Experiment Name / No.: 02

Camlin | Page No.
Date 14/01/2020

Experiment No. :-> 02.

1.) **Aim :->** To verify Thevenin's Theorem

2.) **Apparatus :->** Wires, D.C. sources, Resistances Ammeter, Voltmeter

3.) **Theory :->** It provides a mathematical technique for replacing a given network, as viewed from two terminals, by a single voltage source with a series resistance. It makes the solution of complicated networks quite quick and easy. The application of this extremely useful theorem will be explained with the help of following simple example

Suppose, it is required to find current flowing through Load Resistance R_L, as shown in diagram

This expression proceed as follows :-

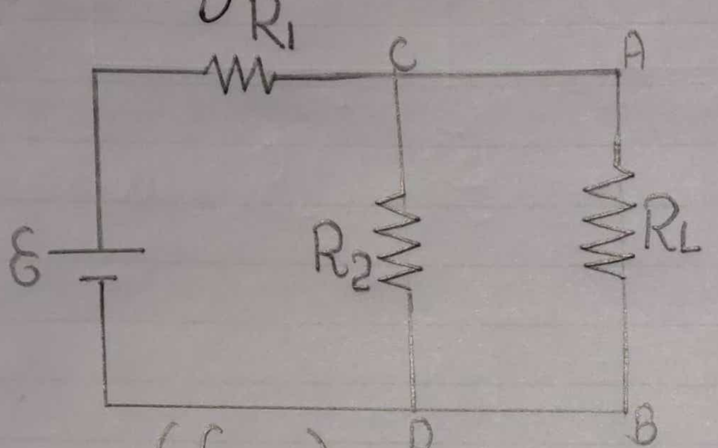
1) Remove R_L from the circuit terminals A and B and redraw the circuit as shown in diagram. Obviously the terminal have become open circuited

Teacher's Signature:

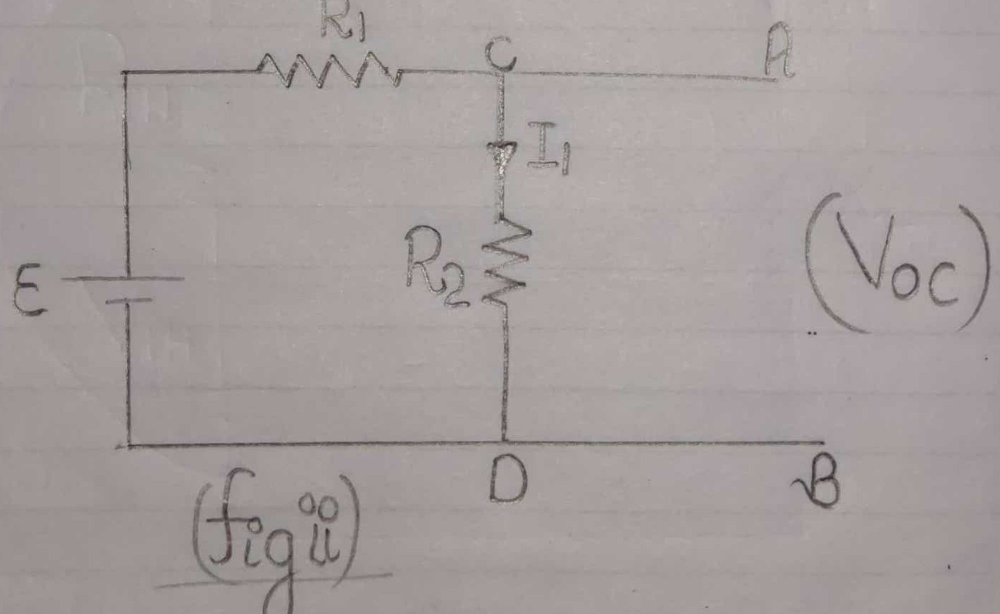
Experiment No :-> 2.

Aim :-> To verify Thevenin's Theorem.

Circuit diagram :->



(fig i)



(fig ii)

2.) Calculate the open circuit voltage (V_{oc}) which appears across terminals A and B when they're open i.e. when R_L is removed

As seen, V_{OC} = drop across, $R_2 \Rightarrow IR_2$ where I is the circuit current when A and B is open :-

$$I = \frac{\varepsilon}{r + R_1 + R_2}$$

$$V_{OC} = IR_2$$

$$V_{OC} = \left(\frac{\varepsilon}{r + R_1 + R_2} \right) R_2$$

It is also called Thevenins voltage

3.) Now imagine the battery to be removed from the circuit, leaving its internal resistances r behind and redraw the circuit as shown in diagram When viewed inwards from the terminals A and B, the circuit consists of two parallel paths one containing R_2 and another containing $(R_1 + r)$ The equivalent resistance of the network as viewed from these networks terminals is given as

$$\left(\frac{(R_1 + r) R_2}{R_1 + r + R_2} \right) = R_{TH}$$

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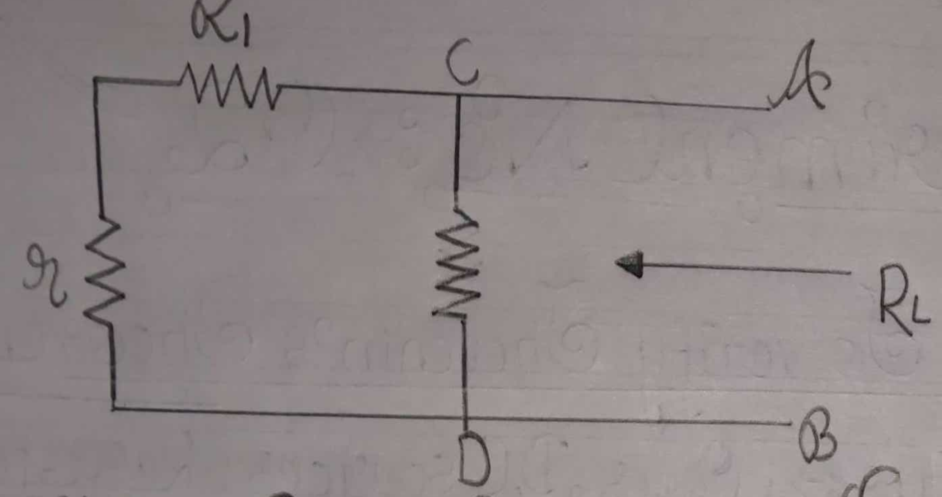
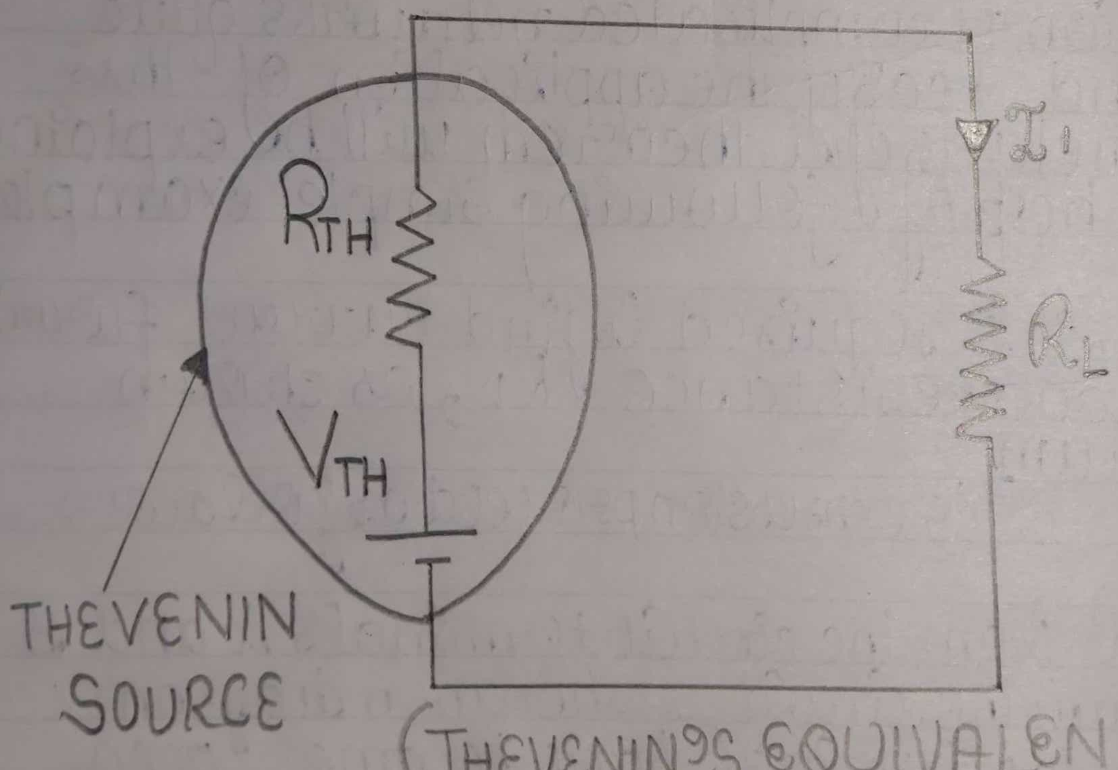


Circuit with R_L and $\mathcal{E}$ removed (fig iii)



(THEVENIN'S EQUIVALENT CIRCUIT) (fig iv)

The resistance is called Thevenin's Equivalent Resistance.

Consequently as viewed from Terminals A and B, the whole network (excluding R_L) can be reduced to single source (called Thevenin's source) whose emf is equal to Voc and whose internal resistance is equal to R_{TH} as shown in diagram

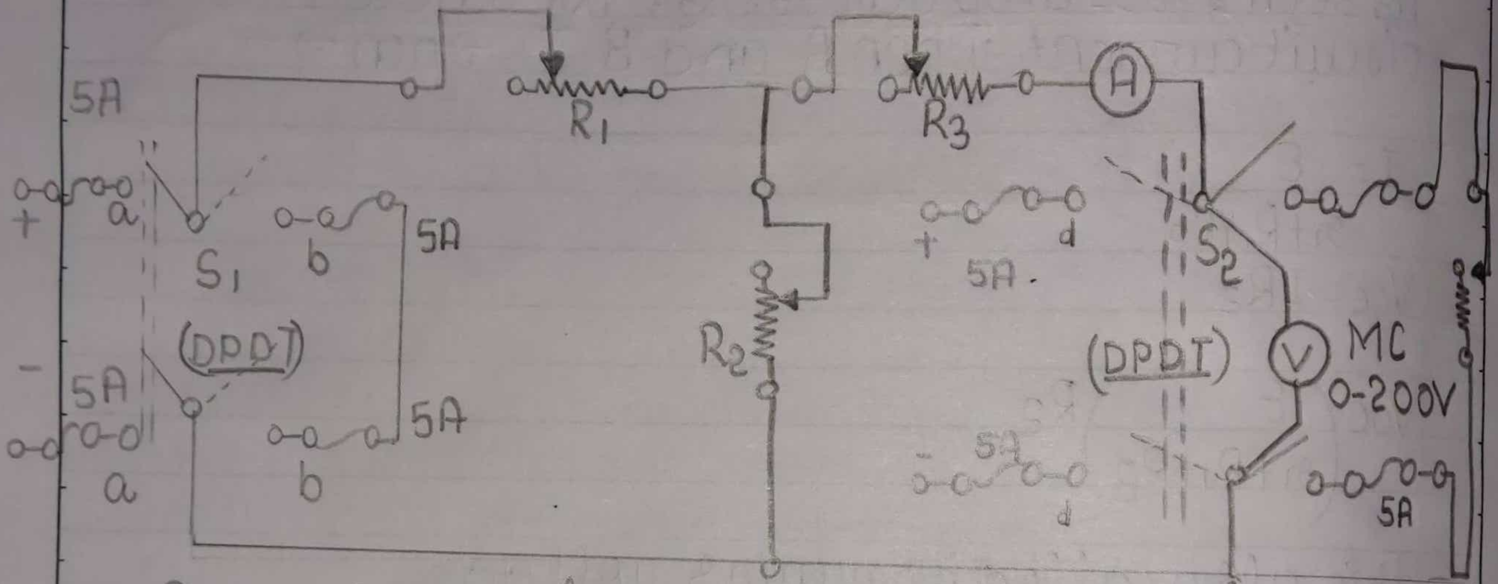
R_L is now connected back across terminals A and B from where it was temporarily removed earlier. Current flowing through R_L is given by :- $\left(\frac{V_{TH}}{R_{TH}+R_L}\right)$

4) Procedure :-

1) Keep all the resistances close to their maximum respective values

2) Close the switch S_1 to "aa" and S_2 to "cc" positions. Observe the Load current (I_L) and Voltage (V_L) readings. The Load resistance

$$R_L = \left(V_L / I_L\right)$$



Circuit diagram for experimental set up for verification of Thevenin's Theorem

Experiment Name / No.: 02

Camlin Page No.

Date 14/01/2020

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Teacher's Signature:

Experiment Name / No.: 02

Camlin | Page No.

Date 14 | 01 | 2020

3) Remove the load by opening the switch S_2 and read the open circuit voltage (or Thevenin equivalent voltage) V_{TH}

3) Next, compute the resistance (R_{TH}) of the network as seen from the load terminals.

4) Replace the 220 V source by a short by closing S_1 to "bb". Apply 110 V at the output terminals by closing S_2 to "dd". Read the voltmeter (V) and ammeter (I) and get

$$R_{TH} = V/I$$

5) Now compute the load current, Applying Thevenin theorem

$$\left(\frac{V_{TH}}{R_{TH}+R_L}\right)$$

6) Compare the above computed load current with its observed value in step(2) & verify the theorem

Case I :-> Circuit analysis of to determine load current (I_L)

Teacher's Signature:

Experiment Name / No.: 02

Camlin | Page No.
Date 14/01/2020

To get the load current, select switches S_1 to Power and S_2 to load. And then click on simulate we will get the value of load current I_L from Case 1 tab.

Case 2: Thevenin Voltage Analysis :->

Apply switch S_1 to power and S_2 to intermediate Simulate the program. Read Thevenin voltage (V_{TH}) from Case 2 Tab. Read.

Thevenin Resistance analysis

Apply switch S_1 to short and S_2 to power. Simulate the program. Read Thevenin Resistance (R_{TH}) from case 2 tab.

Case 3: Using V_{TH} and R_{TH} to determine the load current

Click on simulate to get the Load current (I_L) from the Thevenin experiment equivalent parameter of the above circuit. Compare the load currents (I_L) obtained in this case from Case 1 & fill data to the observation table.

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S.no of observation	Load Current (I_L) from case	Load voltage (V_L)	Load Resistance $R_L = V_L/I_L$	Thevenin voltage (V_{th}) from case 2a	2nd voltage source (V) for case 2(b)	Ammeter Reading (I) from case 2	Thevenin Resistance $R_{th} = V/I$	Load current $I_L = V_{th}/(R_{th}+R_L)$
1	0.10645	53.225	500	82.500	220	0.80000	275.00	0.10645
2	0.10924	54.620	500	85.549	225	0.79474	283.11	0.10924
3	0.11124	56.1762	505	88.571	230	0.78986	291.19	0.11124
4	0.11315	57.7065	510	91.570	235	0.78531	299.24	0.11315
5	0.11498	59.2147	515	94.545	240	0.78107	307.27	0.11498

Case 1

Case 3

Case 1 = Case 3
Hence Proved

Experiment Name / No.: 02

Camlin Page No.

Date 14/01/2020

Result :-> The Thevenin's Theorem has been verified as the results from the observation Table are Identical. Ans.

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