ECEN 214 - Lab Report

Lab Number: 3

Lab Title: Equivalent Networks and Superposition

Section Number: 502

Student's Name: Jeweliana Mendez and Joaquin Salas

Student's UIN: 231000889 and 731000141

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TA: Pranabesh Bhattacharjee

A. Procedure:

Task 1.

In Task 1, we made a circuit that consisted of a combination of series and parallel resistors with different ohms values as well as two voltage sources at different measurements. In order to understand the superposition principle, students measured the voltage across the 1kΩ resistor. After this was done, students modified the circuit to allow it to work without the second voltage source. After recording the voltage of the newly modified circuit, the circuit was modified again to allow the current to flow without the first voltage source.

Task 2.

In Task 2, the same circuit was made once again, except for the addition of a diode, which acted as a switch in the circuit depending on the direction of the current. Following the same procedures as task 1, students were able to observe the effects that the superposition principle has on the circuit in a non- linear device.

B. Data Tables:

Table 1: Circuit without diode

Parameter	Measured	Calculated	% difference	SPICE	% difference (SPICE to measured)
V_L	**0.275 V**	**0.2654 V**	**0.5 %**	**0.2655**	**3.58**
$V_{L,1}$	**-0.291 V**	**-0.2909 V**	**0.01 %**	**0.2909**	**0.34**
$V_{L,2}$	**0.5564 V**	**0.5564 V**	**0 %**	**0.5564**	**0**
$V_{L,1} + V_{L,2}$	**0.2654 V**	**0.2655**	**0.01 %**	**0.2654**	**0**

Table 2: Circuit with Diode

Parameter	Measured	SPICE	% Error
V_L	**-0.0024 mV**	**0**	**1**
$V_{L,1}$	**0.154 V**	**0.164**	**6.1**
$V_{L,2}$	**-0.003 mV**	**0**	**1**
$V_{L,1} + V_{L,2}$	**0.151 V**	**0.161**	**6.2**

C. Sample Calculations:

For table 1:

$1 \cdot I_1 + 2(I_1 - I_2) + 5.1(I_1 - I_3) = 0$

$\Rightarrow 8.1I_1 - 2I_2 - 5.1I_3 = 0$

$2(I_2 - I_1) + 5.1(I_2) + 4 = 0$

$\Rightarrow -2I_1 + 7.1I_2 = 4$

$-3 + 2I_3 + 5.1(I_3 - I_1) = 0$

$\Rightarrow -5.1I_1 + 7.1I_3 = 3$

Solving the system of equations for "I", we get $I_1 = 0.618A,\ I_2 = 0.518A, I_3 = 0.978A$

Now, using Ohm's law to calculate voltage across the 1kΩ resistor…

$8.1I_1 - 2I_2 - 5.1I_3 = V_1 \Rightarrow V_1 = 0.2655$ V

$-2I_1 + 7.1I_2 = V_2 \Rightarrow V_2 = -0.2902$ V

$-5.1I_1 + 7.1I_3 = V_3 \Rightarrow V_3 = 0.5564$ V

D. Discussion:

The superposition principle works in Task 1 due to the circuit being a closed circuit no matter how it is broken apart to solve the circuit part by part. The purpose of the superposition principle is to break about complex circuits in order to add the sums of the individual results. Since the current and voltage continues to flow no matter the separation, it allows the superposition principle to be applied. In task 2, since the diode was added to the circuit, it resistriced the circuit's current to only flow in one direction. If it was to flow from the opposite direction, the circuit would act as if there was an open circuit. A resistor is considered a linear element due to the voltage drop across a resistor being consistent in both directions of the current. The diode is a non- linear element due to the current only flowing through from the positive terminal to the negative terminal. If it is to flow from the negative terminal to the positive terminal, it would act as if it is an open switch.

E. Conclusion:

This lab allowed students to have a better understanding of the Thevenin's equivalent circuit and superposition principle. Students did this by building two DC circuits and observing the effects that components such as a diode will have on the voltage under different circumstances. With this better understanding of the superposition principle, students will be able to solve more complex circuits with their independent sources present by breaking the circuits into parts and adding the sum of the individual results.