Engineering 65 - Circuit Theory

Lab no. 1

Authors:

Hao Dinh Mai

ID no. 100248784

Instructor

Professor Pinto De Castro

TA

Derek Hollenbeck

Section

Friday 9:00 am - 11:50 am

Date

09/09/22

Fall 2022

Objectives

- Review basic safety protocols, emergency procedures and exits within lab setting
- Familiarize with power supply tools and it's interconnection component to the multimeter
- Familiarize with voltage and current multimeter tools as instructed by the lab instructor
- Understand how the resistors work and read these components in accordance to its' color coordination.
- Apply tool's usage comprehension through application by taking measurement of resistors and comparing the measurement value to the standard value which is provided to us.

Introduction

Circuit theory is a course designed to introduce the concept of how the interconnection of elements of a mechanical system influences the behavior of electricity inputs. Hence, being the initial lab and also an introductory lecture, the beginning of the session was dedicated to the familiarization of the lab room's setting including the emergency exit, and what are the necessary protocols to take if an accident were to occur. Personal lab tool sets were also handed out, and instructions on what each component is and how to use them were introduced.

The second half of the lab session dove into the technicalities involving concepts such as what appropriate SI (International Standard units) unit system to use when recording data via the notation to account for when stating solutions to lab problems. Instructions were given on how to operate the power supply and information including the various outlets within the machine and which output to use for this specific lab. Additional information shines insight on how to measure the ohm for resistors with high ohm resistance in the range of thousands and millions given that the supplied multimeters are not applicable for such resistors.

Methods and Procedure

This lab is an introductory session to demonstrate the application of power source, multimeter and resistors which were all supplied to us. The objective of the lab is to understand and apply the working mechanics of these devices. Ergo, the lab starts off by demonstrating how to account for the voltage deriving from a power supply. First, turn on the power supply and set it at 5 volts, then connect the power supply using the red and ground wired to the connectivity of a breadboard and by using a wire from our lab kit, connect the positive input to the negative input as indicated by the breadboard icon using the wire. Next, using the multimeter - adjust the multimeter by switching the setting to the voltmeter, then using the leeds of the multimeter, we can account for the voltage by placing it on the wire that is inserted on the breadboard powered by the powersource. The second step is to then repeat the step above, but this time, the power source will be adjusted to 10 v and with the same setting of the multimeter, we will measure the voltage coming from the powersource into the breadboard again. The mission statement for this procedure of the lab is to see the discrepancy values between the original voltage via the voltage supply and the measured value we obtain by measuring the current running through the wire on the breadboard. Promptly, it is evident that though the values share a close proximity, yet the error margin shows that there were voltages which were lost as a result of it being transferred from the power source to the wire.

The second section of the lab is to find the ohm resistance within each resistor in accordance to their color coordination, for each color pattern coordination denotes a specific ohm resistance. Note that some of the ohms may reach the values within the thousands or millions; thereby, it is strongly advised to use the appropriate multimeter which can account for how large the number will get and the conversion that follows. Thereby, within the lab table there are 12 resistors, all the indicated ohm values for various resistors are given including the percentages of indicated tolerance; our job is to fill out the color pattern of each resistor and measure the actual ohm using the multimeter. Duly note that, during a certain point in which the ohm reaches the digits in range of thousands, the supplied multimeter within the lab kit will be obsolete for it can only intake ohm values up to the hundreds digit. Thereby, using a specified multimeter which can intake ohm into the million digit we will be able to take the measurement of kilo-ohms and mega-ohms; however, consider the fact that if the multimeter is set to measured mega-ohms then when measuring kilo-ohms, the proper conversion needs to be applied for the correct result.

Results and Data Discussion

Indicated Value	Color Code	Measured Value	Indicated Tolerance	Measured Tolerance
100 Ω	Brown, Black, Brown	99.7 Ω 99.9 ohm	5%	0.3%
270 Ω	red, purple,red,	264 ohm	5%	2.22
470 Ω	yellow purple brown	459 ohm	5%	2.34
680 Ω	blue, gray, brown	668 ohm	5%	1.76
1 kΩ	brown, black, red	979 ohm	5%	2.1
2.2 kΩ	red, red, red	2.13 ohm	5%	3.18
3.3 kΩ	orange, orange, red	3.032 ohm	5%	2.21
5.6 kΩ	Green,blue,red	5.48 ohm	5%	2.14
10 kΩ	brown, black, orange	9.90 ohm	5%	1.00
100 kΩ	Brown, Black, yellow	98.9 ohm	5%	1.01
4.7 MΩ	Yellow, purple, blue	4.65 ohm	5%	1.06
10 MΩ	brown, black, blue	9.94 ohm	5%	0.64

The above table shows the various color patterns of resistors which were employed within this tab along with the actual measured value derived by taking the measurement of each resistor. Recall that each pattern represents a specific ohms, and as we measure the resistor in real-life, though the resistance ohm should not be identical to the indicated ohms, the measured value should be within proximity of the indicated value with a reasonable error margin percentages. Once all the ohm resistance data are collected, the next step is to find the measured tolerance percentages. According to the lab instructions, the given formula: Measured Tolerance (%) = 100*(Ra-Ri)/Ri. Accounting for the fact that the indicated value is given which takes the variable of 'Ri' and the measured value which we have recorded through measured denoting 'Ra', the rest will be mathematical inputs and simplification. Thereby, as a result, under the measured tolerance categories resides the percentage tolerance from the computation of each individual resistors' measured value with indicated values. Substantially, it is apparent that the measured ohms values for each resistor are very close to that of the indicated value. Thus, concluding that the values from the experiment are corrected, the percentage of error that is present as seen in the table above, the highest, is 3.18 percent, which indicates that our measurements are not too far off.

Conclusion

The mission statement for this specific lab is designed with the expectation to help students familiarize themselves with the lab's setting, and the various electrical instruments such as the power supply, the multimeter and the resistors with different ohm ranges. Hence, as demonstrated within the lab report and reference to the table above, the objective for this lab was sufficed. The values for all the ohms were recorded by using the appropriate tools which allows the computation of the measured tolerances percentage between the ideal ohm number and the actual measured value of ohms taken by a multimeter. From this aspect, it is just to note that in theory, the values are perfect because the loss of voltage when being transferred is not accounted for; hence, input in will be input out which aligns with kirchhoff law. Unfortunately, in actual application, the current input will not be the total output due to factors such as material in which the current is running through, the environment in which the experiment is conducted and the size of medium in which the current is being transferred through. Therefore, when employing the knowledge of circuit theory in a professional setting, it is a must to account for the margin of tolerance error when designing circuit models to ensure that the elements within the circuit can handle the current load and are fairly distributed the current to prevent circuit failure.

References

- Nilsson, J., & Reidel, S. (2018, January 9). *Electric Circuits* (11th ed.). Pearson.