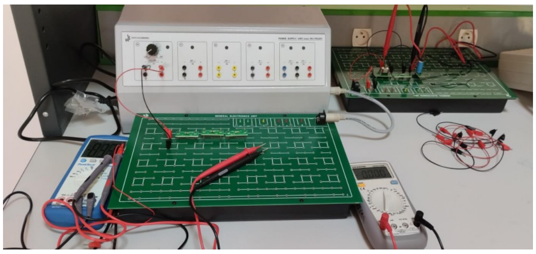
PRACTICAL ELECTRICAL WORK



universite of Tissemssilt

Presented By : Melle : ZEFFANE Soumia

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Objectifs

-The electrical tools and means present in the laboratory and how they are used by students, with the rules of caution.

compute the value of electricalresistance by various methods. Apply and Know how you can replace two

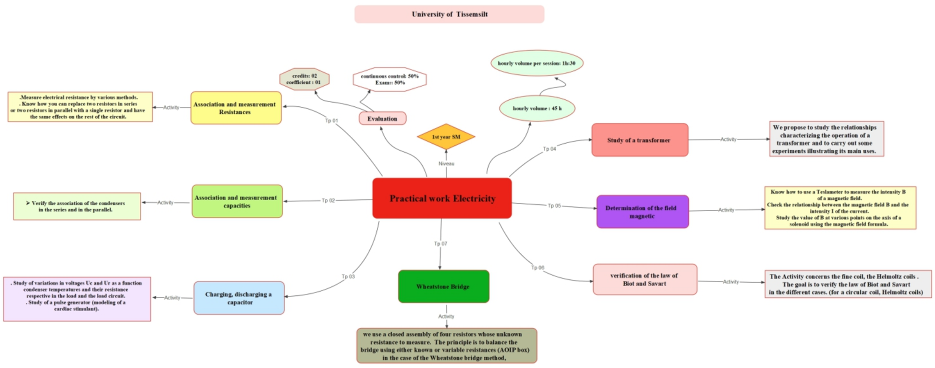
resistors in series or two resistors in parallel with a single resistor and have the same effects on the rest of the circuit.

Association and measurement capacities : Employ the association of the condensers in the series and in the parallel and Determination of the value of the equivalent capacitor using both theoretical and

Experimental methods.

- Knowing how to connect capacitors in series and in parallel.

Introduction



The electronics laboratory has the following equipment:

• Continuous power supply: single or double;

• Function generator (call » also GBF): Bass generator

frequencies;

• Oscilloscope;

• Voltmeter, Ammeter, Ohmmeter (multimeter)

(with digital display);

• Suitcase made up of components and test plates;

• Cables and Probes.

-To know the ohmic value of a resistor, you must identify the colors present on the resistor and associate it with the universal color code. The international standard ***IEC 60757***, Color Designation Code (1983), defines a color code that is affixed to resistors, capacitors (and other components). This code defines the value of

resistors, capacitors, etc.

I TP N° 0 :Introduction to equipment and Preparation session for electricity practicals

1.

Related terms

The electronics laboratory is generally equipped with the following

- Case consisting of components and test plates.
- electric wires, different types of resistors (standard) capacitor, electric field measuring device, multi-turn coils, transformer, Continuous power supply.
- Multimeter (Voltmeter, Ammeter, Ohmmeter).
- Function generator (also called FG): Low-frequency generator.
- Oscilloscope.

1.1. reminders:

Electronic Circuit: is a set of components comprising a generator, one or more receivers (resistors, capacitors, coils, etc.) connected by conductors (wires), and traversed by a current.

Continuous power supply: is designed to deliver a constant and uninterrupted electrical output. It ensures a consistent flow of power without significant fluctuations or interruptions, Contributing to the stable operation of connected devices.

Function generator: is a type of electronic test equipment used to generate various types of electrical waveforms as output signals (sine waves, square waves, triangular waves, sawtooth waves, and more.

function generator

1.2.

Oscilloscope: is a sophisticated electronic test instrument used for visualizing and analyzing the wave form of electrical signals. It displays how voltage changes over time on a graphical screen, providing valuable insights into the behavior of electronic circuits.

Multimeter: a multifunctional device that combines the Voltmeter, Ammeter, and Ohmmeter.

Multimeter

1.3.

Voltmeter: is a device for measuring the voltage (potential difference in volts) between two points in the circuit where voltage measurement is desired. It is connected in parallel. Care must be taken to choose the scale immediately higher than the voltage one intends to measure. For example, for a circuit powered by a voltage of 6V, the 20V scale would be selected.

Ammeter: is a safety tool used to check the presence of current in an electrical circuit and measure its intensity (in Amperes) and direction. It must be passed through by the current (connected in series) so that it can measure its intensity.

Resistance: is a passive component whose role is to convert electrical energy into heat through the Joule effect. It is practically found in all electrical devices. To measure the resistance (in Ohms), one must know the voltage across its terminals and the current flowing through it. Take into account Ohm's law.

The word "résistance" primarily refers to a physical property, but it has come to be used for a type of component. Some prefer to call it a "resistant dipole."

Series Connection: It is said that multiple elements are connected in series when they are traversed by the same current.

Parallel Connection: It is said that multiple elements are connected in parallel when they are subjected to the same voltage.

II TP N° 1 : ASSOCIATION AND MEASUREMENT OF RESISTANCES

1. 1- Objectives

- Understanding electrical components.

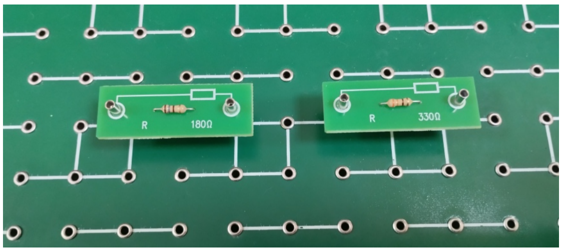
- Determining the value of resistance using two methods: color codes and the Multimeter.

- Knowing how to connect in series and in parallel.

- Measuring the equivalent resistance experimentally and theoretically

1.1. 2- Materials used:

- Various resistances

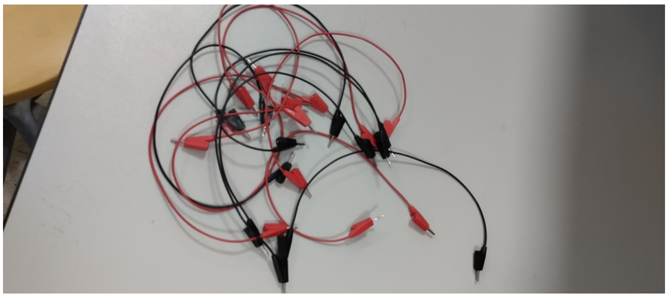


Various resistances

- Multimeters

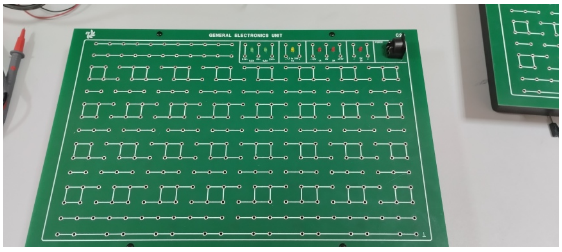
Multimeters

- Conductive wires



Conductive wires

- Testboard (printed circuit board)



Testboard (printed circuit board)

1.2. 3 -Theoretical part :

1. Definition of resistance

The electrical resistance ***R*** of a circuit is defined as the degree of opposition to the movement of electric current in this circuit.

- ***The value of a resistor***

There are two ways to determine the value of a resistor: the color coding method, and the voltammetric method.

- ***The color code*** Most often, low power resistors (less than 5W) come with color rings (rings) around them.

Each color corresponds to a number. The correspondence between the numbers and the colors of the rings constitutes what is called the color code which is used to determine the value of a resistance as well as its tolerance [1, 2,3].

To determine the ohmic value of a resistance, it is necessary to identify the presented colors and match them to the universal color code(see table 1). The international standard ***IEC 60757***, titled "***Colour coding designation***", defines a color code that is applied to resistances, capacitors (and other components).

With this table, you will be able to guess all the possible values of a resistance.

COULEUR DE L'ANNEAU	1er ANNEAU	2ème ANNEAU	3ème ANNEAU	4ème ANNEAU
	NOMBRE CORRESPONDANT			TOLERANCE
Argent	—	—	Diviseur par 100	± 10 %
Or	—	—	Diviseur par 10	± 5 %
Noir	—	0	—	—
Marron	1	1	0	± 1 %
Rouge	2	2	00	± 2 %
Orange	3	3	000	—
Jaune	4	4	0000	—
Vert	5	5	00000	—
Bleu	6	6	000000	—
Violet	7	7	0000000	—
Gris	8	8	00000000	—
Blanc	9	9	000000000	—
Sans couleur	—	—	—	± 20 %

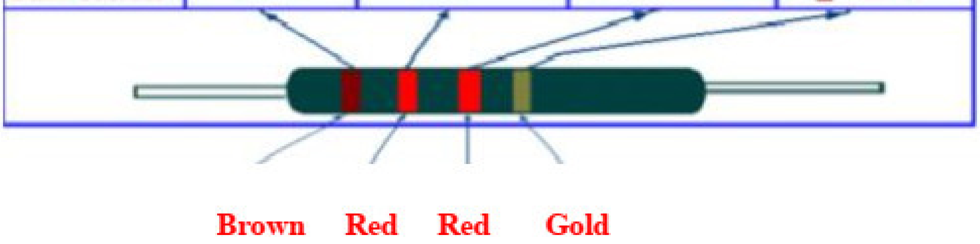


Table 1: resistance color code

1.3. 4- Manipulation :

4-1 Measurement of resistance using color codes and the multimeter

We have different resistances whose values are indicated by the color code provided below.

- Using this table, provide the theoretical values of the resistors, as well as the values obtained using the multimeter .

	Color code (Ω)	Multimeter (Ω)
R1		
R2		
R3		
R4		
R5		
R6		

Table 02 : Measurement of resistance using color codes and the multimeter.

- Compare the obtained results, what do you observe ?

- In your opinion, what is the best method for measuring the value of resistance ?

- give a conclusion about these Experiences ?

1.3.1. 4-2 Verification of the laws of resistance association.

4-2-1 Association of resistance in series:

Set up the following circuit: place 2 resistances in series on the testboard, connect them and the multimeter with conductive wires.

Figure 1: Resistances placed in series.

When two or more resistances are successively traversed by the same current, it is said that they are connected in series, or more simply, they are in series. The fact that the current flowing through these resistances is the same for all is a specific characteristic of series connections, so several resistances in series are all traversed by the same current.

a)

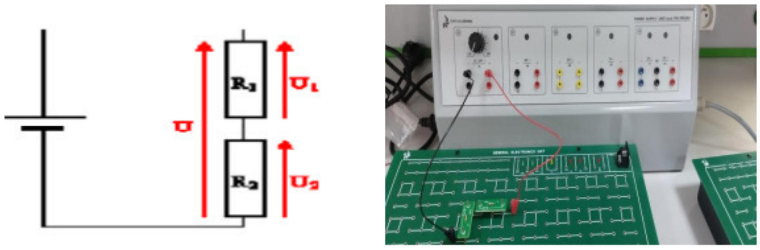


Figure 1: Resistances placed in series.

4-2-2 Ohm's law:

The Ohm's Law applied to each of the resistance allows us to write:

$$U_1 = R_1 I \qquad U_2 = R_2 I$$

The voltage U across the terminals of the combination of the two resistances placed in series is equal to the sum of the voltages across each resistance, which is then:

$$U = U_1 + U_2$$
$$U = R_1 I + R_2 I = (R_1 + R_2) I$$

The equivalent resistance ***R = U/I*** is therefore :

$$R = R_1 + R_2$$

The equivalent resistance ***R*** of two resistors or more placed in series is easily calculated.

Indeed, the resistances are traversed by the same current of intensity ***I***.

- Complete the following table by calculating the theoretical and experimental equivalent resistance.

	Experimental R_{eq} (Ω)	Theoritical R_{eq} (Ω)
Mesure 1		
Mesure 2		
Mesure 3		
Mesure 4		

I-4-2-2 Association of resistance in parallel:

Set up the following circui t: place 2 resistances in parallel on the testboard, connect them and the multimeter with conductive wires.

Figure 2 : Resistances placed in parallel.

In this type of setup, each of the two resistors, ***R1*** and ***R2***, has one of its terminals connected to the '**+**' of the power supply and the other to the '**-**'. Both, therefore, experience the same voltage, supplied by the power source. This situation is a specific characteristic of parallel connections. Across the terminals of several elements connected in parallel, there is always the same voltage.

$$U = U_1 = U_2$$

The current intensity from the generator is equal to the sum of the intensities of the currents flowing through the resistances

$$I = I_1 + I_2$$

The Ohm's Law applied to each of the resistance allows us to write:

$$U_1 = R_1 I_1 \qquad U_2 = R_2 I_2$$

$$I_1 = \frac{U}{R_1} \qquad I_2 = \frac{U}{R_2}$$

$$I = I_1 + I_2 = \left(\frac{U}{R_1} + \frac{U}{R_2}\right) = U\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

We can deduce the equivalent conductance ***1/R :***

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Note: This relationship can be generalized for any number of resistances. In the case of 2 resistances, the relationship can be expressed as follows:

Exercise :

Consider three resistances of ***10, 15 and 20 KΩ,*** placed in series:

- What is the role of a resistance in a circuit :

....

- Draw the possible circuit :

....

- In series connection, how is the voltage and the current :

....

Calculate the equivalent resistance:

....

....

III TP N° 2 :ASSOCIATION AND MEASUREMENT OF CAPACITORS

1. 1- Objectives

1- Objectives

- Determination of the value of the equivalent capacitor using both theoretical and Experimental methods.

- Knowing how to connect capacitors in series and in parallel.

1.1. 2- Materials used:

- Different types of capacitors.

- Multimeters.

- Conductive wires.

- Testboard (printed circuit board).

Figure 1: Symbolic representation of an ideal capacitor

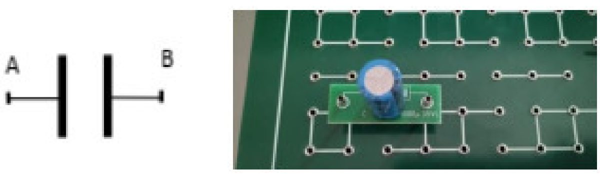


Figure 1: Symbolic representation of an ideal capacitor

1.1.1. 3- Introduction

Capacitors are essential components in electronic circuits, serving various purposes such as energy storage, filtering, and coupling. Understanding how to associate capacitors and accurately measure their properties is crucial for designing and troubleshooting electronic systems.

Capacitors have two conductive plates that are typically made of metal. These plates are separated by a dielectric material. The conductive plates serve as the terminals for connecting the capacitor to an electrical circuit. The space between the two conductive plates is filled with a dielectric material, which is an insulator. The dielectric material affects the capacitance and Other electrical characteristics of the capacitor. Common dielectric materials include ceramic, polyester, polypropylene, and electrolytic materials.

When a potential difference ***U*** is applied between the plates of a capacitor, an electric charge ***Q*** accumulates in the capacitor. This charge is proportional to the applied voltage and to a characteristic quantity of the capacitor called ***capacitance***, such as:

$$Q = C \cdot U$$

The time required to discharge this capacitor depends on the capacitance and associated resistance; it is referred to as the time constant ***τ***:

$$\tau = R \cdot C$$

a) 4 - Manipulation:

4-1 Association of capacitors in series :

If the capacitors are connected in series, then each of the capacitors stores the same quantity of electric charge ***Q***. For the two capacitors, ***C1*** and ***C2*** connected in series:

$$Q = U_1 C_1 = U_2 C_2$$

Furthermore, the sum of voltage ***U1*** and ***U2*** across these two capacitors is equal to ***U***, the voltage of the source :

$$E = U_1 + U_2 \rightarrow U_1 = C_2 / (C_1 + C_2) = C_1 / (C_1 + C_2) = U_2$$

The equivalent capacitance of the two capacitors connected in series is:

$$C_{1/2} = C_1 \cdot C_2 / C_1 + C_2$$

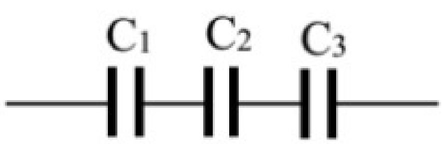


Figure .2: capacitors in series

- Set up the previous circuit: place 2 capacitors in series on the testboard,

connect them and the multimeter with conductive wires.

- Complete the following table by calculating the theoretical and experimental equivalent Capacitance:

	Experimental C_{eq} (F)	Theoretical C_{eq} (F)
Mesure 1		
Mesure 2		
Mesure 3		
Mesure 4		

4-2 Association of capacitors in parallel :

In the parallel capacitor arrangement, each capacitor is at the same potential difference ***U***,

which is equal to the source voltage ***E***. In this case, the total charge is the sum of the charges ***Q1*** and ***Q2*** stored by capacitors ***C1*** and ***C2***, respectively:

$$Q = Q_1 + Q_2 = C_1 . U + C_2 . U$$

$$U = Q / C_1 + C_2$$

$$Q = C_{1/2} . E = C_{1/2} . U$$

The equivalent capacitance of the two capacitors connected in parallel is :

$$C_{1/2} = C_1 + C_2$$

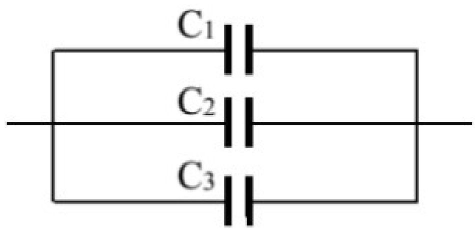


Figure .3: capacitors in parallel

- Set up the previous circuit: place 2 capacitors in series on the testboard,

connect them and the multimeter with conductive wires.

- Complete the following table by calculating the theoretical and experimental

equivalent Capacitance:

	Experimental C_{eq} (F)	Theoretical C_{eq} (F)
Mesure 1		
Mesure 2		
Mesure 3		
Mesure 4		

- Compare the values of the experimental and theoretical capacitances obtained

From the three tables. What do you observe ?

- What is the role of using a capacitor ?

- give a conclusion ?

Exercice :

2- Consider three capacitors of ***15, 20 and 35 nF***, placed in parallel:

- What is the role of a capacity in a circuit:...

- Draw the possible circuit:

....

....

....

....

- In parallel connection, how is the voltage and the current :

....

....

- Calculate the equivalent capacity:

....

IV Practical work Exam

1. Tp Exam

Democratic and Popular Republic of Algeria
Ministry of Higher Education and Scientific Research
University of Tissemsilt
Faculty of Science and Technology
Department of Material Sciences

first year of SM-2[nd] semester

Tp Exam

Family name;	**First name;**

Questions: **08 pts.**

Answer by true or false the following statements:

1- We use the voltmeter to measure the voltage ☐

2- The voltmeter must be branched in series with the components of the circuit ☐

3- The Ammeter is safety tool used to check the presence of current in a circuit ☐

4- In parallel connection, the diverse elements are subjected to the same voltage. ☐

5- Two capacitors is connected in parallel, their C_{eq} is $C_{eq}=C_1.C_2 / C_1 + C_2$ ☐

6- A set of resistances is connected in series, their R_{eq} is $R_{eq}=R_1.R_2 / R_1 + R_2$ ☐

7- The time constant τ is equal to : $\tau = U.I$ ☐

8- The Thevenin resistance is the equivalence resistance. ☐

Exercise 1: **12 pts.**

1- Consider three resistances of **10, 15 and 20 KΩ**, placed in series:

- What is the role of a resistance in a circuit:...
....
- Draw the possible circuit: ☐
- In series connection, how is the voltage and the current :
- ....
....
- Calculate the equivalent resistance:
- ....

....

1

Best of luck

2- Consider three capacitors of 10, 18 and 75 nF, placed in parallel:

- What is the role of a capacity in a circuit:……………………………………………………………………
- Draw the possible circuit:
- In parallel connection, how is the voltage and the current :

  ……

  ……
- Calculate the equivalent capacity:

  ……

  ……
-

Best of luck

V Référence

1. Références :

[1] Wasif Naeem , Concepts in electrical circuits, Ventus publishing APS, ISBN 978-87-76-81-499-1, 2009.

[2] Cathleen Shamieh, et Gordon Mc Comb, L'électronique pour les nuls, First-Gründ, ISBN: 9782754043656, 2010.

[3] https://www.apprendre-en-ligne.net/crypto/passecret/resistances.pdf