Student Name: Yolanda chen | Date: 2021.09.08
Lab partner(s): Praneel Jasinghe | Lab No./Title: 2
Section # (GTA): 3 Yi Xie

Instructions:
- ***Submission must contain only original, individual, and current work.***
- ***After completion, save as PDF before submitting.***

Task 2.7.1

Objective:

The goal of this task is to make sure we know how to calculate the AC and DC root mean square after we get the value from the DMM and that we know the difference between the sine wave and the triangle wave.

Results/Calculations:

Step 2: :

$s(t) = 2\sin(2\pi 1000 t) + 4$

AC RMS : $2/\sqrt{2} = 1.41$

DC RMS $= \sqrt{(2/\sqrt{2})^2 + 4^2}$

$= 4.2426$

Step 3-4:

Table I: relationship between RMS Voltage and Frequency with Sine wave

Quantity	Theoretical Value (V)	Measured Vlaue (V)	%Error	Comments
RMS Voltage (V)	1.41	1.4103	0.0213%	The percent error is
Frequency (kHz)	1	1	0	

Step 5:

RMS voltage: -2.0022 V
Frequency: 2kHz
DC RMS:1.155V
AC RMS: 2.31V

Table II: relationship between RMS voltage and Frequency with Triangle Wave.

Quantity	Theoretical Value (V)	Measured Vlaue (V)	%Error	Comments
RMS Voltage (V)	2.31	2.0022	13.32%	The value is a bit off
Frequency (kHz)	1	2	100%	We were told to use

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Conclusion:

For this task we used the DMM to get the voltage and then calculated the RMS ourselves. We got a pretty precise result for the sine wave, however, our result for the triangle wave was off by 13.32% which is quite a lot so we know that there were probably some things that we could've done better.

Task 2.7.2

Objective:

For this task we are supposed to write a function that will generate the RMS voltage for us using either MATLAB or Python.

Results/Calculations:

Step 3:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% ECE 20007 Instrument Control Skeleton File   %
% 01/14/2019                                   %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%% Instrument Addresses
% These are found as VISA addresses in Keysight connection expert)
% Leave address blank for any unused instruments
fg_addr = 'USB0::0x0957::0x2C07::MY57801018::0::INSTR';
dmm_addr = 'USB0::0x0957::0x0618::MY50120007::0::INSTR';
scope_addr = '';
psu_addr = '';

%% Connect to devices with addresses specified
instrreset;

fg = instr_connect(fg_addr, 'usb');
dmm = instr_connect(dmm_addr, 'usb');
psu = instr_connect(psu_addr, 'serial');
scope = instr_connect(scope_addr, 'usb');


%% Insert measurement code here
dmm_rms_volt(dmm)


%% Disconnect from all instruments used
instr_disconnect(fg);
instr_disconnect(scope);
instr_disconnect(dmm);
instr_disconnect(psu);
```

Student Name: Date:

Lab No./Title:

Section # (GTA):

Step 2:

Table III: DC and AC RMS for Sine and Triangle waves

Signal	Theoretical DCRMS (V)	Measured DCRMS (V ____)	%Error	Theoretical ACRMS (____V)	Measured ACRMS (V ____)	%Error
Sinewave	1.155	0.8641	25.186147186147%	2.31	2.0022	13.32%
Triangle wave	1.155	0.8641	25.186%	2.31	2.0022	13.32%

The measured DC RMS and AC RMS are both kind of off from the theoretical value but I think this is normal because we always have some sort of factors that wasn't included in the ideal situation.

Conclusion:

This task was hard because we didn't know what kind of code we should write, and we didn't know if there's a template for the code, so we were stuck for a while. But after that it is relatively smooth because the code just generates the numbers, and we write them down.

Student Name:

Date:
Lab No./Title:
Section # (GTA):

Task 2.7.3

Objective:

For this task we had to write another function that outputs the RMS value for each value while using the function generator instead of the power supply.

Results/Calculations

Step 2-4 (code):

P

Skel.m

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% ECE 20007 Instrument Control Skeleton File   %
% 01/14/2019                                   %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%% Instrument Addresses
% These are found as VISA addresses in Keysight connection expert)
% Leave address blank for any unused instruments
fg_addr = 'USB0::0x0957::0x2C07::MY59002227::0::INSTR';
dmm_addr = 'USB0::0x2A8D::0xB318::MY61210057::0::INSTR';
scope_addr = '';
psu_addr = '';

%% Connect to devices with addresses specified
instrreset;

fg = instr_connect(fg_addr, 'usb');
dmm = instr_connect(dmm_addr, 'usb');
psu = instr_connect(psu_addr, 'serial');
scope = instr_connect(scope_addr, 'usb');

fg_sin(fg,1, 1400,0.75,1);
fg_sin(fg, 2, 60, 1.4, 0);

fg_output(fg, 1,'ON');
fg_output(fg, 2,'ON');
%% Insert measurement code here
dmm_rms_volt(dmm)


%% Disconnect from all instruments used
instr_disconnect(fg);
instr_disconnect(scope);
instr_disconnect(dmm);
instr_disconnect(psu);

%% Insert any plotting or calculations here
```

Dmm_rms_volt.m

```
function [dc_rms, ac_rms] = dmm_rms_volt(instr)
```

Step 3:

Table IV: Type in an appropriate caption for the table below.

Signal	Theoretical DCRMS (V)	Measured DCRMS (V)	%Error	Theoretical ACRMS (V)	Measured ACRMS (V)	%Error
Sinewave	0.265	0.2753	3.8868%	0.265	0.2741	3.434%
Triangle wave	0.265	0.2743	3.51%	0.265	0.2742	3.472%

The percent error are all around 3 – 4% so I assume that our values are pretty accurate.

Conclusion:

We had to write a function for this task and it outputted the RMS value for us. This is particularly useful when we have to test it with different parameters because the program can just do the calculation for us.

Student Name:

Date:

Lab No./Title:

Section # (GTA):

Task 2.7.4

Objective:

For this task we need to build a circuit and configure a sine wave for it then write down the RMS value.

Circuit Schematic(s):

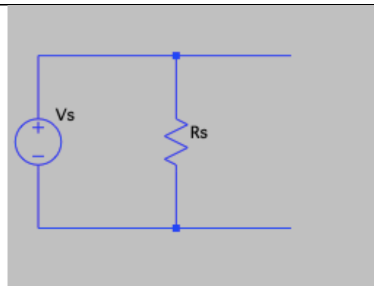

Figure 1: circuit Schematic for verifying Ohm's Law using a AC voltage source.

Results/Calculations:

Step 3-4 (data)

Table V: relationship between amplitude, voltage and current

Set Amplitude (V__)	**Meas'd RMS Voltage (V)**	**Meas'd Current (mA_)**
10	1	0.3319
10	2	0.6626
	3	0.9948
	4	1.3255
	5	1.6563

Set Amplitude (___)	**Meas'd RMS Voltage (___)**	**Meas'd Current (___)**
Set Value	Measured Data	Measured Data

Step 4 (plot)

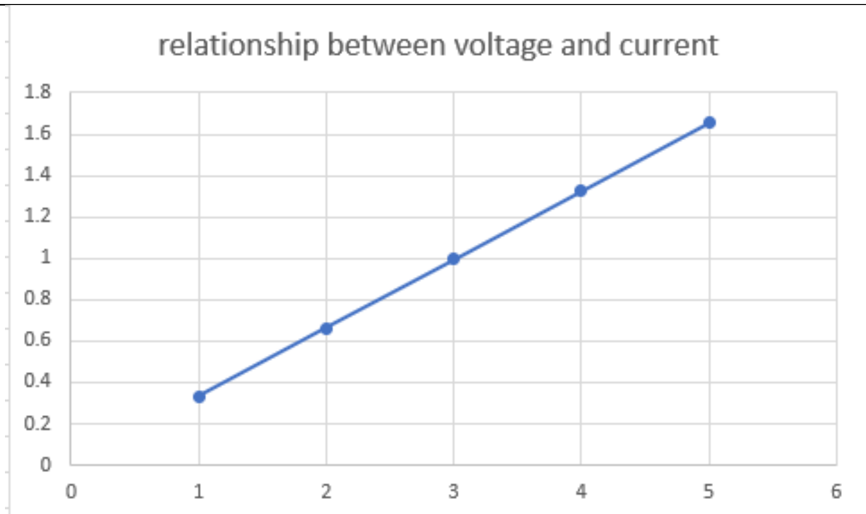

Figure 2: relationship between voltage and current

The Ohm's law still hold with an AC voltage source because as we can see in the plot, when the voltage increases, the current increases as well, which corresponds with Ohm's Law.

Conclusion:

For this task it was relatively easy because we just have to connect the resistor and DMM and function generator and then vary the numbers to get different outputs. The values came out pretty good as we can see in the plot.

Student Name: ---Full Name---

Date: June 4, 2021
Lab No./Title: # - ---Experiment_Title---
Section # (GTA): # (---GTA_Name---)

Task 2.7.5

Objective:

For this task, we are to build three kind of circuits and then measure the voltage and current of each bulb.

Circuit Schematic(s):

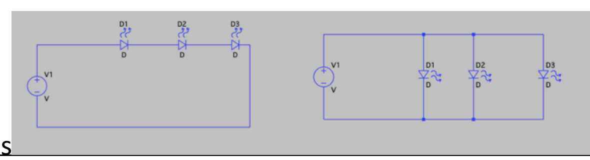

Figure 3: circuit schematic for the three circuits

Results/Calculations:

Step1

Table VI: voltage, current and power for all three bulbs in 3 separate circuits

Circuit	Bulb	Voltage (___V__)	Current (___A__)	Power (_W_)
3a	B1	1.628	0.10413	0.16952364
	B2	1.65	0.10413	0.1718145
	B3	1.677	0.10413	0.17462601
3b	B1	3.72	0.0509	0.189348
	B2	1.021	0.0509	0.0519689
	B3	1.12	0.0509	0.057008
3c	B1	4.746	0.018	0.085428
	B2	4.756	0.018	0.085608
	B3	4.849	0.018	0.087282

Student Name: ---Full Name--- **Date:** June 4, 2021

Lab No./Title: # - ---Experiment_Title---

Section # (GTA): # (---GTA_Name---)

Step 2:

We noticed that the lightbulbs are the brightest when its in parallel and dimmest when it is in series. This is right because each lightbulb gets the most power when they are in parallel. We can see this in the data we collected as the voltage are highest and closest to 5V when it's in parallel.

Step 3:

I would guess that its figure2.9 where they are all in parallel since this is the most energy efficient way to distribute the voltage and brightness across the whole building.

Step 4:

Table VII: voltage. Current and power across the bulbs in figure 2.9

Circuit	Bulb	Voltage (___v___)	Current (___mA)	Power (_W__)
3a	B1	1.0783	75.955	81.9022765
	B2	1.0674	74.96	80.012304
	B3	1.024	75.56	77.37344
3b	B1	Rest is not needed		
	B2	Because the question		
	B3	Only says figure 2.9		
3c	B1			
	B2			
	B3			

The function generator does not like it when there's a load so that is why the voltage is so low even though the circuit is connected in parallel. We tested out the voltage given by the function generator by connecting it directly to the DMM and it outputs close to 5V so it shows that the function generator just doesn't like it when there's a load.

Conclusion:

The values we got were correct and we observed the difference between the three different circuits. The lightbulb also shines differently when the circuit is connected differently so we got to see that difference.