Experiment 01: Kirchhoff's laws

I. The aim of the experiment

Verification of Kirchhoff's laws, law of meshes and law of nodes

II. Theoretical study

Kirchhoff's laws are generally applicable to all electrical circuits.

Law of rings

The Law of rings (loops) states: The algebraic sum of the tensions in a closed rings of an electrical circuit is zero;

$$\sum V_i = 0$$

Law of nodes

The law states: The algebraic sum of the currents entering a node in an electrical circuit is equal to the algebraic sum of the electrical currents leaving it.

$$\sum I_{ent} = I_{sort}$$

Required: Calculate theoretically I_i and V_i

We take the following values: R_1= 700Ω , R_2= 1,5 kΩ, R_3= 1,2 kΩ R_4= 180 Ω

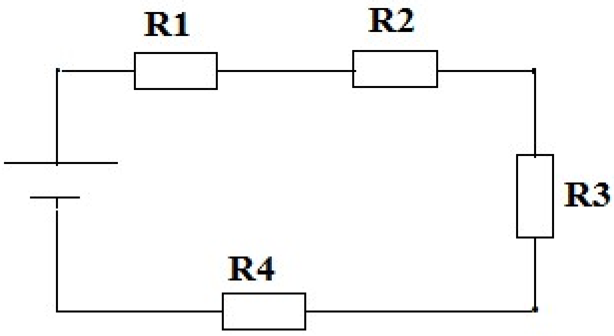
III. Used materials

DC generator + 4 boxes of adjustable resistors + ampere meter + volt meter + multimeter + connecting wires.

VI. Practical study

Considering the following values: R_1= 700Ω , R_2= 1,5 kΩ, R_3= 1,2 kΩ R_4= 180 Ω, V=15v

1. *Law of rings*



In order to verify the loop law (Kirchhoff's first law) the four resistors are connected in series with the DC generator (see the corresponding Figure)

Required:

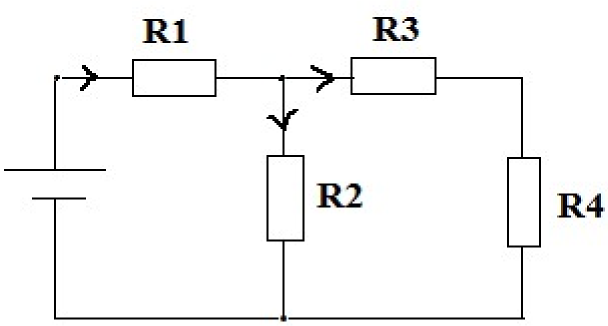
1- Using a volt meter, measure the voltage at both ends R_i.

2- Complete the table below.

3- Comment on the results obtained, and then conclude.

$Tension$	$V_{calculed}$	$V_{measured}$	ΔV	caliber
V_{R1}				
V_{R2}				
V_{R3}				
V_{R4}				

2. *Law of Nodes*: Kirchhoff's second law



In order to verify Kirchhoff's Law 2, perform the corresponding structure

Required:

1. Measure using an ampere meter the intensity of the current passing through each resistor.
2. Complete the table below.
3. Comment on the results obtained, then conclude

$intensity\ I$	$I_{calculed}$	$I_{mesured}$	ΔI	caliber
I_{R1}				
I_{R2}				
I_{R3}				
I_{R4}				

Experiment 02: Collecting and connecting capacitors

I. The aim of the experiment

Check:

- Law of connecting capacitors

II. Theoretical study

Association of capacitors

Using: $V = X_C = \frac{Q}{C}$ and $X_C = \frac{1}{C\omega}$

a) In series: show that the equivalent capacitor is written in the form

$$\frac{1}{C_{eq}} = \sum \frac{1}{C_i}$$

b) In parallel: show that the equivalent capacitor is written in the form

$$C_{eq} = \sum C_i$$

III. Used materials

Capacitor boxes, ampere meter, voltmeter, multi meter and connecting wires.

VI. Practical study

Experiment : Association of capacitors

1) Achieve the experimental setup shown in figure 1. Where:

$$C_1 = 5.2\ \ \mu F \qquad C_2 = 7.7\ \ \mu F \qquad C_3 = 0.1\ \ \mu F$$

2) Using a multi meter, measure the value of C_{eq}.

3) Achieve the experimental setup shown in figure 2 and figure 3.

4) Using a multi meter in order to measuring C_{eq}. (in each case).

5) Fill out the table below,

6) Comment on the results.

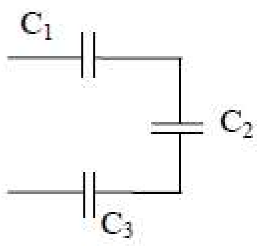


Figure 01

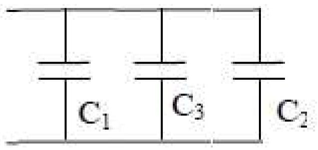


Figure 02

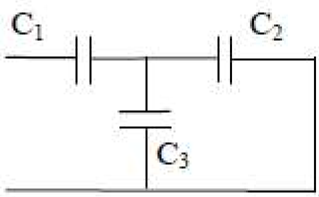


Figure 03

Connection type	$C_{eq\,cal}$	$C_{eq\,mes}$	ΔC
serial			
parallel			
mixed			

Experiment 03: Collecting and connecting resistors

I. The aim of the experiment

Check:

- Law of connecting resistors

II. Theoretical study

Association of resistors

A) In series: Verify that if the resistors are connected in series, the equivalent resistance is written in the form: $R_{eq}=\sum R_i$

b) In parallel: Verify that if the resistors are connected in parallel, the equivalent resistance is written in the form:

$$\frac{1}{R_{eq}} = \sum \frac{1}{R_i}$$

III. Used materials

Resistor boxes, ampere meter, voltmeter, multi meter and connecting wires.

IV. Practical study

We take the following values:

$R_1 = 750\,\Omega \quad R_2 = 1.5K\,\Omega \quad R_3 = 2.5\,K\ \Omega$

Experiment : Connecting resistors

1. Achieve the experimental setup shown in figure 1.
2. Calculate the value of R_{eq} and measure it experimentally.
3. Perform the experimental setup shown in figure 2 and figure 3.
4. Calculate R_{eq} and then measure its values experimentally (in each case) using a multi meter.
5. Calculate the absolute uncertainty in the resistance value.
6. Fill out the table below.

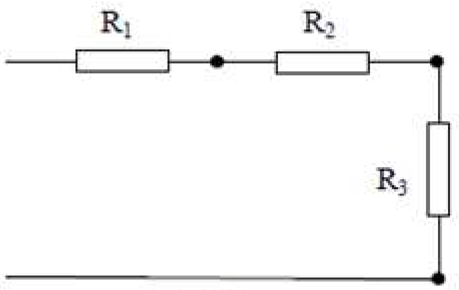


Figure01

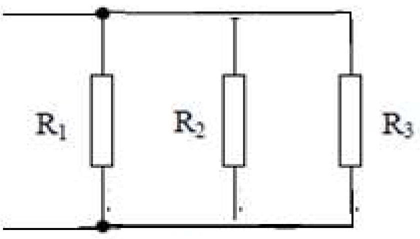


Figure02

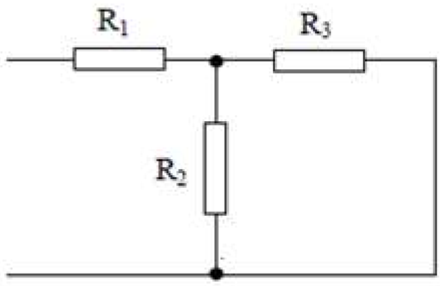


Figure03

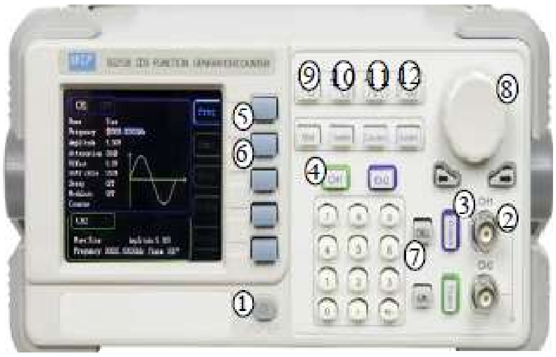
Connection type	$R_{eq\,cal}$	$R_{eq\,mes}$	ΔR
Serial			
Parallel			
mixed			

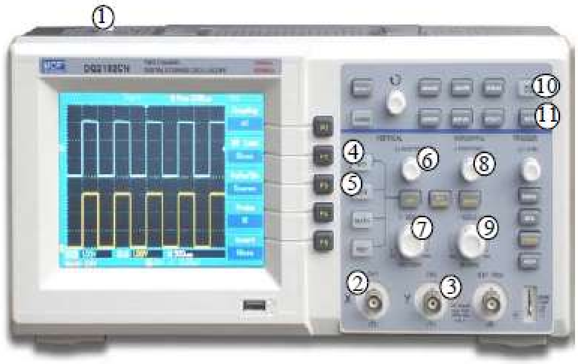
Experiment 04: Digital cathode oscilloscope

I. Aim of the experiment:

- How use a cathode oscilloscope
- Measuring the voltage and periods

II. Theoretical study :





Cathodic oscilloscope

1. Power button
2. Input CH1
3. CH2 Y input
4. The signal is at CH1
5. The signal is at 2 CH
6. Control the vertical position of the signal at CH1 and CH2
7. Vertical sensitivity control (VOLTS/DIV)
8. Control the horizontal sensitivity of the signal at CH1 and the signal at CH2
9. Horizontal sensitivity control (SEC/DIV)
10. Mode (on - off)
11. Reset the device

Low voltage generator GBF

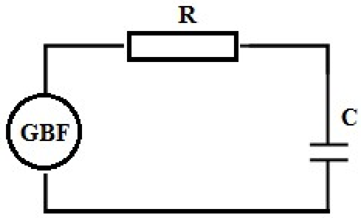
1. Power button
2. Input CH1
3. CH1 signal output
4. The signal is at 1 CH
5. Frequency adjustment button
6. Capacity adjustment button
7. Numeric keypad (to set values)
8. Edit button
9. The sinusoidal signal
10. The square signal
11. Triangular signal
12. Qualitative indication

III. used materials:

Oscilloscope with two inputs (Digital Scannig Oscilloscope), potential difference generator (S62110DDs), dust impedance, variable capacitor, connecting wires to the input

II. Practical study

We take: R_1=1K Ω and C=100 nF f=1 kHz (changeable)



Experiment 1: switching of the oscilloscope

- Achieve the experimental setup shown in the figure above
- Install the oscilloscope so that we can see on the screen the difference in the entry latency on channel CH1(X).
- Turn the device on, using (On/Off)
- Press the auto N°11 button
- Adjusting the time base: We use the 4N° button.

Experiment 2: Measurement of variable voltages

1. Square signal

1- Connect the GBF to the CH(x) channel of the cathode oscilloscope.
2- Adjust the GBF device in order to obtain a square signal with a voltage of 1.5 KHz and an amplitude of 2V.
3- Using the 7N° and 9N° buttons of the oscilloscope, adjust the device in order to obtain a signal that shows 3 periods, then draw it on millimeter paper.
4- Extract V_{max} for the signal,
5- Extract the period of the signal and deduce its frequency.
6- Extract the amplitude peak to peak of the signal.

2. Triangular signal

1- Connect the GBF to the CH2(y) channel of the oscilloscope
2- Run GBF
3- Adjust the GBF in order to obtain a triangular signal with; V=3v and f=1kHz
4- Use buttons 7 and 9 to get 3 periods on the signal.
5- Repeat the same questions asked in paragraph (1).

3. Sinusoidal signal

1- Connect the GBF device, then turn it on.
2- Adjust the GBF in order to obtain a sinusoidal signal where f=500Hz. And V=1V.
3- Try using buttons 7 and 9 in order to get 3 periods of the signal, then draw them on millimeter paper.
4- Repeat the answer to the same questions asked in paragraph (1).
5- Find the average and effective value (theoretical relationship) of the tension
6- Measure the tension of the signal using a voltmeter in AC mode.
7- What does this value represent?