EXPERIMENT II ANALYSIS OF SIMPLE ELECTRICAL CIRCUITS USING KIRCHHOFF's and OHM's LAWS

Fall - 2023/2024

EEE 281 – Electrical Circuits
Lab 2 Report

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Date:

07.11.2023

- **Objective**

In this experiment, we will learn what are the concepts of voltage and current dividers. We will understand the differences between combining resistors in parallel or series in circuits. In the prework, we used Kirchhoff's current and voltage law, OHM's Law, Superposition Principle to analyze the circuits in the experiment. We will understand the logic behind Wheatstone Bridge circuit. We will learn how to use voltage supplies, Function Generator, Multi-Meter, Digital Oscilloscope while we create circuit with DC and AC signals. We will learn the X-Y mode of Digital Oscilloscope, we examined different graphic types that changes according to circuit design. We used LTSpice for design the circuits and see the graphs before the experiment.

- **Results**

Experimental Work 1:

<u>What we used:</u>

-Digital Oscilloscope

-Function\Arbitrary Waveform Generator

-Resistors (1kΩ, 3.3kΩ,6.8kΩ,4.7 kΩ,).

We started the experimental work by setting up the circuit of figure 2.2 from the prework manual.

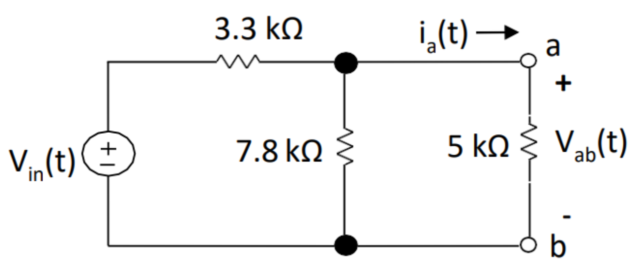
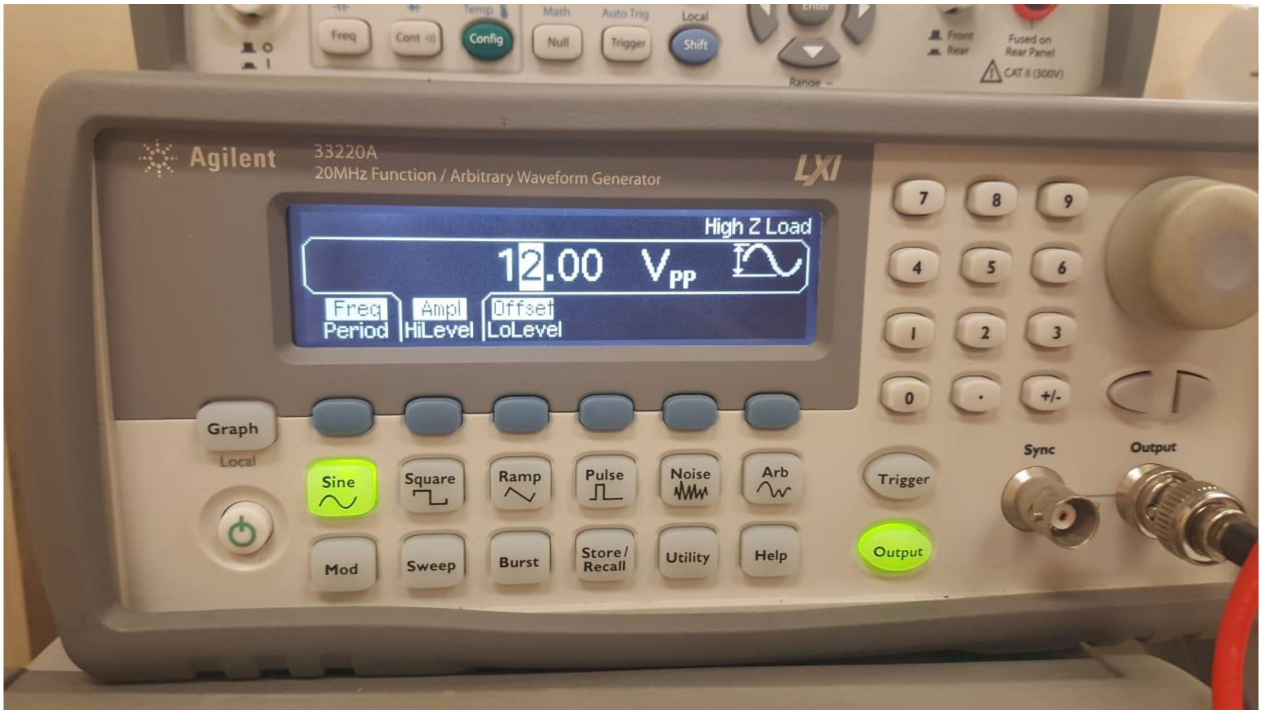


Figure 2.2

By setting the function generator to High Z mode during the experiment, our set up was ready.



1: Experimental Work 1 (Function/Arbitrary Waveform Generator in Hz Mode)

a) Without connecting voltage source to the circuit, we first measured the equivalent resistance, Rab.
Using the function generator as an AC voltage source we set Vin(t)=6sin (100 πt).
$\omega = 2\pi f = 100\pi$
f = 50 Hz   Amplitude = 6
Arranging function generator to 12Vpp and 50 Hz, we measured Vab,rms and Ia,rms values.

TABLE 1:

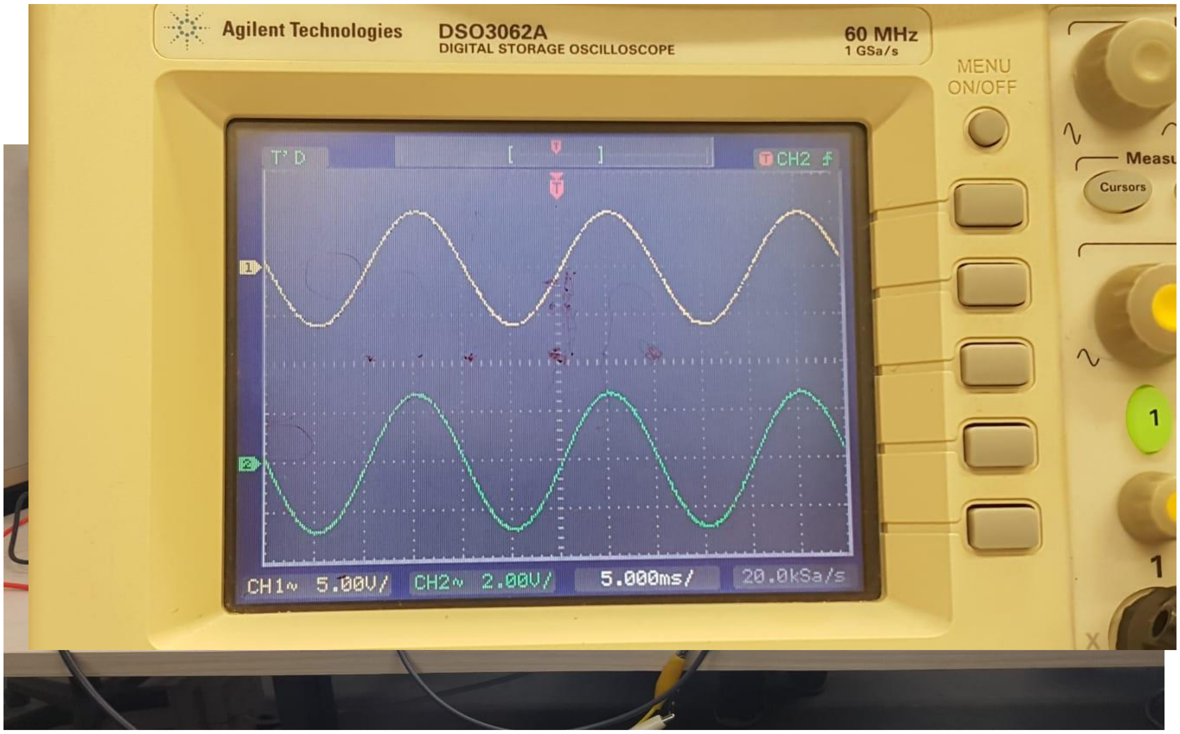
Rab Calculated from Prework 1.B(a) (kΩ)	Ia,rms Calculated from Prework 1.B(b) (A)	Rab Measured (kΩ)	Vab, rms Measured (V)	Ia,rms Measured (mA)
3.046	Ia = 0.096 **$I_{rms} = \sqrt{(1/(1/50)\int ((0.48/5)*\sin(100\pi t)\,dt)}$**	4.64	1.81	0.39

Rab = 4.64, Ia=0.39 mA .

$I_{rms} = \sqrt{(1/(1/50)\int 6\sin(100\pi t)/5)}$

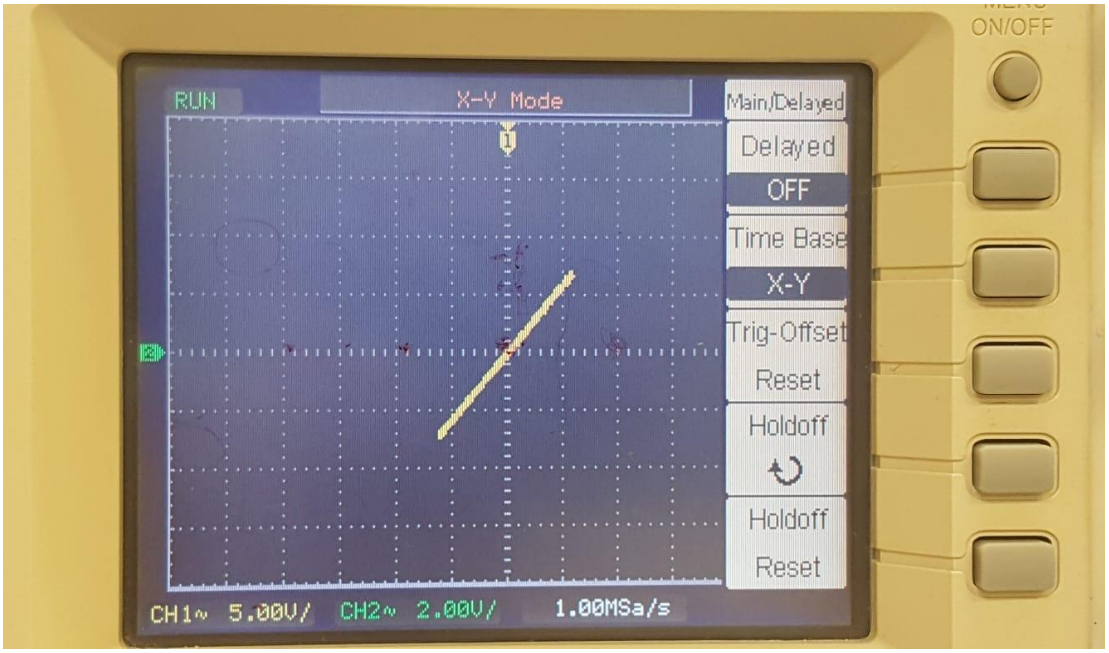
Values that we measured in the lab are approximate with our calculations in the pre-work.

Differences between them stems from measurement errors.



***2**: Experimental Work 1 (Digital Oscilloscopes)*

b) Changing the necessary settings on the oscilloscope, we plot the graph in X-Y mode. The graph gives us the signal in Channel 2(Y) as a function of the signal in Channel 1(X).



3: (Digital Oscilloscope in X-Y mode)

Experimental Work 2: Circuit with Multiple Sources

What we used:

- Power Supply

- Digital Oscilloscope

-Function\Arbitrary Waveform Generator

-Resistors (6 x 1kΩ).

We started the experimental work by setting up the circuit of figure 2.3 from the prework manual.

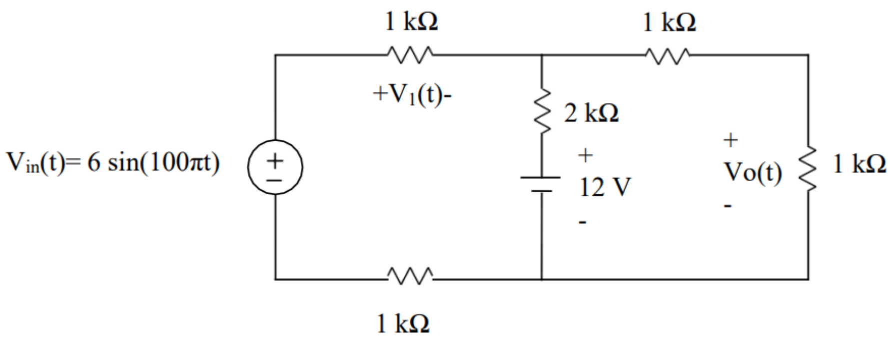
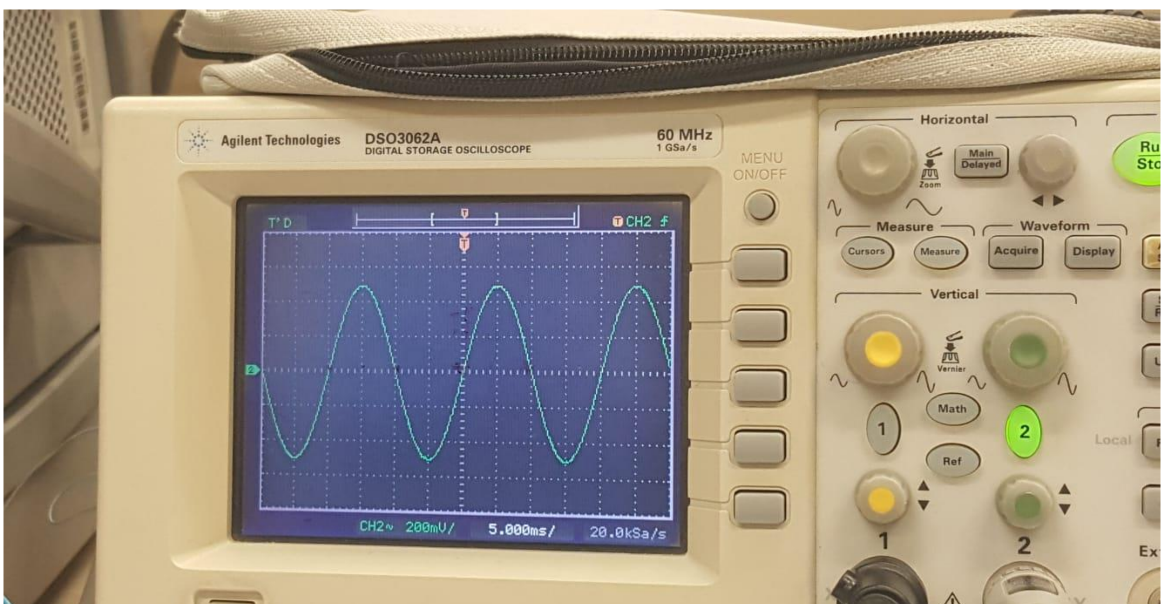


Figure 2.3

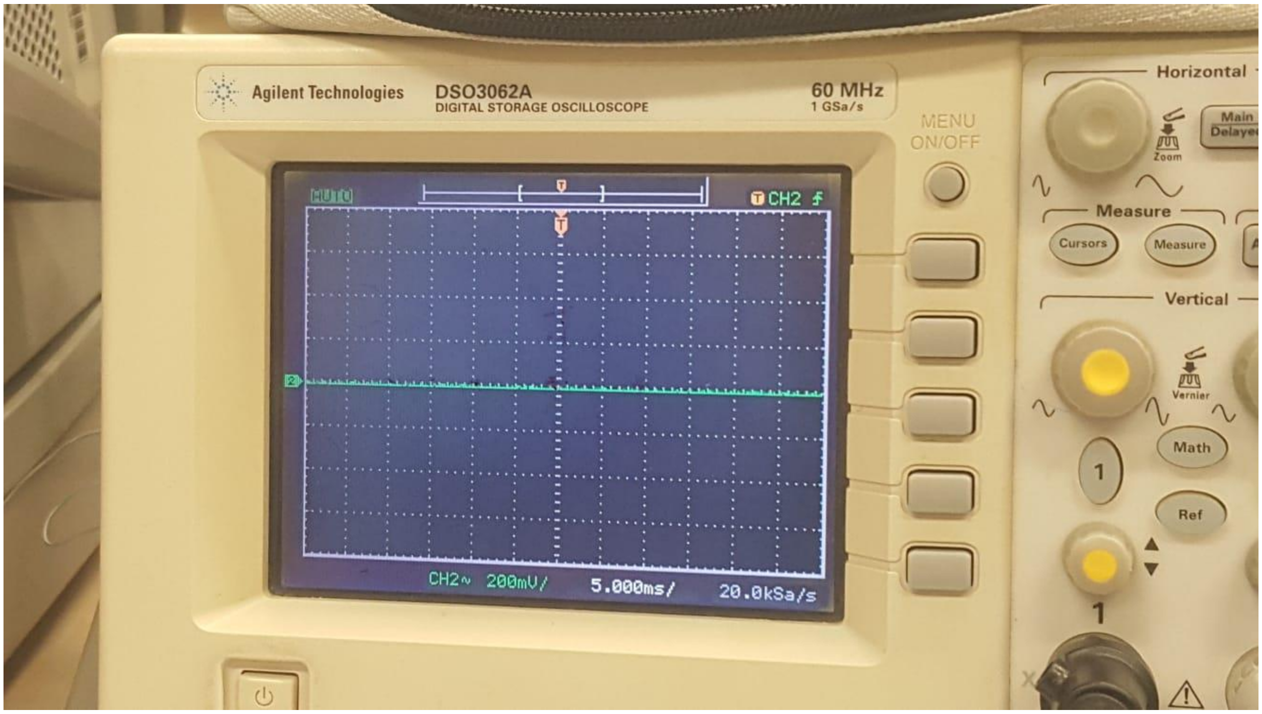
a) Using the same function generator and setting up the circuit we plotted the waveform of 3 cases on the oscilloscope:

1) AC Power Supply is ON and DC Power Supply is OFF



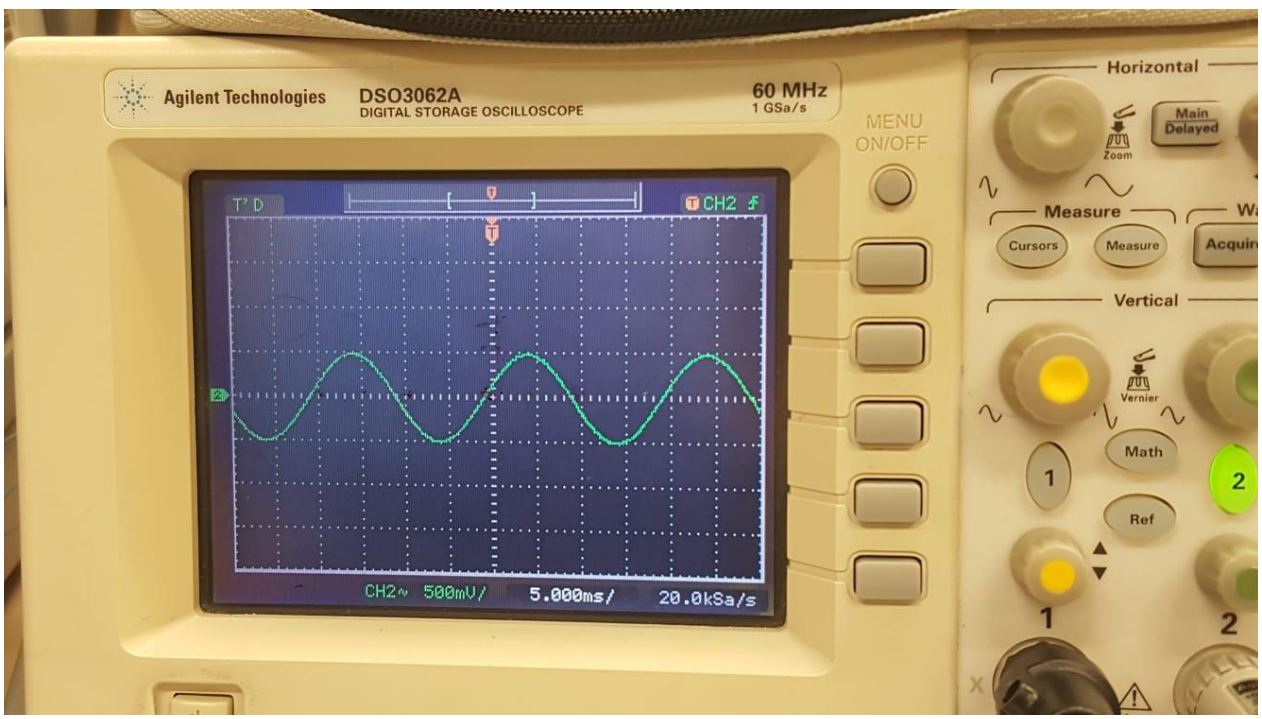
4: (i. When the 12V DC Power Supply is turned off)

2) AC Power Supply is OFF and DC Power Supply is ON



5:(ii. When the Function Generator is turned off)

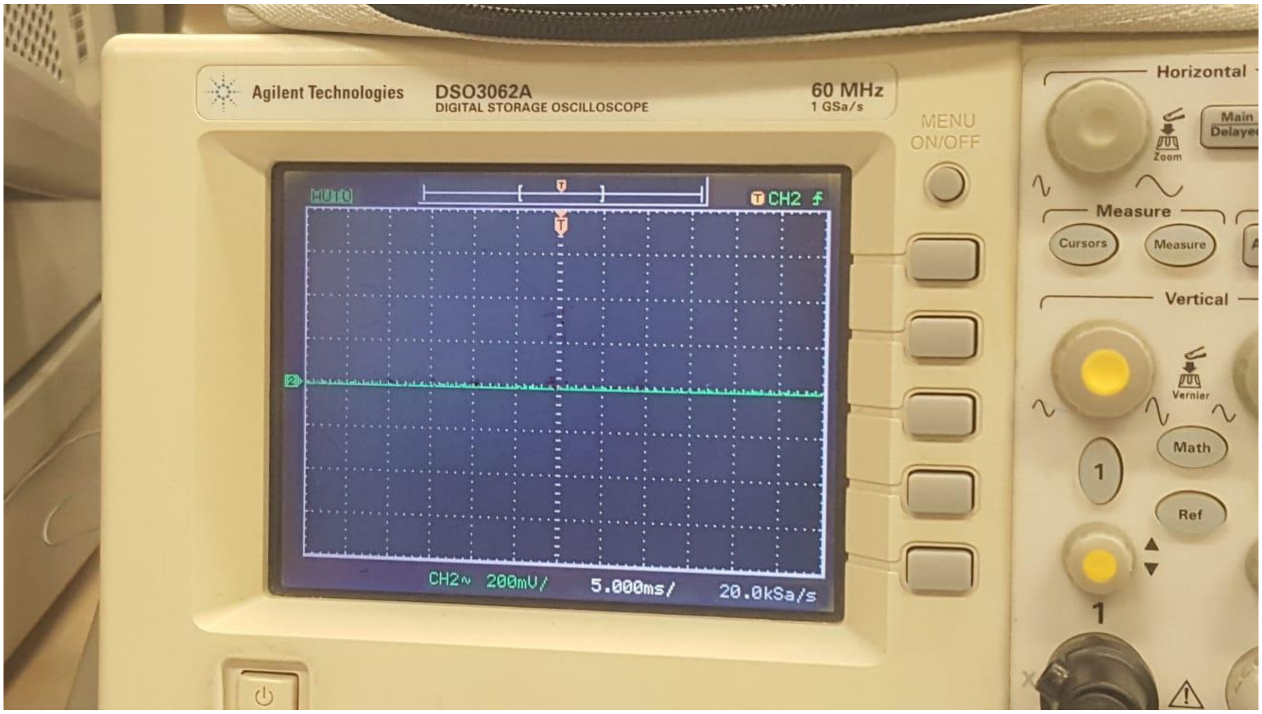
3) AC Power Supply is ON and DC Power Supply is ON



6: (iii. When both the DC power supply and function generator are turned on)

The plots are consistent with the superposition principle. In graph i. we see the effect of AC power supply to the circuit and in graph ii. we see how DC Power Supply affects the circuit. In graph iii. We observe measurement errors because we are using oscilloscope.

b) Experimental Work 2 (When the connection between the first node and channel 1 is provided)



The differences between pre-work and lab-work stems from Digital Oscilloscope. Since ground leads of both probes are connected each other inside the oscilloscope, we observe measurement errors. Because of that, when we connect ground leads of two probes to different nodes in the circuit we observe short circuit. Then we will see zero voltage signal between these two nodes.

- **Conclusion**

  We understand the difference between connecting resistors series and parallel.
  We used Function Generator as an AC Power Supply and we measured the current by using Digital Multimeter.
  By using Digital Oscilloscope we observed different graphs when we use only AC in a circuit, when we use only DC in circuit and when we use both AC and DC power supplies in the circuit. In that way, we used Oscilloscope to understand Superposition Principle.
  We understand that oscilloscope can cause measurement errors.