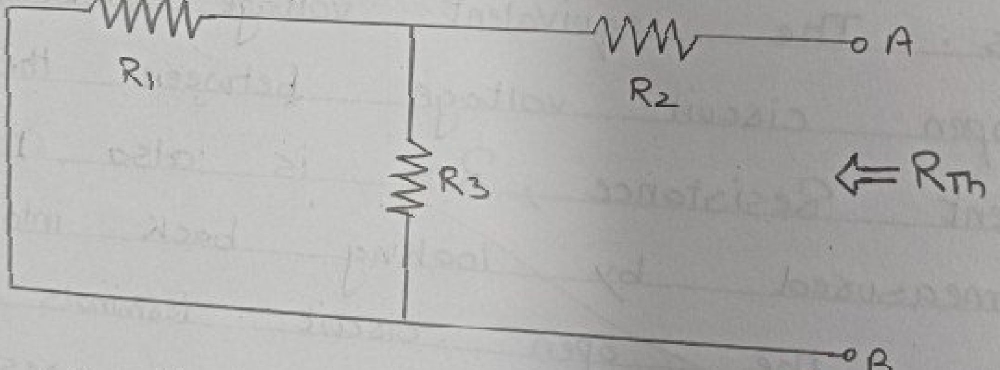


Fig. 4.3 Measurement of R_{Th}

$R_1 \rightarrow (330 \pm 1\%)\,\Omega$

$R_2 \rightarrow (750 \pm 1\%)\,\Omega$

$R_3 \rightarrow (330 \pm 1\%)\,\Omega$

$R_L \rightarrow (750 \pm 1\%)\,\Omega$

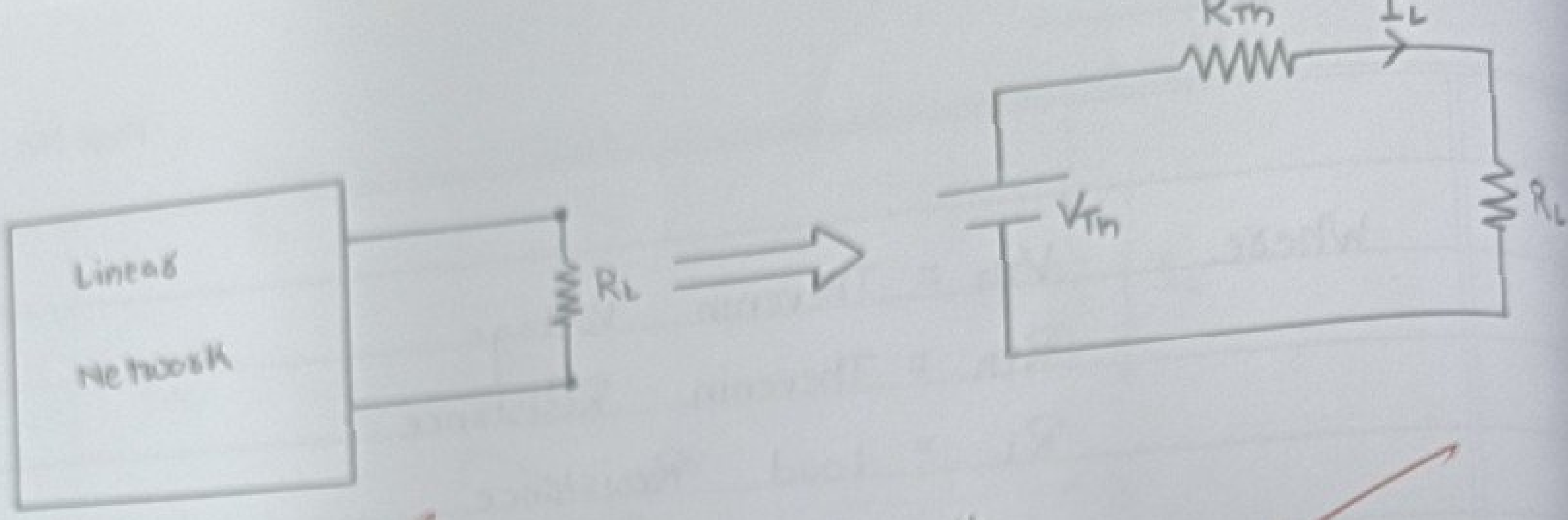


Fig. 4.4 Thevenin's Equivalent Circuit

Where V_{Th} = Thevenin Voltage
R_{Th} = Thevenin Resistance
R_L = Load Resistance

Apparatus Required :

S. No	Name	Range /Value	Quantity
01.>	DC Voltmeter	0-20V	1
02.>	DC Ammeter	0-200 mA	1
03.>	Breadboard	—	1
04.>	Connecting Wires	—	8
05.>	Carbon Resistors	(330-750) Ω	4

Procedure :

01.> The circuit is connected as shown in Fig. 4.1.
02.> Note the reading of ammeter which is load current in the circuit.
03.> Find the open circuit voltage across the terminal AB when load Resistance is removed (Fig. 4.2).
04.> Measure the Thevenin's resistance by using Fig. 4.3.
05.> Compute the current flowing through R_L (fig. 4.4) using the equation.

$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$

And compare the first reading

Observation Table :

S. No.	Vdc (Volts)	I_L (mA)	R_L (Ω)	V_{Th} (Volts)	R_{TH} (Ω)	$I_L = V_{Th}/(R_{Th}+R_L)$ (mA)
01.)	3	0.7	752	0.93	562	0.7
02.)	5	1.1	752	1.55	562	1.17
03.)	7	1.6	752	2.17	562	1.65
04.)	10	2.3	752	3.09	562	2.35

Conclusion :

Hence, Thevenin's theorem is verified for D.C. circuits.

Date

Precaution :

01.) As the input is ~~[illegible]~~ on DC supply, use only the DC meters.

02.) Connect the DC meters with proper polarity.

03.) Connect the circuit as per the diagram.

04.) All connections must be tight and proper.

Learning Outcomes :

01.) We learnt to create circuit on Breadboard.

02.) We learnt colour coding of different resistors.

03.) We learnt about Thevenin's Theorem and verified it.

Applications :

01.) Thevenin's theorem is used in the analysis of power systems.

02.) Thevenin's theorem is used in source modelling and resistance measurement using the wheatstone bridge.

X+

27/03/23

Experiment No. - 05

Aim :

To verify Norton's theorem for DC circuits.

Theory :

It states that, in any Linear, Bilateral network consisting of many sources and impedances, current in any branch AB, is equal to current due to a single current source connected in parallel with a resistance impedance where, the single current source is the short circuit current flowing in the branch AB, and the parallel resistance is the total resistance measured by looking back into the network from the terminals AB. While measuring all the sources are to replaced by their internal resistances.

Formula :

$$I_L = \frac{I_{sc} \cdot R_N}{(R_N + R_L)}$$

, where $I_{sc} \rightarrow$ Short circuit current

$R_N \rightarrow$ Norton Resistance

$R_L \rightarrow$ Load Resistance

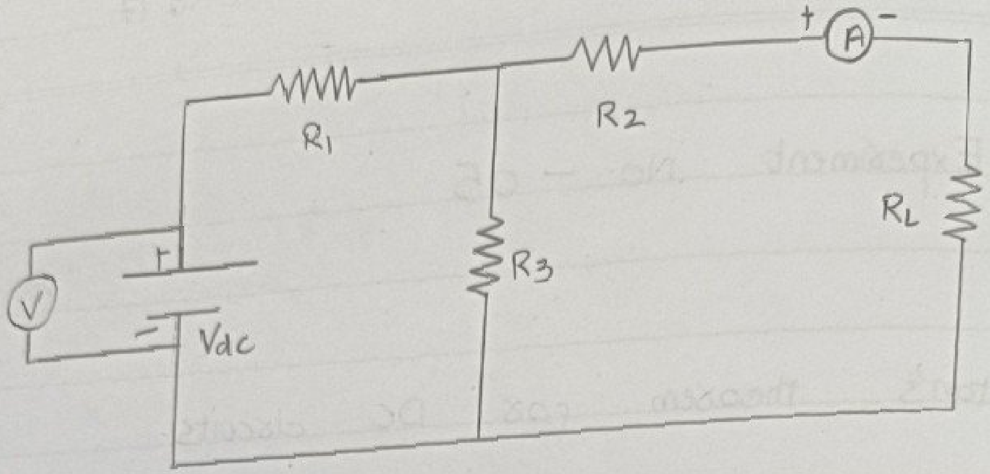


Fig. 5.1 → Connection Diagram of Norton Theorem

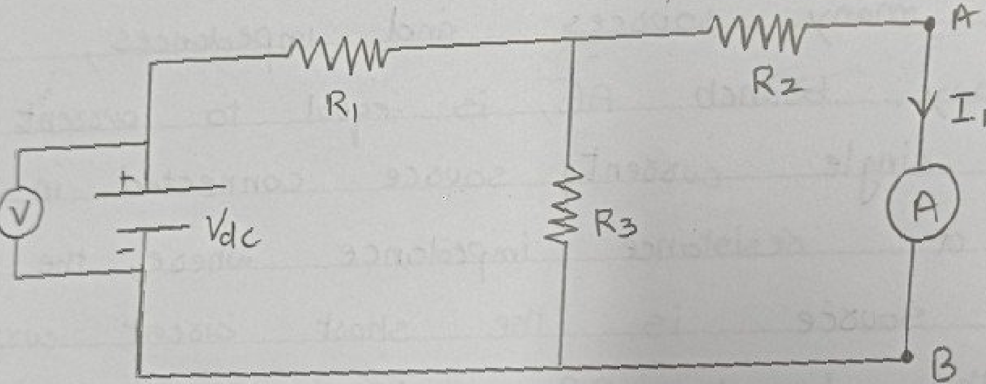


Fig. 5.2 → Calculation of Isc

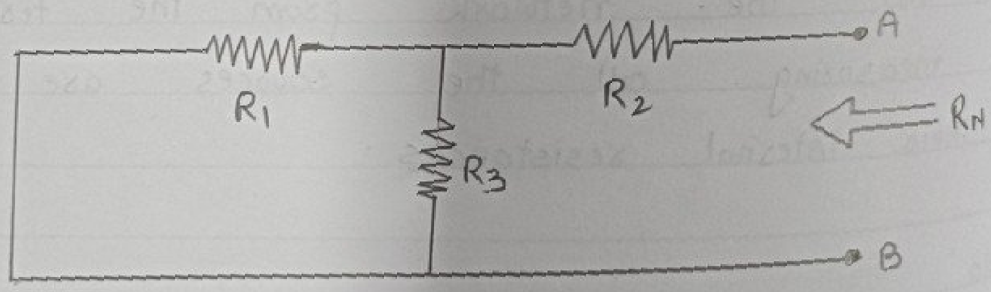


Fig. 5.3 → Measurement of R_N

$R_1 \rightarrow (100 \pm 1\%)\ \Omega$

$R_2 \rightarrow (517 \pm 1\%)\ \Omega$

$R_3 \rightarrow (100 \pm 1\%)\ \Omega$

$R_4 \rightarrow (330 \pm 1\%)\ \Omega$

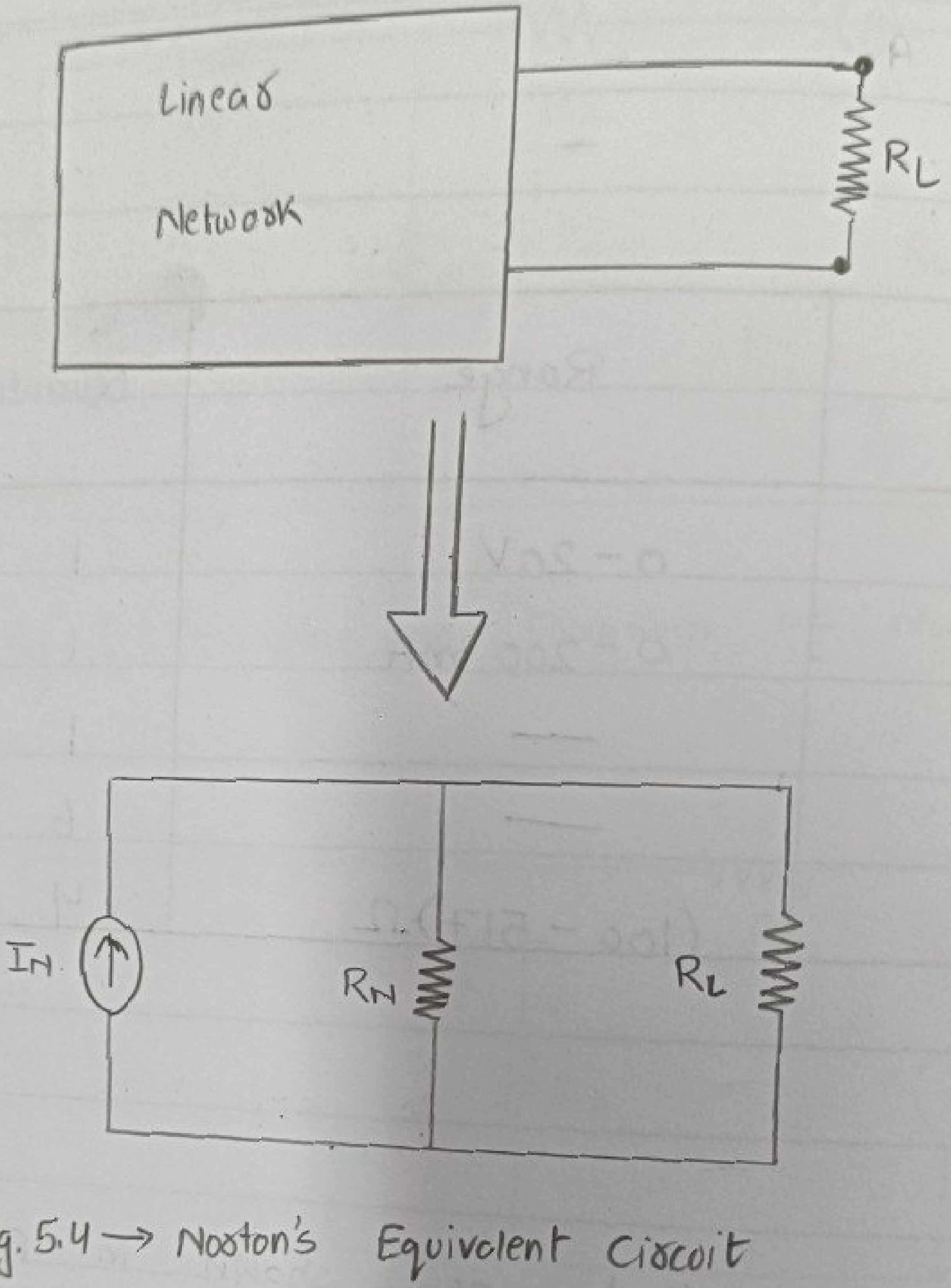


Fig. 5.4 → Norton's Equivalent Circuit

Date

Apparatus Required :

S. No.	Name	Range	Quantity
01.)	DC Voltmeter	0 - 20V	1
02.)	DC Ammeter	0 - 200 mA	1
03.)	Breadboard	—	1
04.)	connecting wires	—	6
05.)	carbon Resistor	$(100 - 517)\Omega$	4

Procedure :

1.) The circuit is connected as shown in Fig. 5.1.

2.) Note the reading of ammeter which is Load current in the circuit.

3.) Find the short circuit current through the terminal AB when Load Resistance is short circuited (Fig. 5.2)

4.) Measure the Norton's Resistance by using (Fig. 5.3)

5.) Compute the current flowing through R_L (Fig. 5.4) using the equation

$$I_L = \frac{I_N R_N}{(R_N + R_L)}$$

And compare with First Reading.

Observation Table :

S. No.	Vdc (V)	I_L (mA)	I_N (mA)	R_N (Ω)	R_L (Ω)	$I_L = \frac{I_N \times R_N}{(R_N + R_L)}$ (mA)
01.	2	2.1	3.3	610	330	2.14
02.	4	4.2	6.6	610	330	4.28
03.	7	7.5	11.5	610	330	7.46
04.	10	10.7	16.5	610	330	10.70

Conclusion :

Hence, Newton Theorem is verified for D.C. circuits.

Precaution :

1.) As the input is on DC supply, use only the DC meters.
2.) Connect the DC meters with proper polarity.
3.) Complete the circuit as per the diagram.
4.) All connections must be tight and proper.

Learning Outcomes :

1.) we learnt to create circuit on breadboard.
2.) we learnt colour coding of different resistors.
3.) we learnt about Norton's Theorem and verified it practically.

Applications :

It is widely used for circuit analysis simplification and to study circuit's initial - condition and steady-state response.

EXPERIMENT NO: 06

OBJECTIVE: - To verify maximum power transfer theorem in DC circuits.

THEORY: Maximum power transfer theorem states that the load draws maximum power from the source, when the load resistance is equal to the internal resistance of the source.

At $R_L = R_{th}$, the power consumed by the load is maximum.

The power in the load is given by

$$P = I_L^2 R_L = V_L^2 / R_L.$$

$$= V_L I_L$$

APPARATUS REQUIRED:

S. No.	Name	Range/Value	Quantity
1	DC Voltmeter		1
2	DC Ammeter		1
3	Breadboard		1
4	Connecting wires		6
5	Carbon resistors		2

FORMULA: Power $P = I_L^2 R_L = V_L^2 / R_L$ watt

Where, I_L = Load current.

R_L = Load resistance

V_L = Voltage across the load

CIRCUIT DIAGRAM:

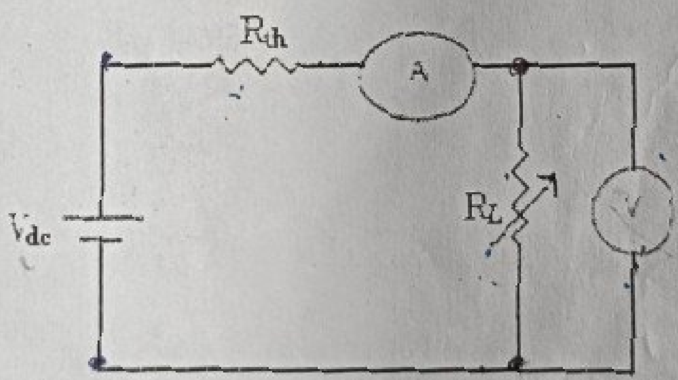


Fig. 6.1 Connection Diagram of Maximum Power Theorem

Experiment No.. 6

* Aim: Verify Maximum Power Theorem

* Theory: load draws max power from the source, when the load resistance is equal to the internal resistance of the source.

At $R_L = R_{Th}$, power consumed is max

$$P = I_L^2 R_L = \cancel{V_L I} \; V_L I_L$$

* Apparatus Required:-

S.No	Name	Range	Quantity
1.	DC Voltmeter	(0-20) V	1
2.	DC Ammeter	(0-200) mA	1
3.	Breadboard	–	1
4.	Connecting wires	–	6
5.	Carbon Resistors	(100-1500) Ω	5

* Formula: $P = V_L^2 / R_L = V_L I_L$ watt

PROCEDURE:

i) The circuit is connected as shown in the Fig. 6.1.

ii) R_{th} is fixed at some suitable value, for a particular value of R_L the ammeter (A) and voltmeter (V) reading are noted

iii) By varying the value of R_L from $R_L < R_{th}$ to $R_L > R_{th}$, the voltage across the load and current through the load are noted.

iv) Now the power is calculated by using the formula

$$P = IL^2\, RL = VL^2 / RL = VL\, IL$$

v) For each value of current IL or VL, take the value of RL at the maximum power. If RL value is equal to the internal resistance of source R_{th}, then the theorem is proved.

OBSERVATION TABLE:

S.No	Load Resistance (R_L) (Ω)	Voltage across load (V_L) (Volts)	Current through load (I_L) (mA)	$P_L = V_L I_L$ (W)	Rth (Ω)

RESULTS: It is found that power consumed is maximum when R_L becomes equal to R_{th}. This verifies the maximum power transfer theorem.

LEARNING OUTCOMES: (to be filled by student)

APPLICATIONS: (to be filled by student)

PRECAUTION:

i) The load resistance RL is varied from $< R_{th}$ to $> R_{th}$.

ii) Internal resistance of the source should be measured before going to the experiment.

iii) All connections should be tight.

VIVA QUESTION:

I. What is max power transfer formula?

II. What is the field of application of this theorem?

III. What is electric network?

IV. What is necessary to know the polarity of voltage drop across a resistance?

V. What is the reason that terminal voltage is less than emf?

VI. What is the resistance of ideal voltage source?

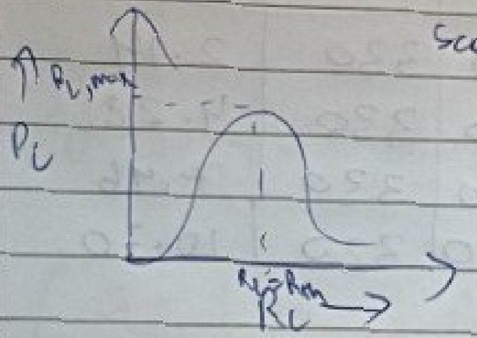
VII. When will the power extracted from a ckt is maximum

10/04/23

Electrical - 06

Graph

Scale



S.No	Load Resistance R_L	Voltage across load V_L (V)	Current I_L (mA)	$P_L = V_L \cdot I_L$	Rth
1	100	0.73	8.2	5.986	330
2	330	1.71	5.4	9.234	330
3	750	2.42	3.3	7.986	330
4	1500	2.88	1.9	5.472	330
5					

$R_1 \rightarrow (100 \pm 1\%)\Omega$

$R_2 \rightarrow (330 \pm 1\%)\Omega$

$R_3 \rightarrow (750 \pm 1\%)\Omega$

$R_4 \rightarrow (1500 \pm 1\%)\Omega$

$R_5 \rightarrow (330 \pm 1\%)\Omega$