# East West University

## Department of CSE

## LAB REPORT

<table>
<tr><td colspan="2">Course Code and Name:<br>CSE209 Electrical Circuits</td></tr>
<tr><td colspan="2">Experiment no:06</td></tr>
<tr><td colspan="2">Experiment name:<br>Verification of Thevenin’s theorem</td></tr>
<tr><td>Semester and Year:<br>Fall 22</td><td>GROUP NO:<br>1</td></tr>
<tr><td>Name of Student:<br>BM Shahria Alam<br>2021-3-60-016<br>Sidratul Moontaha<br>2021-3-60-048<br>Antara Sarker<br>2021-3-60-056<br>Date of Report Submitted:</td><td>Course Instructor information:<br>M Saddam Hossain Khan<br>Senior Lecturer<br>Department of Computer Science & Engineering</td></tr>
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| Date of Report Submitted: 14.12.2022 | |
|---|---|

## *Experiment title: Verification of Thevenin's theorem.*

### *Abstract:*

Thevenin's theorem states that a linear two-terminal network can be replaced by an equivalent circuit containing a voltage source Eth in series with a resistance Rth. Eth is equal to the open circuit voltage between the terminals and Rth is the ratio of the open circuit voltage to the short circuit current through the terminals. Experimentally, Eth may be measured by measuring the open circuit voltage and Rth can be calculated by measuring the open circuit voltage and the short circuit current.

### *Objective:*

To gain knowledge and observe Thevenin's theorem theoretically and using PSpice simulation.

### *Circuit diagrams:*

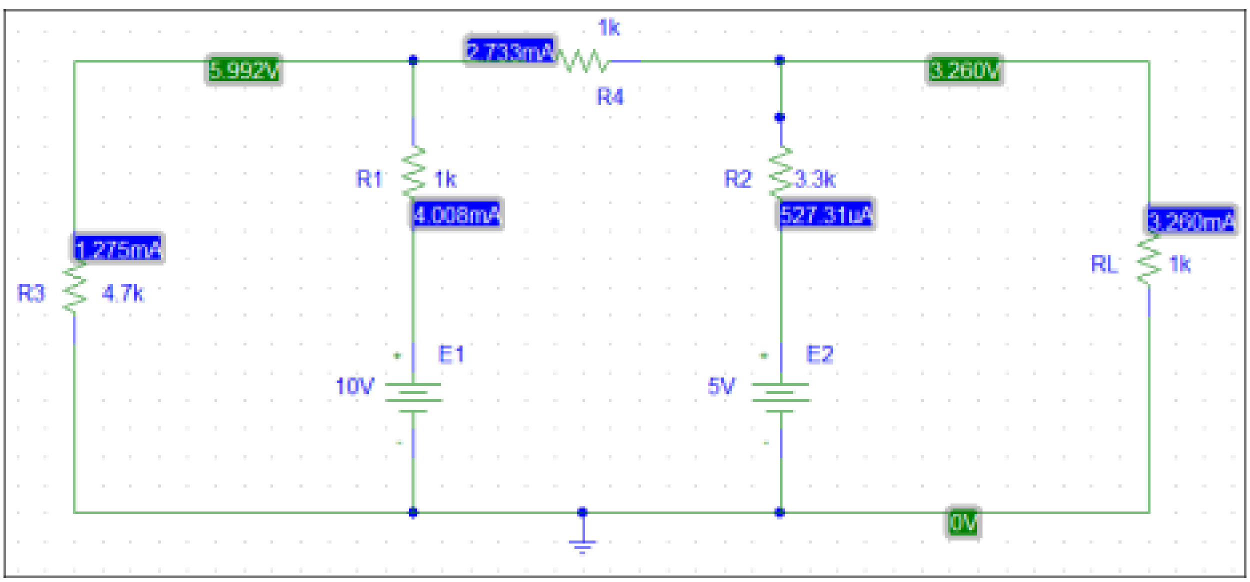


Figure 1. Circuit diagram whose Thevenin's equivalent to be determined.

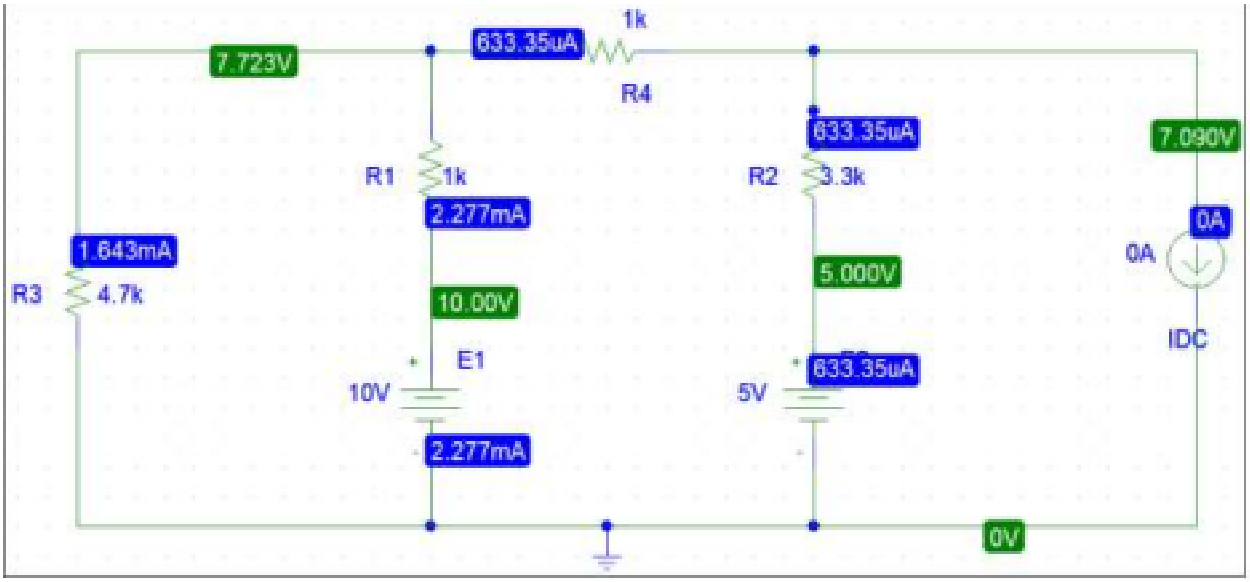


Figure 2. Circuit diagram to measure the open circuit voltage

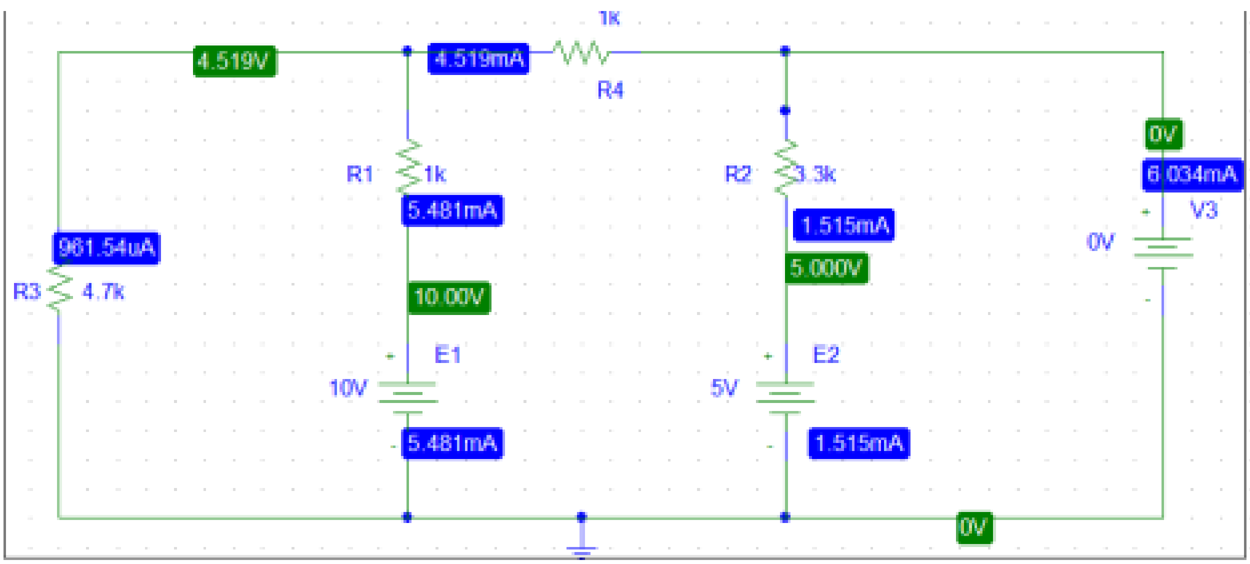


Figure 3. Circuit diagram to measure the short circuit current

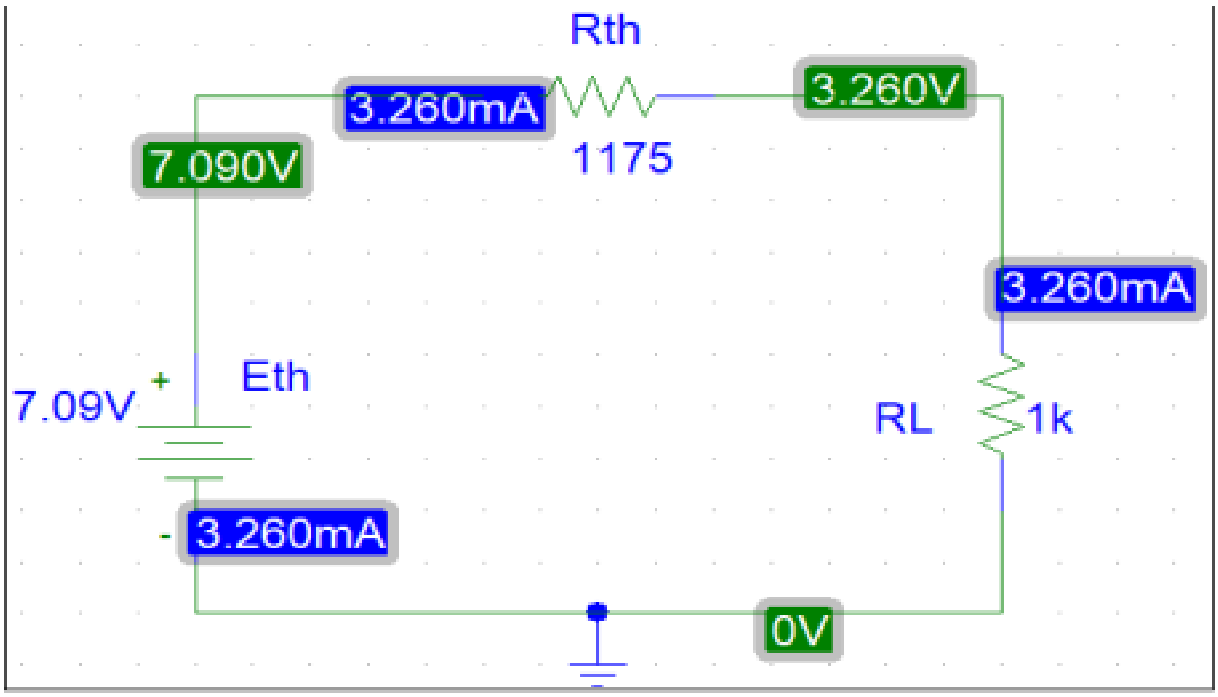


Figure 4. Circuit diagram to verify Thevenin's theorem.

***Table 1:*** Experimental Datasheet for determining Thevenin's equivalent circuit.

| Measured Value of $E_1$ | Measured Value of $E_2$ | Measured Value of $V_L$ | Measured Value of $I_L$ | Measured value of $V_{OC}$ | Measured value of $I_{SC}$ | Measured values of resistors (kilo ohm) |
|---|---|---|---|---|---|---|
| 10V | 5V | 3.3V | 3.3mA | 7.1V | 6.034mA | $R_1$ = 1 ohms<br>$R_2$ = 3.3 ohms<br>$R_3$ = 4.7 ohms<br>$R_4$ = 1 ohms<br>$R_L$ = 1ohms |

***Table 2:*** Experimental Datasheet for Thevenin's equivalent circuit.

| $E_{th} = V_{OC}$ | $R_{th} = V_{OC}/I_{SC}$ | Measured Value of $V_L$ | Measured Value of $I_L$ |
|---|---|---|---|
| 7.1V | 1.15 K ohms | 3.29V | 3.3mA |

## Post-Lab Report Answer:

### Answer to the Post-Lab Question 1:

Measured values are = 10V, = 5V, = 1K, = 3.3K, = 4.7K, = 1K and = 1K

For figure 1:

KVL at mesh 1,

5.7 …………………………. (1)

KVL at mesh 2,

……………………..… (2)

KVL at mesh 3,

-3.3 ……………………..… (3)

From equation (1), (2) and (3)

∴ and = 3.260mA

For figure 2:

KVL at mesh 1,

…………………………. (1)

KVL at mesh 2,

……………………..… (2)

From (1) and (2),

∴ = 7.1V

So, = 7.1V

For figure 3:

KVL at mesh 1,

5.7 = -10…………………………… (1)

KVL at mesh 2,

- + 5.3 – 3.3 = 5…………………… (2)

KVL at mesh 3,

-3.3 + 3.3 = 5………………………………… (3)

From (1), (2) and (3)

=6.034mA

∴ =6.034mA

So, = 7.1V, = 1.15 Kohm

For figure 4:

= 3.3V, = 3.3mA

So, Thevenin's theorem is verified

**Answer to the Post-Lab Question 2:**

Comparing the theoretically calculated values with the experimental (using PSpice) values:

Theoretically calculated values are = 3.29V, = 3.3mA, = 7.1V, = 6.034mA, = 7.1V, = 1.15Kohm, = 3.260V and =3.260mA

Experimentally (using PS pice) Measured values are = 3.29V, = 3.3mA, = 7.090V, = 6.034mA, = 7.1V, = 1.15 Kohm, = 3.29V and =3.3mA

Comment: There are some small differences between the experimental measured values and the theoretical values.

**Answer to the Post-Lab Question 3:**

Solving the circuits of Figures using PSpice:

Simulation for figure 1:

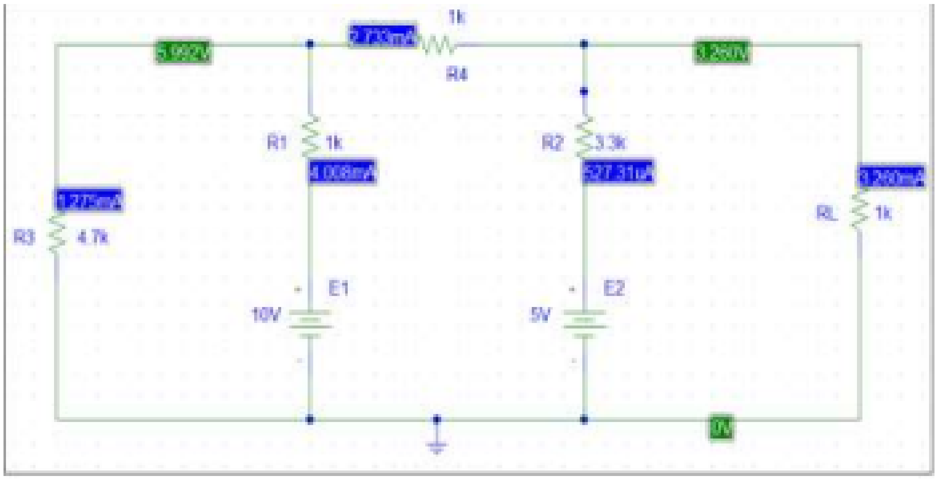


Figure 1. Circuit diagram whose Thevenin's equivalent to be determined. From figure 1, VL= 3.26V and IL= 3.260mA

Simulation for figure 2:

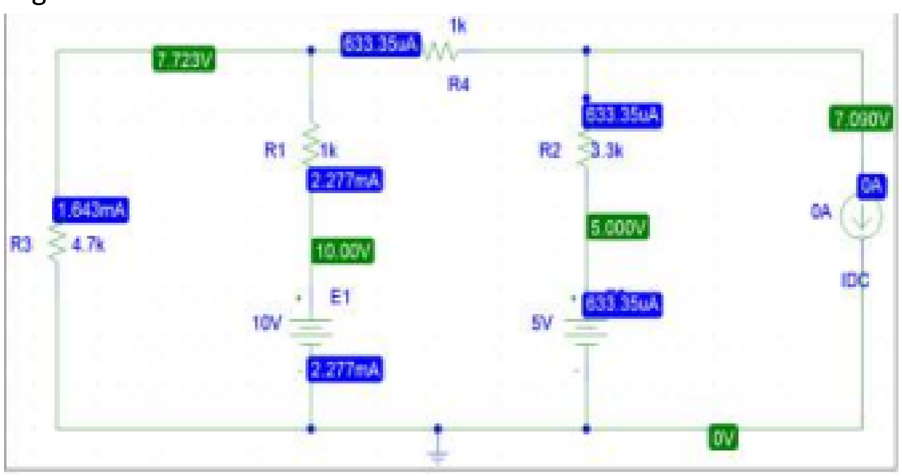


Figure 2. Circuit diagram to measure the open circuit voltage

From figure 2, Voc= 7.090V

Simulation for figure 3:

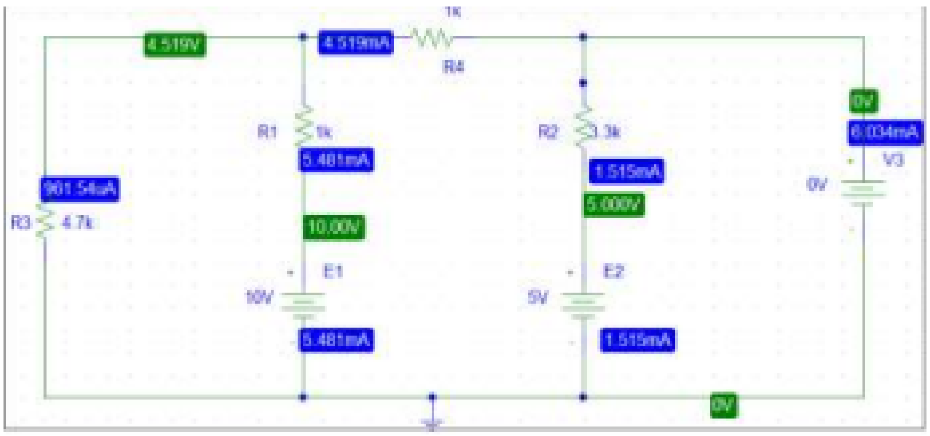


Figure 3. Circuit diagram to measure the short circuit current.

From figure 3, Isc= 6.034mA

Simulation for figure 4:

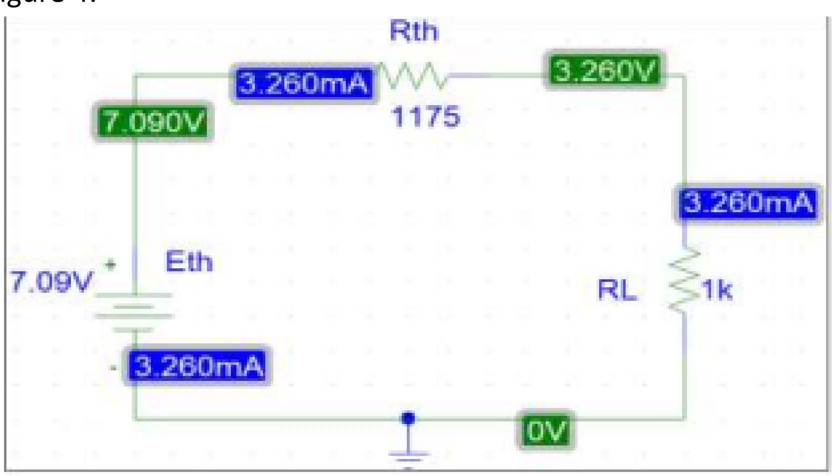


Figure 4. Circuit diagram to verify Thevenin's theorem.

From figure 4, VL= 3.260V and IL= 3.260mA

Since there is no difference, we can say the Thevenin's theorem is verified.

## ***Result & Discussion:***

So after theoretically calculating, the values are = 3.260V, = 3.260mA, = 7.089V, = 6.034mA, = 7.089V, = 1174.84ohm.

Measured values are = 3.260V, = 3.260mA, = 7.090V, = 6.034mA, = 7.09V, = 1175 ohm

.

Here we have slight differences between the theoretical values and the experimental measured values. Pre-Lab data and experimental data are also almost the same. From this experiment, we slightly broaden our knowledge we gained from the previous experiment. By doing this experiment we have been able to simulate our circuits via PSpice and test the results. After doing this experiment we gain knowledge about Thevenin's theorem.

## ***Conclusion:***

In these experiments, the readings were taken very carefully. Though there is no slight difference between calculated value and PSpice value, at the end of the experiment we finally learned about Thevenin's theorem.

## Reference:

[1] Lab manual

Table :

Experiment number :- 06

Table :- 01 Experimental Datasheet of determining Thevenin's equivalent circuit.

| Measure value of $E_1$ | Measured value of $E_2$ | Measured value of $V_L$ | Measured value of $I_L$ | Measured value of $V_{oc}$ | Measured value of $I_{sc}$ | Measured values of resistors ($k\Omega$) |
|---|---|---|---|---|---|---|
| 10 v | 5 v | 3.3 v | 3.3 mA | 7.1 v | 6.2 mA | $R_1 = 1k\Omega$<br>$R_2 = 3.3k\Omega$<br>$R_3 = 4.7k\Omega$<br>$R_4 = 1k\Omega$<br>$R_L = 1k\Omega$ |

Table :- 02 Experimental Datasheet for Thevenin's equivalent circuit.

| $E_{th} = V_{oc}$ | $R_{th} = V_{oc}/I_{sc}$ | Measured value of $V_L$ | Measured value of $I_L$ |
|---|---|---|---|
| 7.1V | 1.15 $k\Omega$ | 3.29 mA | 3.33 mA |

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Name :- Antara Sarker
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12/12/22

Pre labs:

Theme:

Date: / /

Sat Sun Mon Tue wed Thu Fri

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ID : 2021 - 3-60 - 056

Exp no : 06

Group no : 01

Lab 6 - Pre-Lab Report

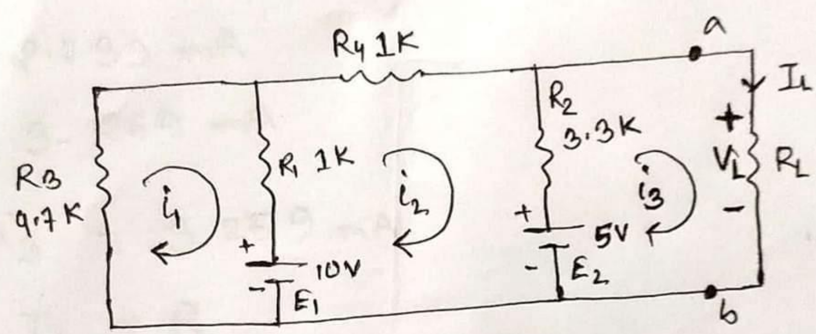



Fig 1

Here, $I_L = i_3$

KVL at mesh 1,

$$4.7 i_1 + 1(i_1 - i_2) = -10$$

$$\Rightarrow 5.7 i_1 - i_2 = -10 \quad \text{——— (1)}$$

KVL at mesh 2 ;

$$(i_2 - i_1) + i_2 + 3.3(i_2 - i_3) = 10$$

$$\Rightarrow -i_1 + 5.3 i_2 - 3.3 i_3 = 5 \quad \text{——— (2)}$$

Theme: Date: / /

Sat Sun Mon Tue wed Thu Fri

$\Rightarrow -V_1 + 1.303 V_2 = 1.515$ —— (2)

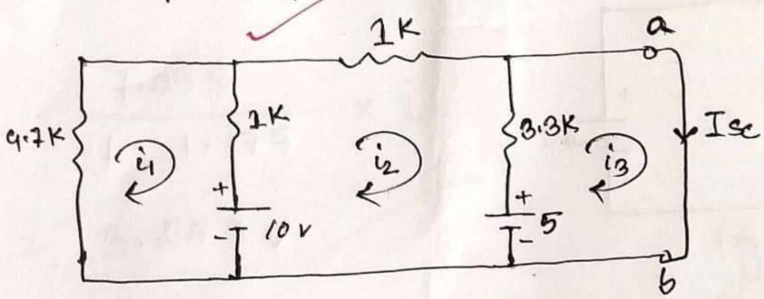
from eq (1) and (2)

$V_1 = 7.727$ V

$V_2 = 7.093$ V

$\therefore V_{oc} = V_2$

$= 7.093$ V




KVL at mesh 1:

$4.7 i_1 + i_1 - i_2 = 10$

$\Rightarrow 5.7 i_1 - i_2 = 10$ —— (1)

KVL at mesh 2:

$i_2 - i_1 + i_2 + 3.3(i_2 - i_3) = 5$

$\Rightarrow -i_1 + 5.3 i_2 - 3.3 i_3 = 5$ —— (2)

KVL at mesh 3:

$3.3(i_3 - i_2) = 5$

$\therefore -3.3 i_2 + 3.3 i_3 = 5$ —— (3)

KVL at mesh 3;

$$3.3(i_3 - i_2) + i_3 = 5$$

$$\Rightarrow -3.3 i_2 + 4.3 i_3 = 5 \quad \text{——— (3)}$$

from eq (1), (2) and (3) we get —

$$i_1 = -1.274 \text{ mA}$$

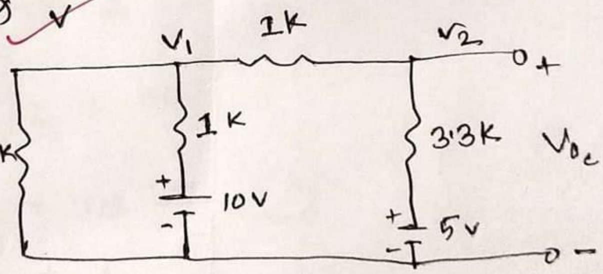
$$i_2 = 2.733 \text{ mA}$$

$$i_3 = 3.259 \text{ mA}$$

$$I_L = i_3 = 3.259 \text{ mA}$$

$$V_L = I_L \times R_L$$

$$= 3.259 \text{ V}$$




KCL at node 1;

$$\frac{V_1}{4.7} + \frac{V_1 - 10}{1} + \frac{V_1 - V_2}{1} = 0$$

$$\Rightarrow 2.212 V_1 - V_2 = 10 \quad \text{——— (1)}$$

KCL at node 2;

$$\frac{V_2 - 5}{3.3} + V_2 - V_1 = 0$$

Theme: Date: / /

Sat Sun Mon Tue wed Thu Fri

From eq (1), (2), (3) we get —

$i_1 = -0.961$ mA ; $i_2 = 4.519$ mA ; $i_3 = 6.034$ mA

$\therefore I_{sc} = i_3 = 6.034$ mA.

$\therefore E_{th} = V_{oc} = 7.093$ ~~mA~~ V.

$\therefore R_{th} = \dfrac{V_{oc}}{I_{sc}} = \dfrac{7.093}{6.034} = 1.175$ K

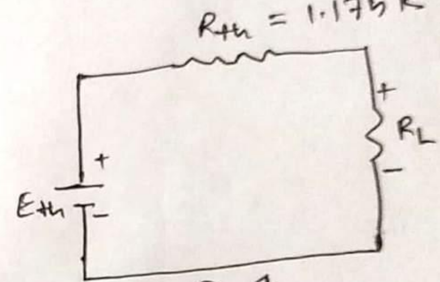



Fig 4

$V_L = \dfrac{7.093}{1 + 1.175} \times 1$

$= 3.259$ v

$I_L = \dfrac{V_L}{R_L}$

$= 3.259$ mA

As $V_L$ and $I_L$ from Fig 1 is equivalent to the $V_L$ and $I_L$ of Fig 4, So the thevenins theorem is verified.

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Exp no: 06

## Lab-6 Pre lab report

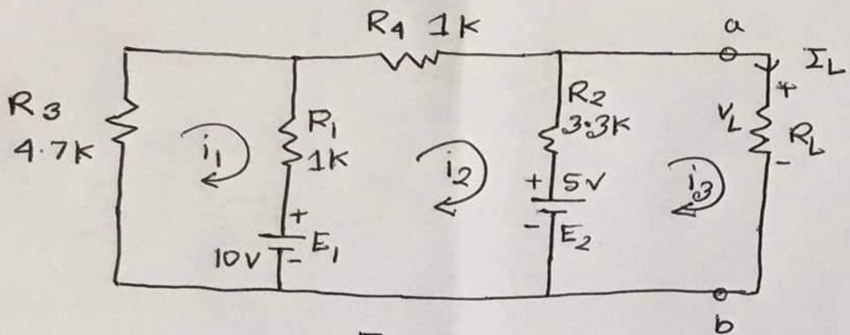



Fig - 1

Here, $I_L = i_3$

KVL at mesh 1,

$$4.7\, i_1 + 1\,(i_1 - i_2) = -10$$

$$\Rightarrow 5.7 i_1 - i_2 = -10 \quad \cdots\cdots (i)$$

KVL at mesh 2;

$$(i_2 - i_1) + i_2 + 3.3\,(i_2 - i_3) = 10$$

$$\Rightarrow -i_1 + 5.3 i_2 - 3.3 i_3 = 5 \quad \cdots\cdots (ii)$$

KVL at mesh 3;

$$3.3\,(i_3 - i_2) + i_3 = 5$$

$$\Rightarrow -3.3 i_2 + 4.3 i_3 = 5 \quad \cdots\cdots (iii)$$

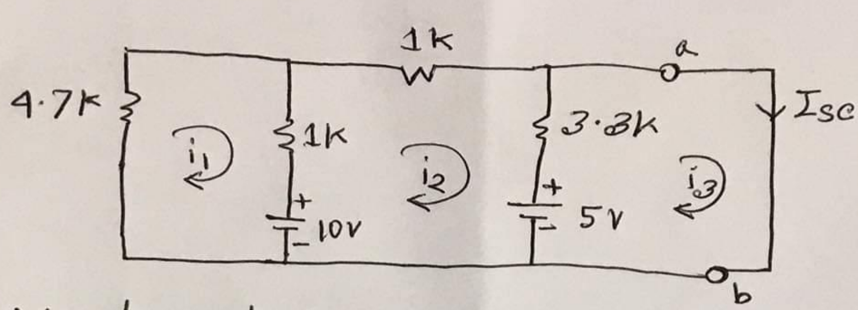
From eq (i), (ii) (iii) we get,

$i_1 = -1.274$ mA

$i_2 = 2.733$ mA

$i_3 = 3.259$ mA

$\therefore I_L = i_3 = 3.259$ mA




KVL at mesh 1,

$$4.7\,i_1 + i_1 - i_2 = 10$$

$$\Rightarrow 5.7\,i_1 - i_2 = 10 \quad \cdots\cdots (i)$$

KVL at mesh 2;

$$i_2 - i_1 + i_2 + 3.3\,(i_2 - i_3) = 5$$

$$\Rightarrow -i_1 + 5.3\,i_2 - 3.3\,i_3 = 5 \quad \cdots\cdots (ii)$$

KVL at mesh 3;

$$3.3\,(i_3 - i_2) = 5$$

$$\therefore -3.3\,i_2 + 3.3\,i_3 = 5 \quad \cdots\cdots (iii)$$

from eq (i, ii, iii) we get.

$$i_1 = -0.961 \text{ mA}$$

$$i_2 = 4.519 \text{ mA}$$

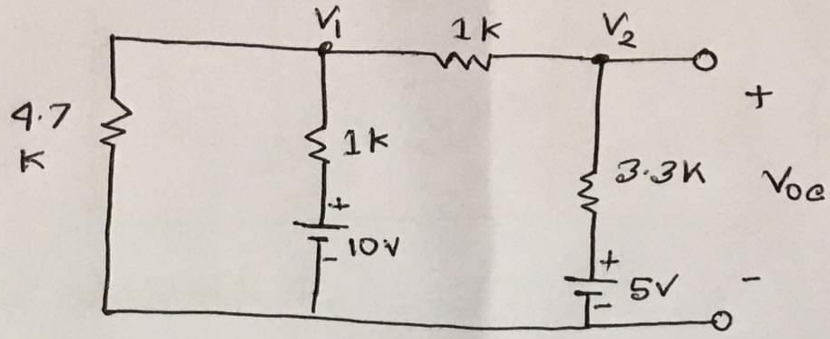
$$i_3 = 6.034 \text{ mA}$$

$$\therefore I_{sc} = i_3 = 6.034 \text{ mA}$$

$$\therefore E_{th} = V_{oc} = 7.093 \text{ V}$$

$$\therefore R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{7.093}{6.034}$$

$$= 1.175 \text{ K}$$




KCL in node 1 ;

$$\frac{V_1}{4.7} + \frac{V_1 - 10}{1} + \frac{V_1 - V_2}{1} = 0$$

$$\Rightarrow 2.212\, V_1 - V_2 = 10 \quad \cdots\cdots (1)$$

KCL at node 2 ;

$$\frac{V_2 - 5}{3.3} + V_2 - V_1 = 0$$

$$\Rightarrow -V_1 + 1.303\, V_2 = 1.515 \quad \cdots\cdots (2)$$

From eq (1) and (2)

$$V_1 = 7.727\,\text{v}$$

$$V_2 = 7.093\,\text{v}$$

$$\therefore V_{oc} = V_2$$

$$= 7.093\,\text{v}$$

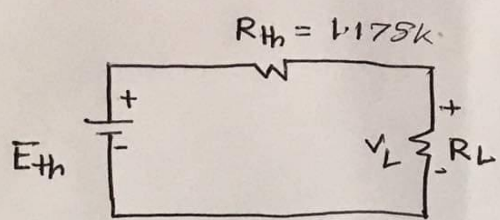



Fig-4

$$V_L = \frac{7.093}{1 + 1.175} \times 1$$

$$= 3.259 \text{ V}$$

$$I_L = \frac{V_L}{R_L}$$

$$= 3.259 \text{ mA}$$

As $V_L$ and $I_L$ from fig 1 is equivalent to the $V_L$ and $I_L$ of fig-4. So, thevenins theorem is verified.

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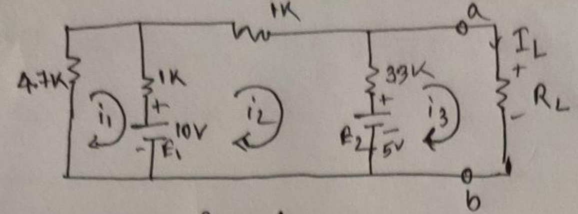



Fig-1

Here, $I_L = I_3$

KVL at mesh 1,

$$4.7 i_1 + (i_1 - i_2) = 10$$

$$\Rightarrow 5.7 i_1 - i_2 = 10 \quad (1)$$

KVL at mesh 2,

$$(i_2 - i_1) + i_2 + 3.3(i_2 - i_3) = 10$$

$$\Rightarrow i_1 + 5.3 i_2 - 3.3 i_3 = 5 \quad (2)$$

KVL at mesh 3,

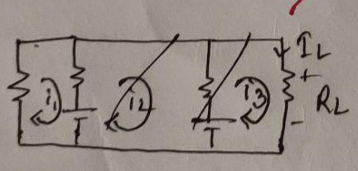
$$3.3(i_3 - i_2) + i_3 = 5$$

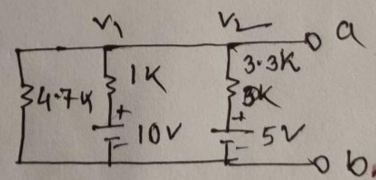
$$\Rightarrow -3.3 i_2 + 4.3 i_3 = 5 \quad (3)$$

From eq. (1), (2) (3), $i_1 = -1.274$ mA $i_2 = 2.73$mA $i_3 = 3.25$ mA

$I_L = 3.25$ mA

$\therefore V_L = I_L R_L = 3.25$ V




KCL in node 1,

$$\frac{V_1}{4.7} + \frac{V_1 - 10}{1} + \frac{V_1 - V_2}{1} = 0$$

$$\Rightarrow 2.21 V_1 - V_2 = 10 \quad (1)$$

KCL at node 2,

$$\frac{V_2 - 5}{3.3} + V_2 - V_1 = 0$$

$\Rightarrow -V_1 + 1.30V_2 = 1.51$ — (2)

From, eq (1) & (2) $V_1 = 7.72V$ $V_2 = 7.093V$

$V_{oc} = 7.093V = V_2$

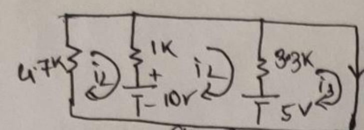



fig-3

KVL at mesh 1,

$4.7i_1 + i_1 - i_2 = 10$

$\Rightarrow 5.7i_1 - i_2 = 10$ — (1)

KVL at mesh 2,

$i_2 - i_1 + i_2 + 3.3(i_2 - i_3) = 5$

$\Rightarrow -i_1 + 5.3i_2 - 3.3i_3 = 5$ — (2)

KVL at mesh 3,

$3.3(i_3 - i_2) = 5$

$\Rightarrow -3.3i_2 + 3.3i_3 = 5$ — (iii)

from, (1), (2), (3), $i_1 = -0.9$ mA $i_2 = 4.51$ mA, $i_3 = I_{sc} = 6.03$ mA

$E_{th} = V_{oc} = 7.093V$ $\therefore R_{th} = \frac{V_{oc}}{I_{sc}} = 1.175\,k\Omega$

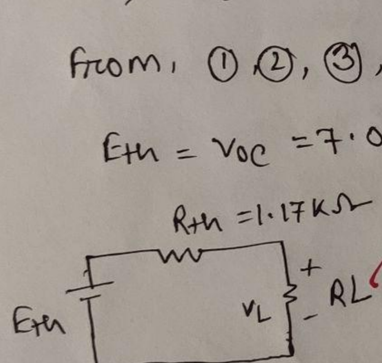



fig-4

$V_L = \frac{7.093}{1+1.175} \times 1 = 3.259V$

$I_L = \frac{V_L}{R_L} = 3.259$ mA

As, $V_L$ and $I_L$ from fig-1 is equivalent to the $V_L$ and $I_L$ of fig-4, so thevenin's theorem is verified.

— o —