AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

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Assignment Title:	Study of Thevenin's Theorem and Maximum Power Transfer Theorem.		
Assignment No:	05	**Date of Submission:**	November 06,2022
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Course Code:	COE2102	**Section:**	T
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	Marks Obtained	9
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Title : Study of Thevinin's Theorem and Maximum Power Transfer Theorem.

Abstract:

The experiment was conducted to invegtigate the study of Thevin's theorem and maximum power transfer theorem. The objectives of this experiment are to find the Thevinin equivalent circuit, measure the load voltage and load current from given network also verify the maximum power transfer theorem. In this experiment, some basic tools like trainer board, voltmeter, ammeter, AVO meter or multimeter, DC source, resistors etc are used. By completing this experiment, we are able to develop the understanding of the Thevinin theorem and also justify the maximum power transfer theorem.

Theory:

Thevinin's Theorem: The Thevinin Theorem is a process of reducing complex circuit to an equivalent circuit which is consist of a single voltage source V_{TH}, a series resistance R_{TH} and a load resistance R_L. After that creating the Thevinin equivalent circuit, we may the easily determine the load voltage V_L and the load current I_L.

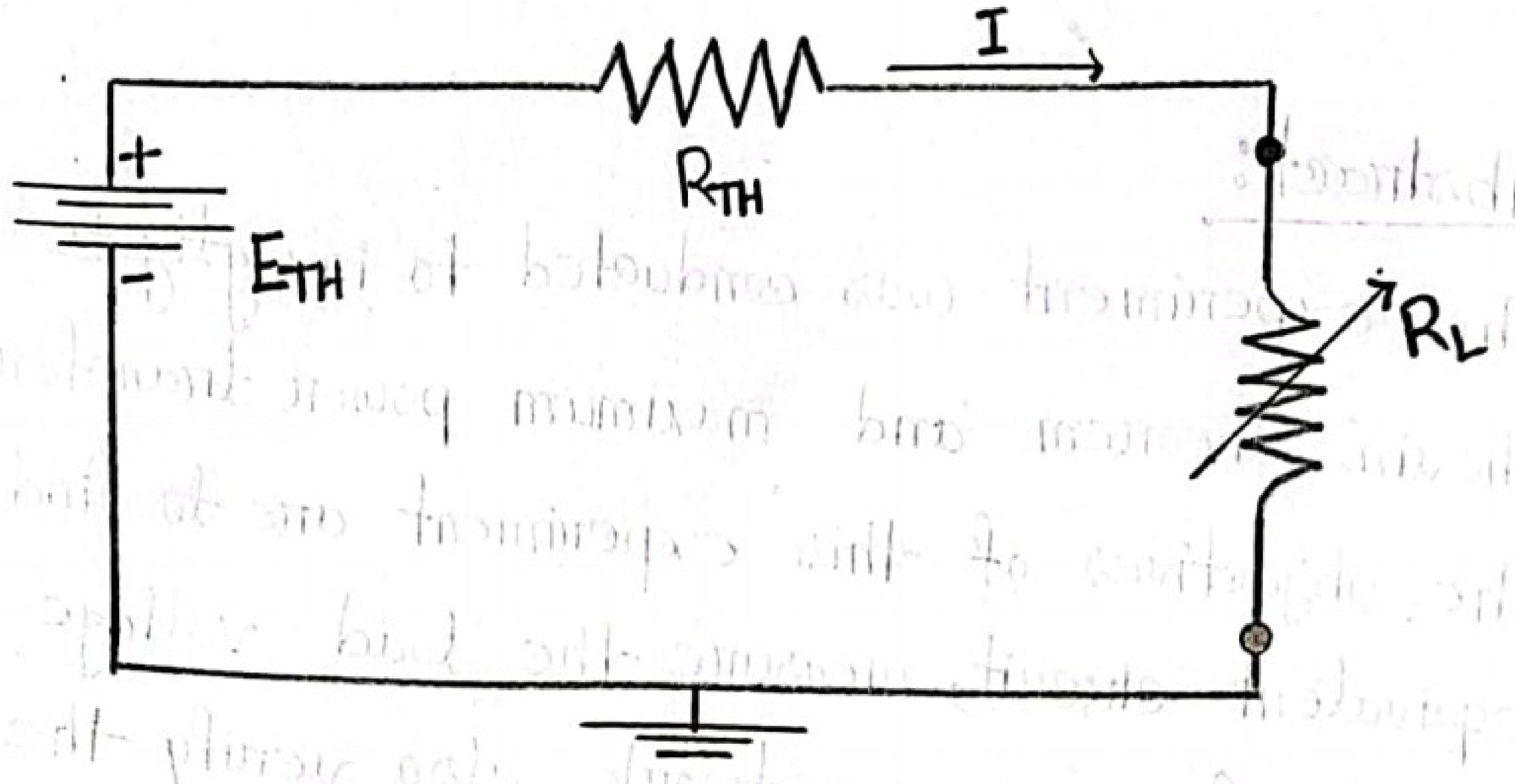


Figure 1: Thevinin's equivalent circuit

Maximum Power Transfer Theorem:

The maximum power transfer theorem states that, "A load will receive maximum power from a dc network when it's total resistance is exactly equal to the Thevinin resistance of the network by the load."
For the Thevinin equivalent circuit (Figure 1), the maximum power will be delivered to the load when, $R_L = R_{TH}$. If the load resistance is lower or higher than the Thevinin resistance of the network, it will observe the less than the maximum power.

From Figure1, the maximum power will be delivered to the load, when,

$$R_L = R_{TH}$$

$$\Rightarrow I_L = \frac{E_{TH}}{R_{TH} + R_L} = \frac{E_{TH}}{R_{TH} + R_{TH}} = \frac{E_{TH}}{2R_{TH}}$$

Now,

$$\text{power } P_L = I_L^2 R_L = \left(\frac{E_{TH}}{2R_{TH}}\right)^2 \times R_{TH}$$

$$= \frac{E_{TH}^2 R_{TH}}{4R_{TH}^2}$$

$$\Rightarrow P_{L\,max} = \frac{E_{TH}^2}{4R_{TH}}$$

Circuit Diagram :

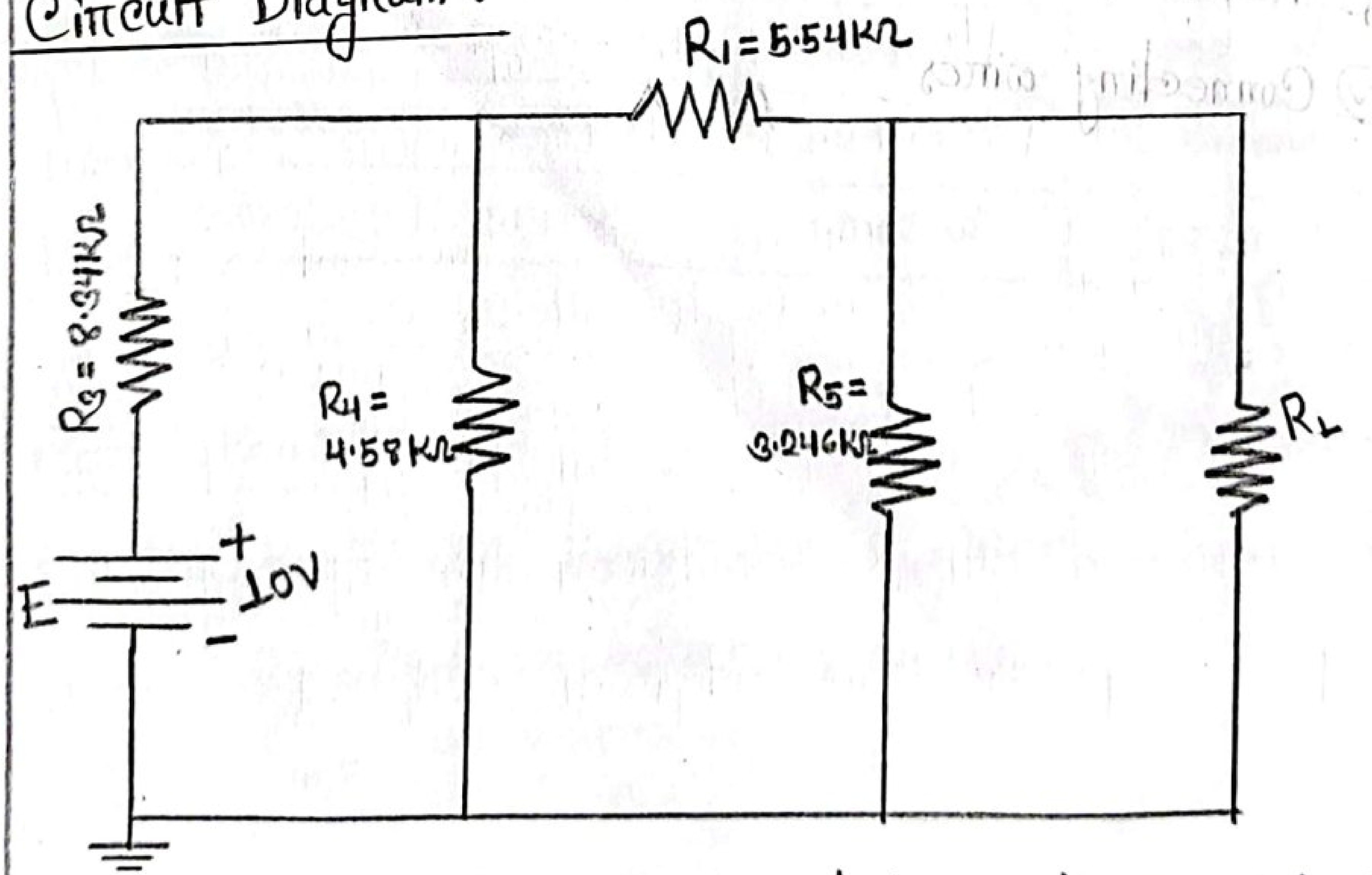


Figure 2: Series-Parallel circuit to apply Thevinins Theorem.

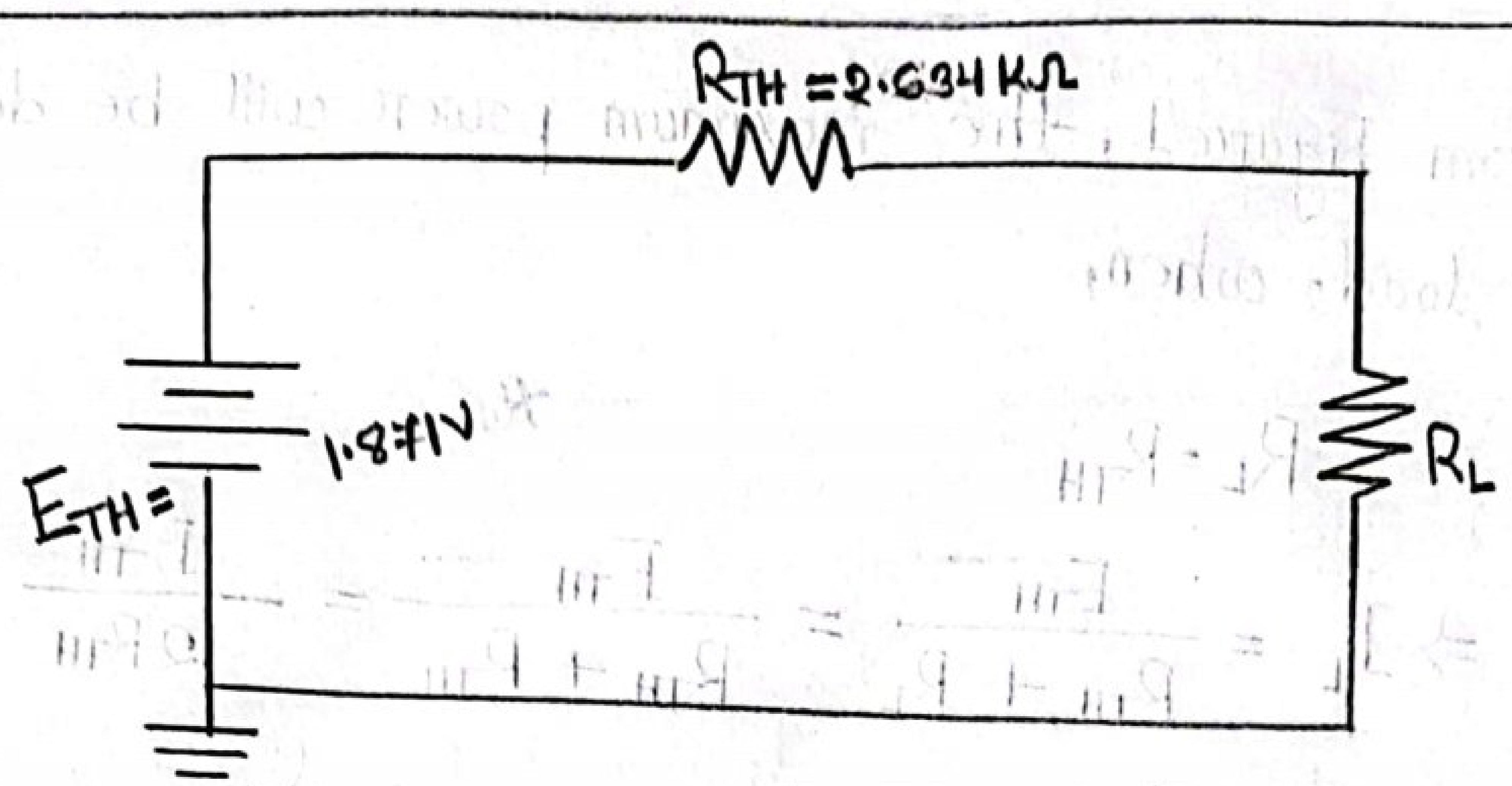


Figure-3 : Thevinin's equivalent circuit from figure-1.

List of Equipment:

(i) Bread Board

(ii) Digital multimeter

(iii) Dc source

(iv) Resistors

(v) Connecting wires

Experimental Data:

Table-1 (For Thevinins Equivalent Circuit)

Thevinins Equivalent Voltage E_{TH}		Thevinins Equivalent Resistance R_{TH}	
Measured value	Calculated value	Mesured value	Calculated Value
1.871 V	0.9802 V	2.634 KΩ	2.212 KΩ

Table-2 (For Maximum Power Transfer Theorem)

R_L	V_L	I_L mA	P_L (mW)
0.634 KΩ	341 mV	0.538 mA	0.184 mW
1.634 KΩ	0.669 V	0.41 mA	0.274 mW
2.634 KΩ	0.879 V	0.334 mA	0.293 mW
3.634 KΩ	1.038 V	0.286 mA	0.297 mW
4.634 KΩ	1.148 V	0.248 mA	0.284 mW

Graph

Calculation:

For R_{TH}, $R_1 = 5.54\,K\Omega$, $R_3 = 8.34\,K\Omega$, $R_4 = 4.58\,K\Omega$, $R_5 = 3.246\,K\Omega$

$$R_{15} = (5.54 + 3.246)\,K\Omega = 8.786\,K\Omega$$

$$R_{415} = \frac{4.58 \times 8.786}{4.58 + 8.786}\,K\Omega = 3.011\,K\Omega$$

$$R_{3415} = \frac{8.34 \times 3.011}{8.34 + 3.011}\,K\Omega = 2.212\,K\Omega \qquad \therefore R_{TH} = 2.212\,K\Omega$$

For E_{TH},

$R_{15} = 8.786\ K\Omega$

$R_{415} = 3.011\ K\Omega$

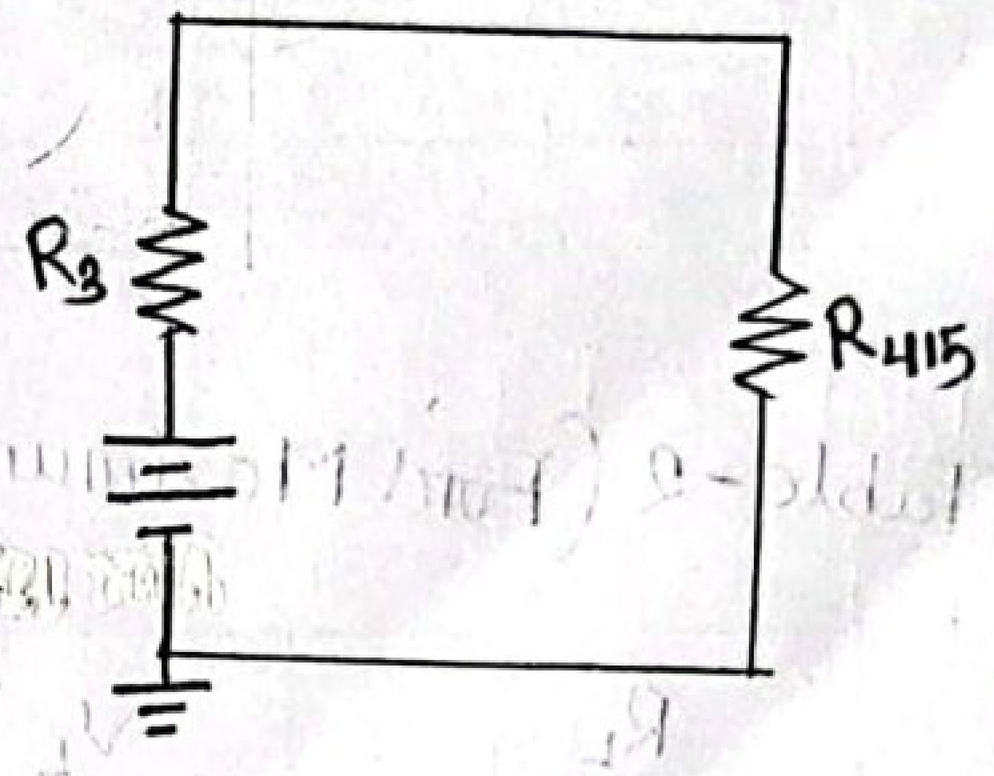
$R_{3415} = (8.34 + 3.011)\ K\Omega$
$= 11.351\ K\Omega$

Apply VDR,

$$V_{R_{415}} = \frac{R_{415}}{R_{3415}} \times 10V$$

$$= \frac{3.011}{11.351} \times 10V$$

$$= 2.653V$$



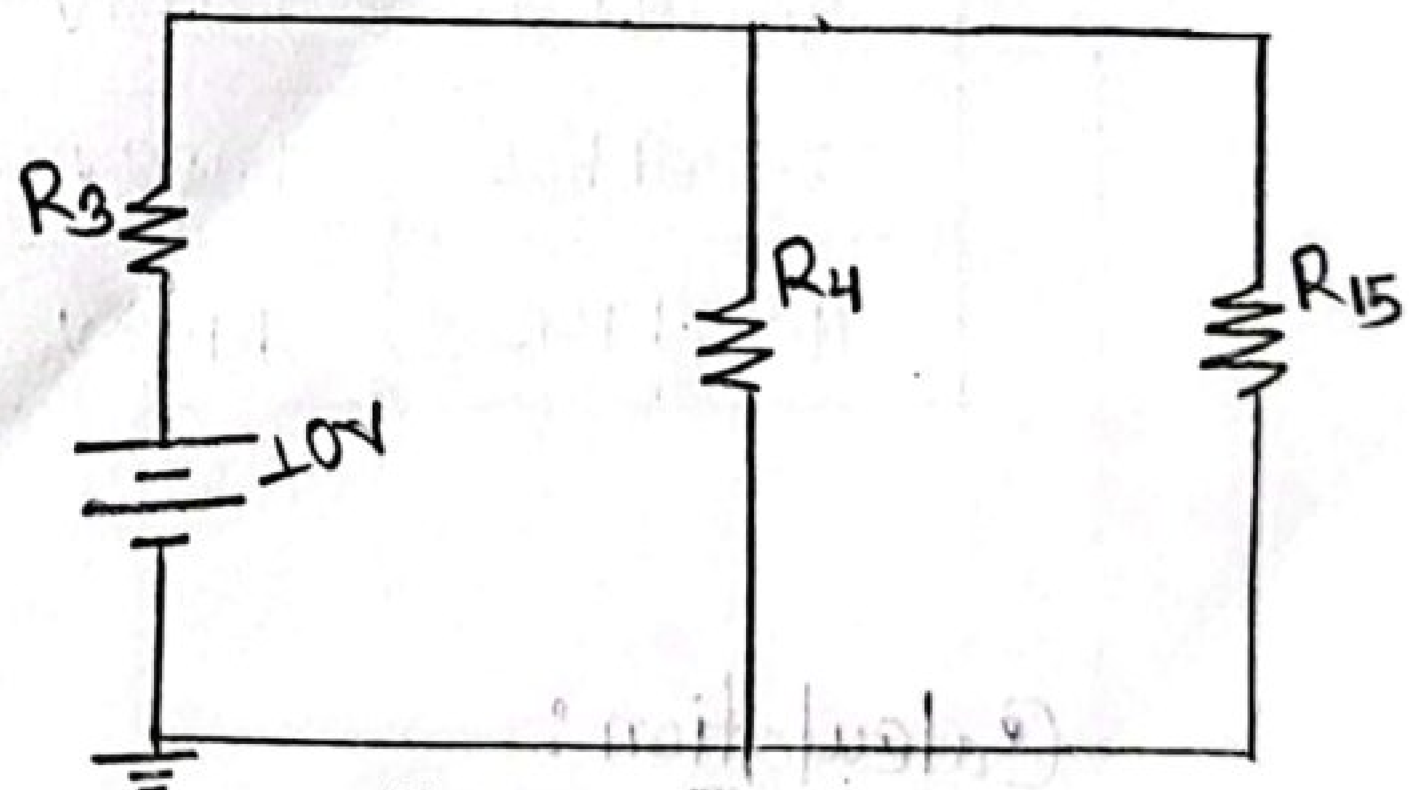
Again Apply VDR,

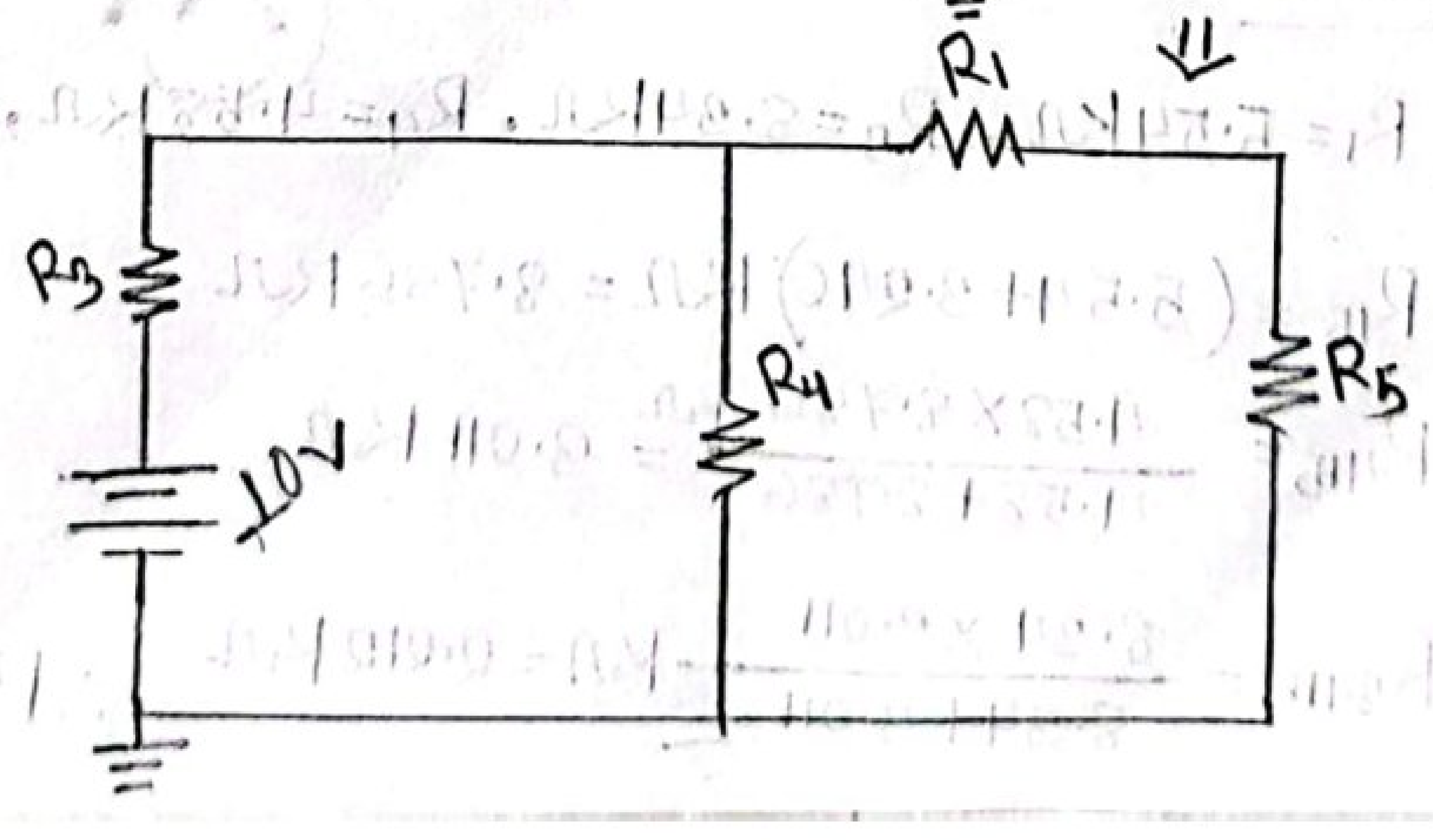
$$V_{R_5} = \frac{R_5}{R_{15}} \times V_{R_{415}}$$

$$= \frac{3.246}{8.786} \times 2.653$$

$$= 0.9802V$$

$\therefore E_{TH} = 0.9802V$





Discussion:

1. The bread board was checked before the start of the experiment.

2. The multimeter was checked also.

3. The value of the voltage was increased gradually as applying of a large voltage can damage the resistors.

4. The resistors was placed properly according to the figure.

5. Every data was measured carefully.

6. All the data was placed in the data table. carefully.

7. After the calculation by using the given equation a result was obtained.

Conclusion: The purpose of the experiment was to establish Thevins Theorem and Maximum Power Transfer Theorem. Conducting the experiment the objects we find Thevinins equivalent circuit, the load voltage and load current from given network. After completing the experim-ent we are able to reducing complex circuit to an equivalent circuit and from the calculation and result we find that a load receive maximum power when it's total resistance is exactly equal to the Thevinins resistance by the load from the network. So conducting the experi-ment we are able to verify the Thevinins Theorem and the Maximum power Theorem is also verified.

References:

i) Lab manual.

ii) Theory slides.