**A green tree on a black background

Description automatically generated**

BIRZEIT UNIVERSITY

Physics Department

## Physics 112

**Experiment No. 4**

**Network Analysis II**

**The Thevenin And Norton Techniques**

………………………………………………………………………………………

Student’s Name: **Mohammad Sheikh** Student’s No**.: 1221541**

Partner’s Name: **Mousa Suhaib** Partners’ No.:  **1210143**

Instructor: **Shayma’ Salama** Section No.: **6**

Date: 10-12-2023

**Abstract:**

**The aim of the experiment:** is to examine and prove experimentally Thevenin’s and Norton’s techniques and compare the results with Kirchoff’s laws.

**The method used:**

by applying the equivalent circuit techniques of Thevenin and Norton. It also aims to confirm the accuracy of both techniques by comparing experimental and calculated results.

The main result we obtained was that both techniques proved to be correct methods for solving complicated electric networks

**The Main Result :**

Req1 = 0.7674

εeq1 = 10.60

Ieq1 = 13.81

In Norton :

Ieq =13.81 mA

IRL = 1.52 mA

In Thevenin :

IL3 = 1.52mA

**Theory:**

A diagram of a circuit

Description automatically generatedDealing with fairly complicated networks, requires adequate methods such as the equivalent circuit techniques of Thevenin and Norton.

Thevenin’s theorem states that: “any network of resistors and supplies having two output terminals as in fig.1 can be replaced by a series combination of a voltage source **(εeq)** and a resistor **(Req)**, as in fig.2.

A diagram of a circuit

Description automatically generated Norton and Thevenin’s techniques are especially important in obtaining the current passing through and the voltage across any one resistor **(RL)** in complicated networks. As an example if we took the circuit shown in fig.1 we can find the value of the current passing through **(RL)** using Norton’s and Thevenin's techniques and the values that we will have will be equal to those of Kirchoff.

**Thevenin’s:**A diagram of a circuit

Description automatically generated

1. Remove **RL**, kill both sources as in fig.4, and you will get:   
   A black background with a black square

   Description automatically generated with medium confidence
2. A diagram of a circuit

   Description automatically generatedRemove **RL**, return both sources back to the circuit as in fig.6 and calculate **εeq** as follows:   
   Using Kirchoff's loop theorem we get:   
   A black background with a black square

   Description automatically generated with medium confidence  
   eliminating **I** between the two equations, yields:   
   A black background with a black square

   Description automatically generated with medium confidence
3. Construct Thevenin's equivalent as in fig.2 using the calculated values of **εeq** and **Req**. Now, you can find the current passing through **RL** as follows:

A black background with a black square

Description automatically generated with medium confidence

**Norton’s:**

1. A diagram of a circuit

   Description automatically generatedReplace **RL** with a short circuit (a wire) as in fig.4, and calculate **Ieq** as follows:   
   A black background with a black square

   Description automatically generated with medium confidence
2. A diagram of a circuit

   Description automatically generated*Construct Norton’s equivalent circuit, fig.5, and calculate the current passing through* ***RL*** *as follows:  
   A black background with a black square

   Description automatically generated with medium confidence  
   A black background with a black square

   Description automatically generated with medium confidence*

**Procedure:**

1. ![A black background with a black square

   Description automatically generated with medium confidence](), A black background with a black square

   Description automatically generated with medium confidence, A black background with a black square

   Description automatically generated with medium confidence are calculated as mentioned above.
2. Thevenin's circuit is connected, and ![A black background with a black square

   Description automatically generated with medium confidence]() is measured.
3. Norton's circuit is connected and ![A black background with a black square

   Description automatically generated with medium confidence]() is measured.

A diagram of a circuit

Description automatically generated**Data :**

R1= 1 kΩ

R2= 3.3 kΩ

R3= 6.2 kΩ

ε1= 12 V

ε2= 6 V

in Northen the IL3 = 1.52 , in Thevenin the IL3 = 1.54

Measure the currents

|  |  |  |
| --- | --- | --- |
|  | Experiment | Calculation |
| Req1 | 0.769 kΩ | 0.7674 |
| εeq1 | 10.63 | 10.60 |
| Ieq1 | 13.60 | 13.81 |

Construct **Northen** equivalent circuit

|  |  |  |
| --- | --- | --- |
|  | Experiment | Calculation |
| IL3 (mA) | 1.52 | 1.52 |

Construct **Thevenin** equivalent circuit

|  |  |  |
| --- | --- | --- |
|  | Experiment | Calculation |
| IL3 (mA) | 1.54 | 1.52 |

**Calculations :**

Req *= =*  = 0.7674 k Ω

**ε**eq= = 12- = 12 – 1.4 = 10.60V

**I**eq = = = 13.81

For Northen :

Ieq = I1 +I2

= + = + = 13.81 mA

IRL = = = 1.52 mA

For Thevenin :

IL3 = = = 1.52mA

**Conclusion :**

We notice that the experimental values are very closed to the theoretical ,beside some values which are exactly the same as the theoretical values . In fact , the values which differ from the theoretical values as a result of many reasons :

1. we ignored the internal resistance of the power sources .
2. when we use the laws we assumed that the resistance of the wires is zero but there is a resistance for the wire even if it is so small.
3. even in the resistors there is some uncertainty that we can find it from the color code on the resistors.

* In this experiment we proof Thevenin's law and Norton's law by getting the values for circuits needed .
* In the two laws that we use here there is some conditions we have to be sure that they are available in the circuit in order to use these laws on it such as the resistors must be linear components that obey ohm’s law.
* The two techniques (Norton and Thevenin) that we used here are biased on the same aim which is that they aim to make all the power sources as one source and all of the resistors in one resistor even if the two methods use a different way.