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Introduction

Electrical engineering is a major that builds up upon previous information like blocks forming a building. That being the case, some of the blocks previously built need to be reinforced. The first lab in EE306 works on recalling lab tactics we have previously taken to ensure our full capability of working with lab equipment in the following lab classes of this course. The first lab class also includes new lab skills that we are required to know to help us during the course. Mastering the usage of lab equipment is no doubt one of the most important skills to have for any electrical engineer. Upon the completion of the course EE250: The Basic Fundamentals of Electrical Engineering, we acquired a general idea on how to work with the most commonly used lab equipment such as digital multimeter, oscilloscope, function generator, breadboard, etc. Also, we learned about the color codes used to identify resistors and capacitors which shows in figure 1 that will help us a lot in Lab 1.

Basic Rules that we might need in Lab 1 are:

- Ohm's Law: $V = IR$
- Kirchhoff's voltage law: $\sum_{k=1}^{n} V_k = 0$
- Kirchhoff's current law: $\sum_{k=1}^{n} \tilde{V}_k = 0$
- Percentage Error in calculations:
  $\%\text{Error} = \frac{|\text{theoretical value} - \text{experimental value}|}{\text{theoretical value}} \text{ x } 100$

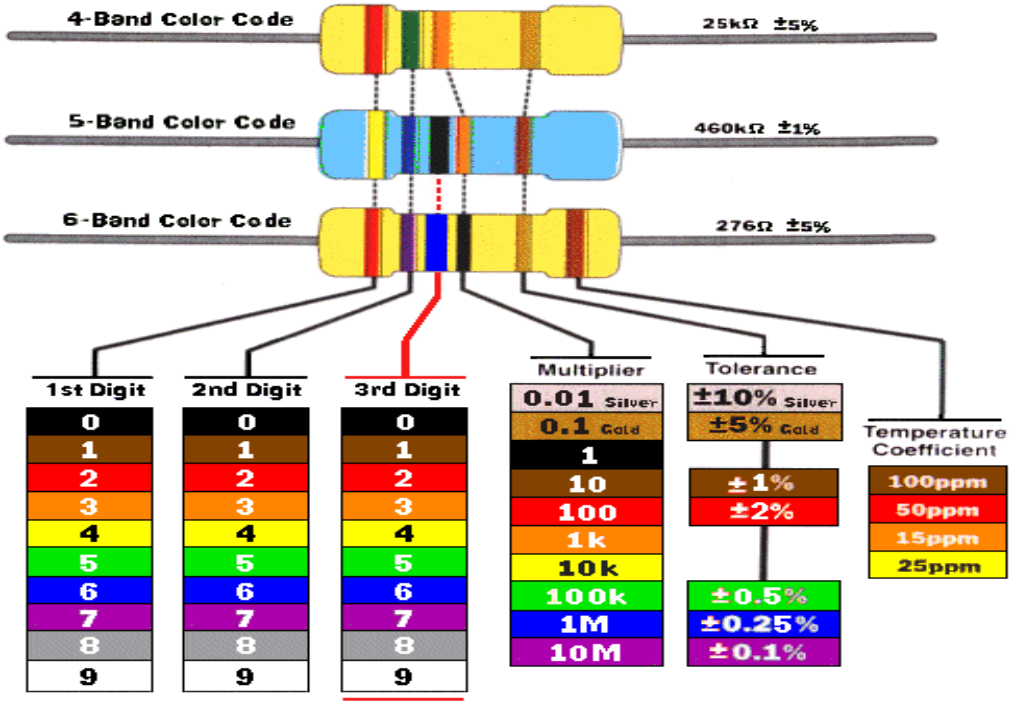

Figure 1. The Resistor Colour Code

Objectives

1. To Refresh the student`s mind and to remember the important fundamental topics.

2. To Familiarize the student with the equipment in the lab and to develop specific techniques to be used throughout the semester.

3. To Let students work by themselves in the lab, set and conduct experiments.

4. To Develop students' skills on measuring the voltage, current, resistance …etc , data collection and analysis.

Apparatus

1. Function Generator

2. Oscilloscope.

3. Digital multi-meter.

4. Probes.

5. Breadboard.

6. Wires to make the connections.

7. power source.

Experiment Steps

1. First, a detailed study of the knobs and controls on the oscilloscope panel, digital multimeter, and function/ signal generator was made.

2. Then, the color code for identification of the resistors and capacitors was listed and memorized.

3. After that, all the equipment needed were properly connected to an outlet.

4. The signal generator was turned on and used to apply a peak to peak sine wave of 1kHz – 10 Volts into a digital voltmeter. After leaving the system for 5 minutes to warm up and stabilize, the voltage values were measure every 30 seconds for 10 reading and recorded with the highest precision possible.

5. Another peak to peak sing wave of 1 kHz – 10 Volts was applied into channel 1 of the CRO. The amplitude was measured using a X1 probe and the error in measurement was included.

6. Step 5 was repeated using a X10 probe

7. The periods and frequencies were measured using the CRO, and the uncertainties were included.

8. The functions and the triggering level control and slope central knobs were studied.

9. The input impedance of the oscilloscope and the output impedance of the function generator were determined using the procedures developed.

10. Finally, the values of resistors and capacitors provided were identified using the color code. The values of 5 resistors from the same type were measured. and the magnitude of error in the identification was found using the color codes.

Results

The experiment is divided into three parts as shown in the procedure section . Therefore there are three parts of the results as the following .

Part one

The DMM is used to measure the experimental value of RMS voltage as shown in table 1. The theoretical value of RMS voltage was found by the following formula, $\frac{\text{Vpp}}{2\sqrt{2}} = \frac{10}{2\sqrt{2}} = 3.53\text{V}$.

Table 1. Readings of part one

No. of Reading	DMM reading of RMS voltage (V)	Error (%)
1	3.39 V	
2	3.39 V	
3	3.39 V	
4	3.39 V	
5	3.39 V	
6	3.39 V	
7	3.39 V	
8	3.39 V	
9	3.39 V	
10	3.39 V	

Part two

The CRO is used to measure the experimental value of peak – peak voltage after connecting a (x1)and (x10)probes as shown in table 2. Take into account that 10 peak – peak volts was inputted to the signal generator (theoretical value).

Table 2. Readings of part two

Probe Switch	Oscilloscope reading of peak-peak voltage (V)	Error (%)
x1		
x10		20%

Also the experimental value of period is measured by using the formula period T = peak to peak horizontal disatnce $\times \frac{\text{tim}}{\text{div}} = 1 \times 500 \times 10^{-6} = 500 \times 10^{-4}$s.

Then the experimental of the frequency f = $\frac{1}{T} = \frac{1}{500 \times 2 \times 10^{-6}} = 1000\ Hz$, to find the error between the theoretical (1000 Hz) and the experimental value is calculated by the formula $\%error = \left|\frac{1 \times 10^3 - 1000}{2000}\right| \times 100 = 0\ \%$.

Part three

The theoretical value of resistance was calculated by resistors color code. And the experimental value was measured using the DMM as shown in table 3.

Table 3. Readings of part three

No. of Reading	Experimental value of resistance (Ω)	Theoretical value of resistance (Ω)	Error (%)
1	10040 Ω	10,000 Ω	$\left\|\frac{10000-10040}{10000}\right\| \times 100 =$ 0.4%
2	99 Ω	100 Ω	1%
3	2200 Ω	2200 Ω	0%
4	3350 Ω	3100 Ω	8.06%
5	558 Ω	560 Ω	0.35%

Discussions

The purpose of doing this experiment is to know how to measure some of the electric quantities (experimental values) and compare it with the theoretical values by calculating errors to find out the reasons behind those errors.

The first part of this experiment was measuring the RMS voltage value. The value of RMS remain constant by time also notice there was no significant error , this might because of the heating effect since the temperature of the room was suitable to conduct the experiment.

The second part, was measuring the peak to peak voltage but after connecting (x1)and (x10)probes . The (x1) probes give approximately the same value with small error and this was expected since it shows the signal's amplitude at the oscilloscope input by a factor of 1. On the other hand, the (x10) probes give a high error as it has a lower accuracy when reduces the signal's amplitude by a factor of 10.

The third part of this experiment was measuring the value of the resistors . the way to know the accuracy of measuring it is by looking for the tolerance color which was (gold) and it should be in the range of (-5% - +5%) . If it was out of this range then the reason would be due to the measurement or temperature changes. Therefore the error of this part is due to the tolerance of the resistors .

The major difficulty of doing this experiment was the equipment itself ,as there was an issue on the screen of the signal generator since it shows (peak) voltage instead of (peak-peak voltage), thus this looses our time to find out the problem. Although , everything was okay and we easily get familiar with the equipments.

Conclusion :

In conclusion, this report showed the purpose of doing this experiment which is knowing how to measure some of the electric quantities (experimental values) and compare it with the theoretical values by calculating errors to find out the reasons behind those errors. This experiment had been achieved by dealing with the most commonly used lab equipments such as DMM, COR, function generator, breadboard, etc. By the end of this experiment we have learned, how to apply the peak to peak voltage and using the DMM to find the RMS's value. Also, using (X1-X10) probes to show the signal on the COR's Screen. Finally, Measuring resistors experimentally and theoretically using DMM and color code respectively.