**AC Superposition**

**LAB # 06**

** Fall 2019**

**Fall 2021**

**CSE202L Circuit system-II**

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“On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work.”

Student Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Submitted to:

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**Objective**

This exercise examines the analysis of multi-source AC circuits using the Superposition Theorem. In particular, sources with differing frequencies will be used to illustrate the contributions of each source to the combined result.

**Theory Overview**

The Superposition Theorem can be used to analyze multi-source AC linear bilateral networks. Each source is considered in turn, with the remaining sources replaced by their internal impedance, and appropriate series-parallel analysis techniques employed. The resulting signals are then summed to produce the combined output signal. To see this process more clearly, the exercise will utilize two sources operating at different frequencies. Note that as each source has a different frequency, the inductor and capacitor appear as different reactance to the two sources.

**Equipment**

1. AC Function Generators

2. Oscilloscope

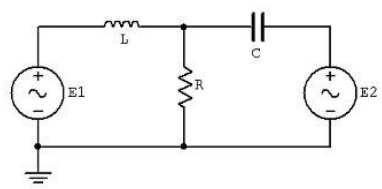
**Components**

1. 0 .1 µF actual: \_\_\_\_\_\_\_\_

2. 10mH actual: \_\_\_\_\_\_\_\_

3. 1kΩ actual: \_\_\_\_\_\_\_\_

**Figure 1**



**Procedure**

To test the Superposition Theorem, sources E1 and E2 will be examined separately and then together.

**Source One Only**

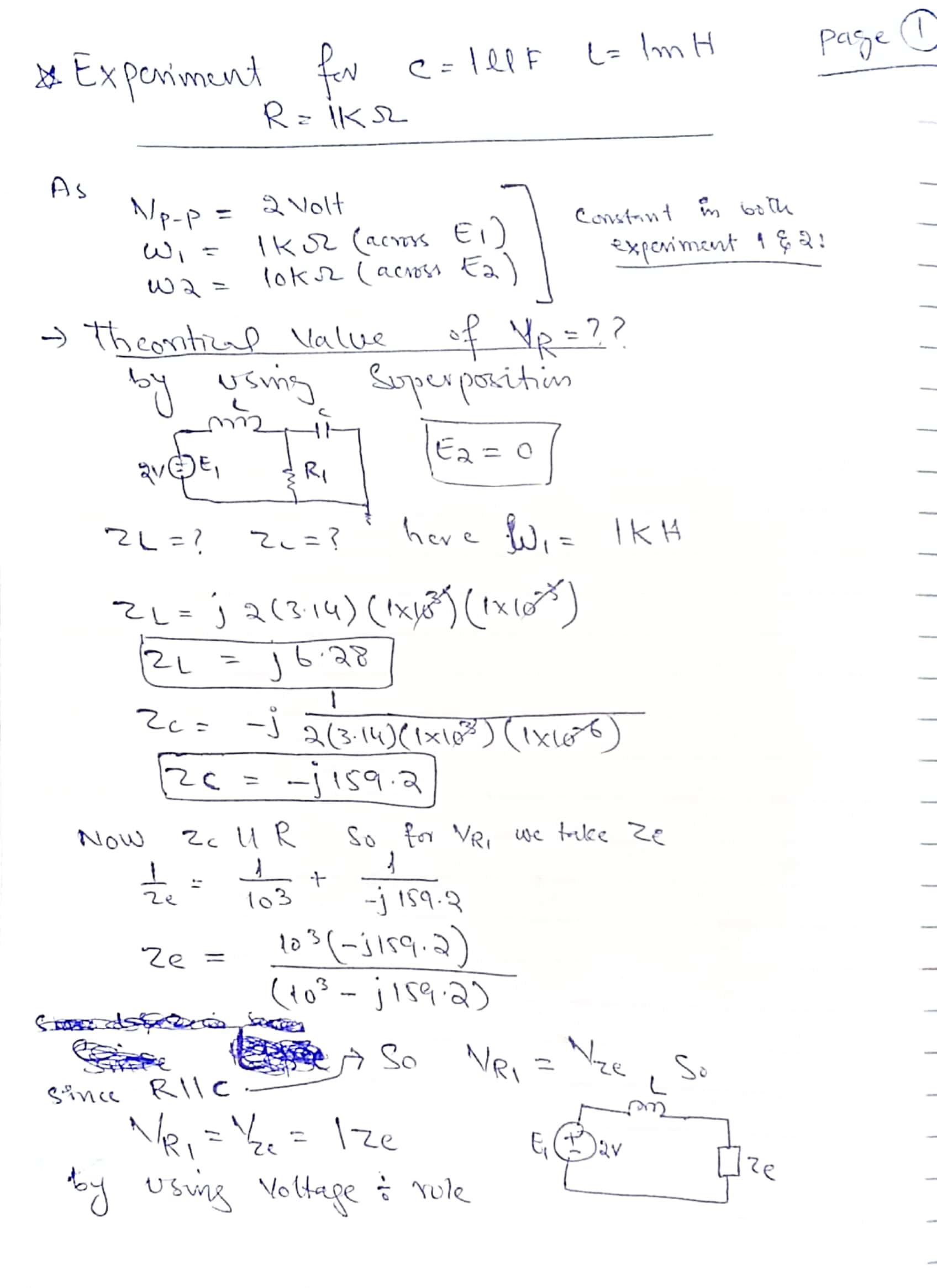
1. Consider the circuit of Figure 1 with C=0.1 µF, L=10mH, R=1kΩ, using only source E1=2 Vp-p at 1 kHz and with source E2 replaced by a 0-V voltage source represented as a short circuit. Using standard series parallel techniques; calculate the voltages across R. Record the results in Table 1.
2. Build the circuit of Figure 1 using C=0.1 µF, L=10mH, and R=1kΩ. Replace E2 with 0-V voltage source represented as a short circuit. Set E1 to 2V p-p at 1 kHz, unloaded. Place probe one across E1 and probe two across R. Measure the voltages across R, and record in Table 1.

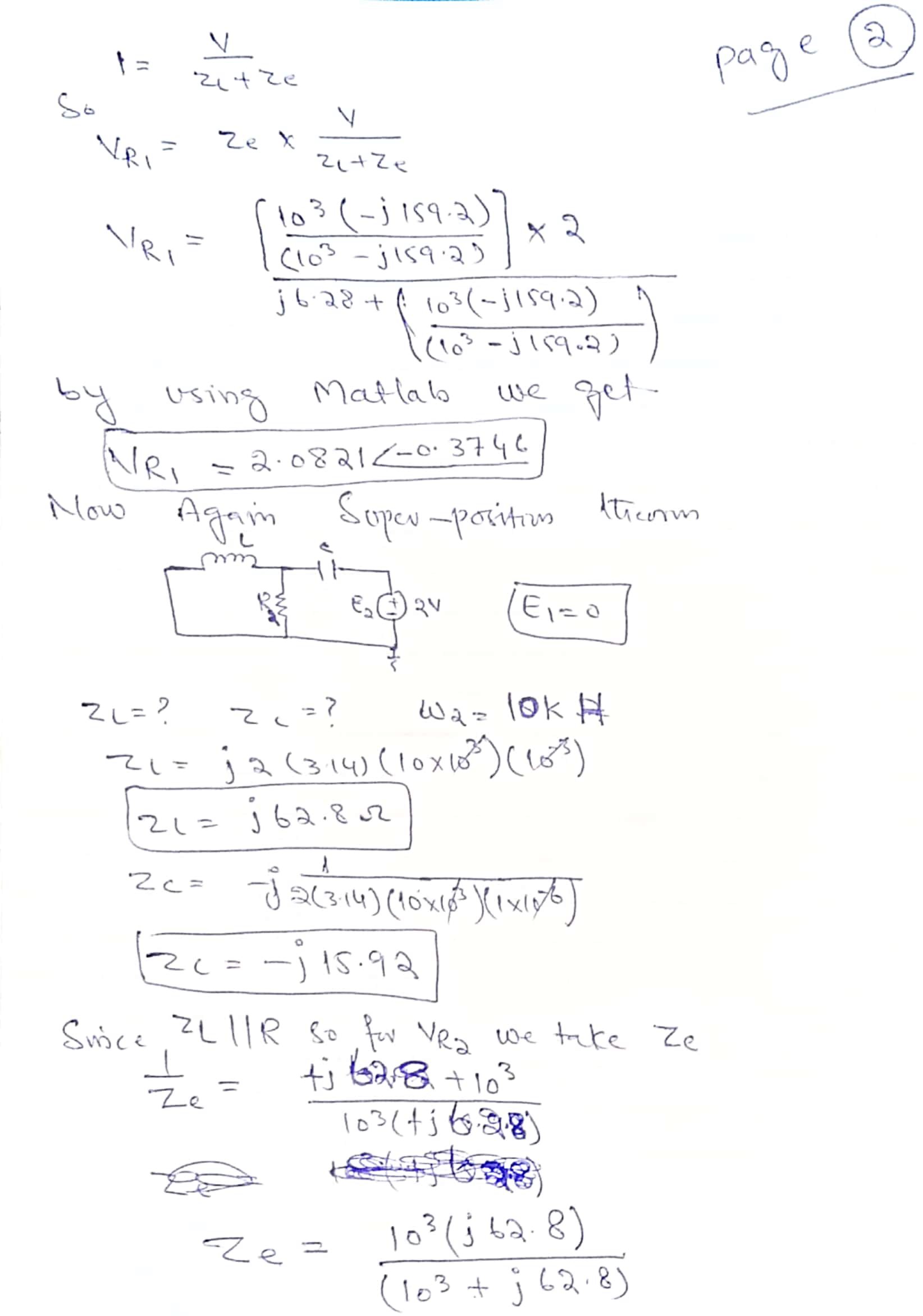
**Source Two Only**

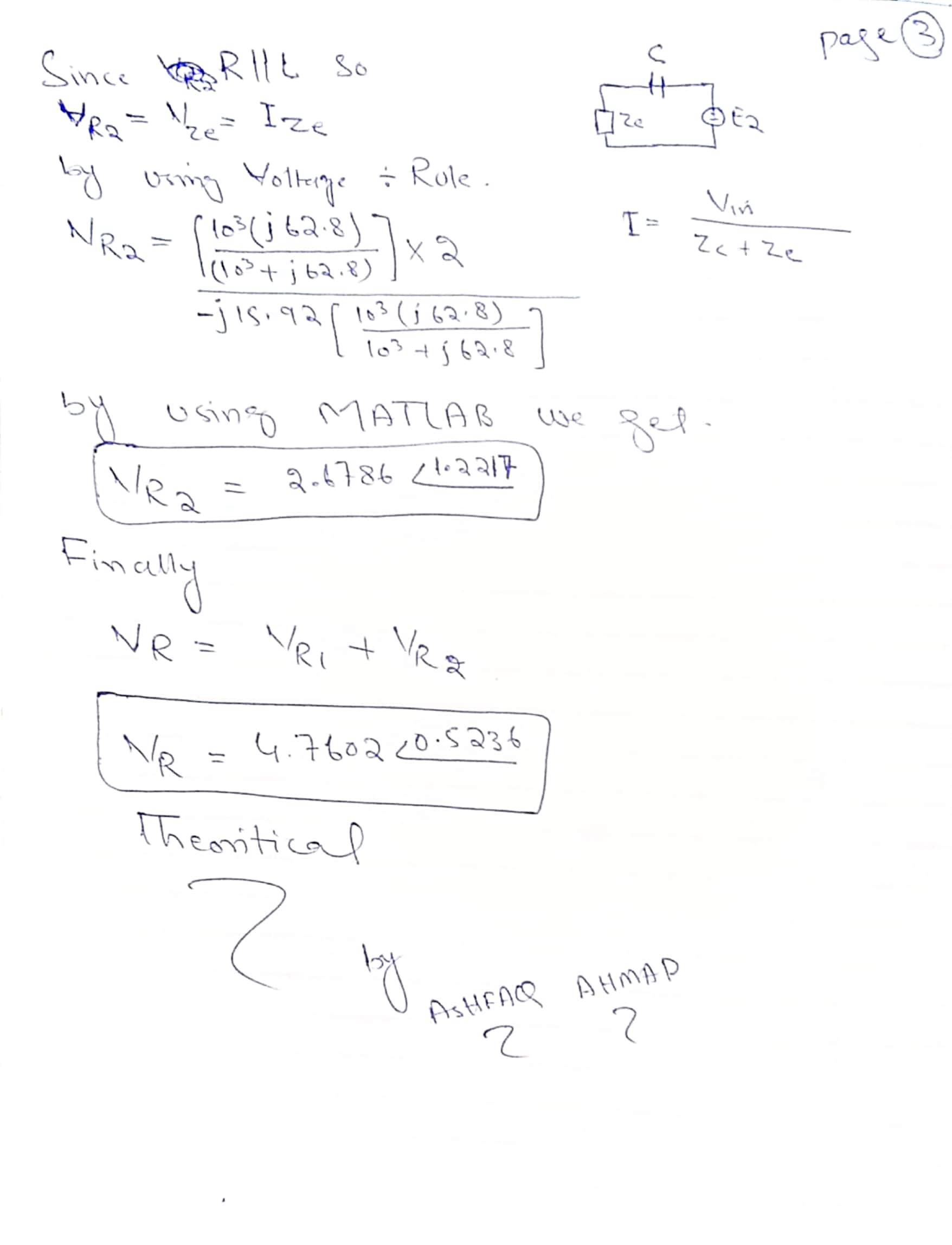
1. Consider the circuit of Figure 1 using only source E2=2 V p-p at 10 kHz and with source E1 replaced by 0-V voltage source represented as a short circuit. Using standard series-parallel techniques; calculate the voltages across R. Record the results in Table 2.
2. Replace the short circuit with source E2 and set it to 2Vp-p at 10 kHz, unloaded. Replace E1 with 0-V voltage source represented as a short circuit. Place probe one across E2 and probe two across R. Measure the voltages across R and record in Table 2.

**Sources One and Two**

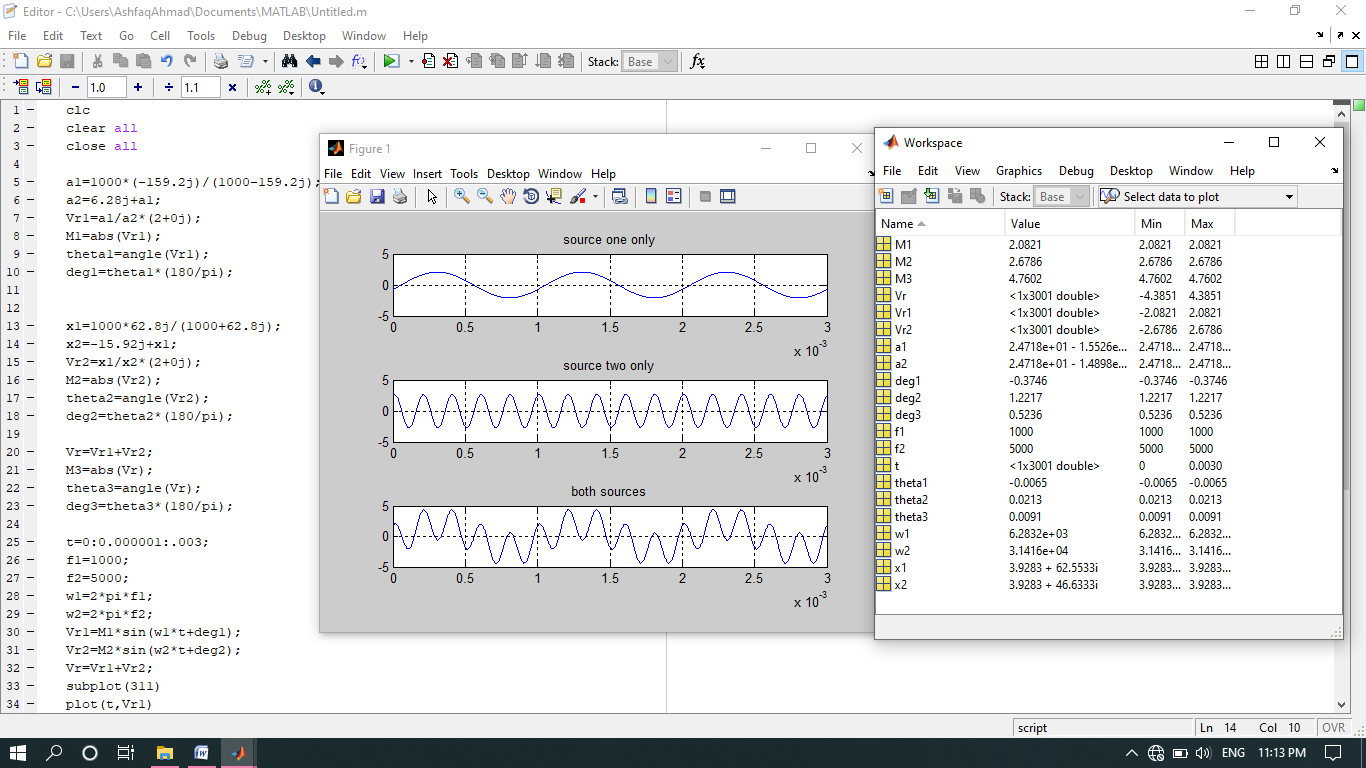
1. Consider the circuit of Figure 1 using both sources, E1=2Vp-p at 1 kHz and E2=2Vp-p at 10 kHz. Add the calculated voltages across R from Tables 1 and 2. Record the results in Table 3.
2. Replace the short circuit with source E1 and set it to 2Vp-p at 1 kHz, unloaded. Both sources should now be active. Place probe one across R. Measure the voltages across R, and record in Table 3.
3. Repeat the experiment for 1uF capacitor, 1mH inductor and 1kΩ resistor.



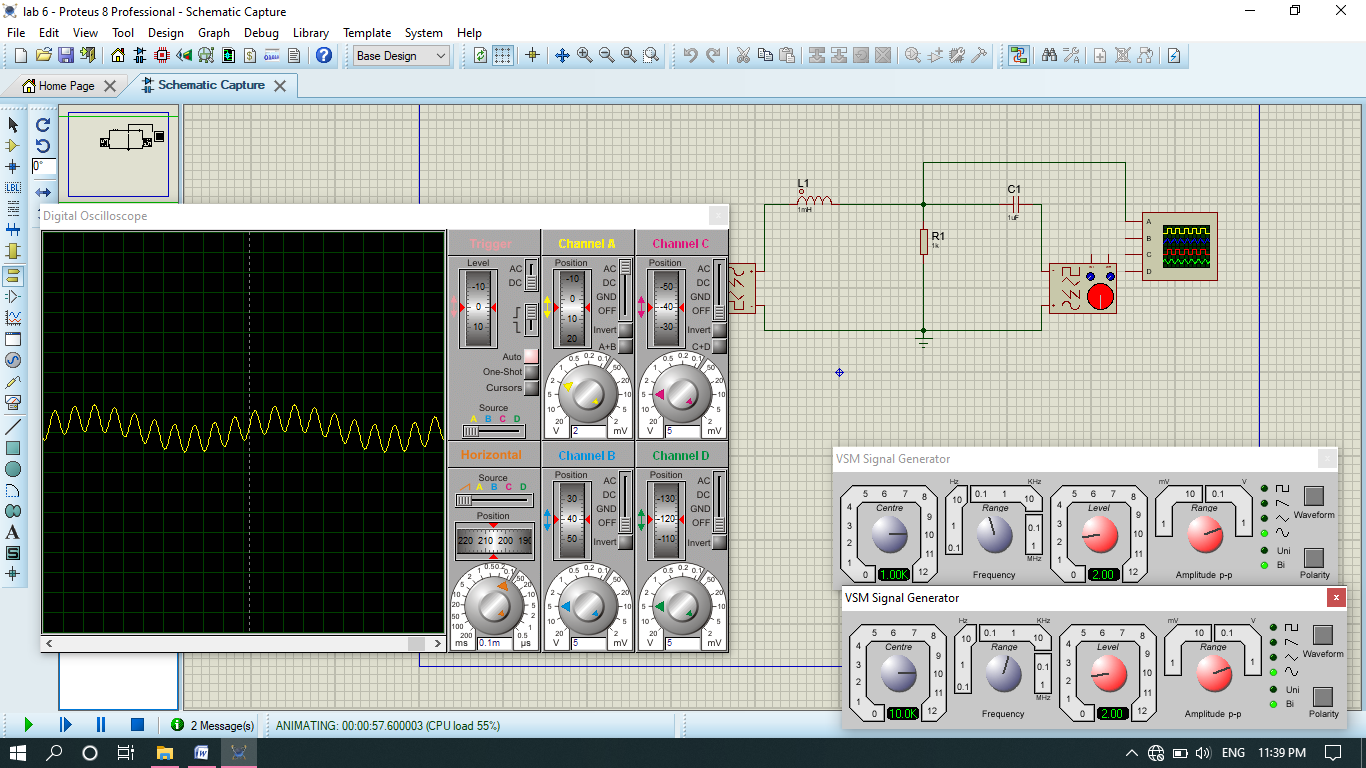




**MATLAB Code:**

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**Proteus simulation:**

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**Data Tables:**

**Experiment 1:**

**For ( C=1uf, L=1mH, R=1K ohm )………**

**Vp-p =2v, w1=1k H (across E1) , W2=10k H (across E2)……….. Constant in both experiments.**

**Source One Only**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 2.0821 | 2.1 | -0.85% |

**Table 1**

**Source Two Only**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 2.6786 | 2.8 | -4.53% |

**Table 2**

**Sources One and Two**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 4.7602 | 4.6 | 3.36% |

**Table 3**

**Experiment 2:**

**For ( C=0.1uf, L=10mH, R=1K ohm )**

**Source One Only**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 2.0778 | 2.00 | 3.74 % |

**Table 1**

**Source Two Only**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 2.6196 | 2.7 | -0.77% |

**Table 2**

**Sources One and Two**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Theoretical | Experimental | % Deviation |
| VR | 4.603 | 4.98 | -6.73% |

**Table 3**

**Questions :**

1. Why must the sources be replaced with a 50 Ω resistor instead of being shorted?

Answer: Normally the function generators have 50 ohm internal resistance. To get the exact result of voltage we must replace the voltage source by 50 ohm resistance for accurate calculation of superposition theorem.

1. Do the expected maxima and minima from step 6 match what is measured in step 7?

Answer: the theoretical and experimental value obtained in step 6 is

|  |  |
| --- | --- |
| Theoretical=4.7602 | Experimental=4.6 |

Similarly the theoretical and experimental value obtained in step 7 is,

|  |  |
| --- | --- |
| Theoretical=4.603 | Experimental=4.98 |

Expected maxima and minima from step 6 match which is measured in step 7 are nearly matching.

3. Does one source tend to dominate the 1kΩ resistor voltage or do both sources contribute in

nearly equal amounts? Will this always be the case?

Answer: No, one source does not tend to dominate the 1 kilo ohm resistor voltage but both contribute nearly the equal amount. This will always be in normal case.

***THE END***