EE 2010 Circuit Analysis
Lab 02: Series and Parallel Resistors

Lab Section: **Printed Name (Last, First):**

Learning Objectives:

- Compare analysis with simulation and realization of resistive circuits
- Become proficient in Multisim GUI and functions
- Be able to measure multiple quantities in a Multisim simulation
- Be able to use these laboratory tools to build and verify operations of a simple circuit

A. Before coming to lab:

1. Analysis of a resistor circuit

For the circuit shown below,

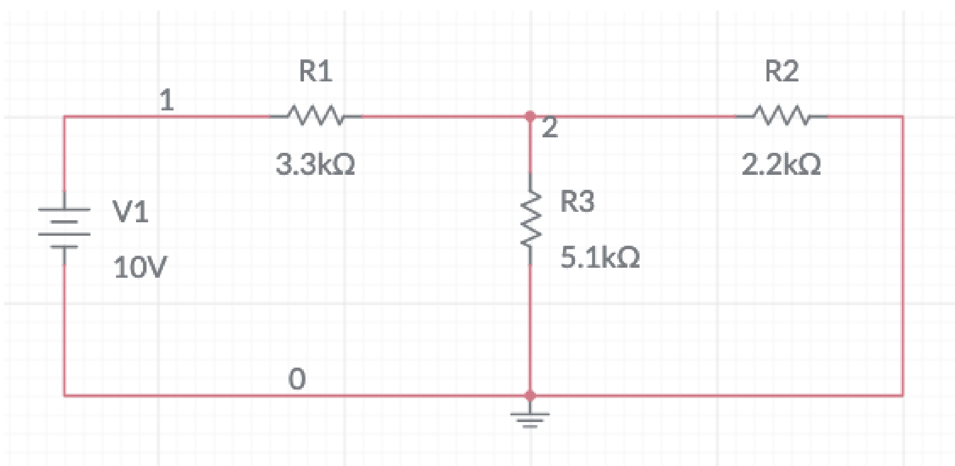

Figure 1: Series, parallel resistor circuit

use appropriate analytical techniques to find:

1.1 The resistance as seen by the voltage source 4836.986Ω

1.2 The total current supplied by the voltage source 0.002067403A

1.3 The voltage across R_3 3.01369863014V

1.4 The current through R_2 0.00136986301A

1.5 The current through R_3 0.0005909213A

1.6 The current through R_1 0.00303030303A

1.7 The total power supplied by the voltage source 0.0303030303W

2. Build a Multisim simulation of the resistive circuit.

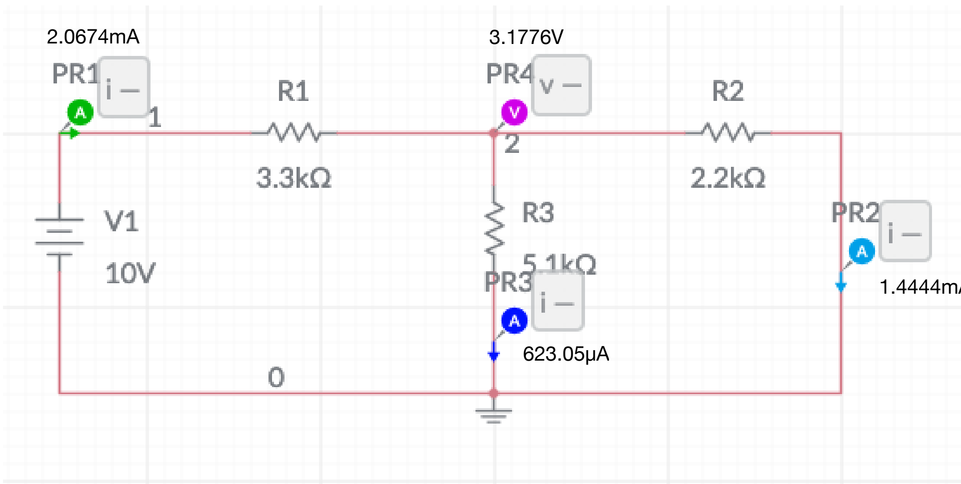

Figure 2: Series, parallel resistor circuit

2.1 Using the voltage and current probes shown in the simulation schematic, verify the predicted analytical quantities.

2.2 Comment on any discrepancies between the *analysis* and the corresponding *simulation* quantities:

They are fairly similar, and the models are not perfect

2.3 Capture a screenshot of your circuit and upload it to Pilot under **Assessment** → **Dropbox**. If you aren't sure how to find the dropbox or don't see one available, contact your TA via email or during their office hours for assistance.

Explore "what-ifs" by changing component values, placement, and voltage sources.

B. In Lab Procedures:

1.1 Assemble the components for the circuit shown below,

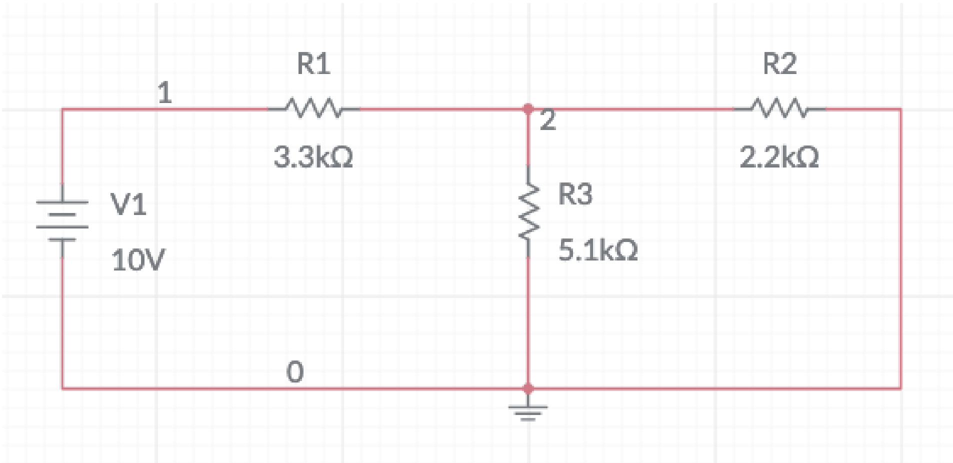

Figure 3: Series, parallel resistor circuit

1.2 Verify the resistor values via the color code:
R_1 band colors: orange, orange , red , gold
R_2 band colors: red red red gold
R_3 band colors: green brown red gold

1.3 Verify the resistor values via DMM measurement:
R_1 measured value: 3.26 KΩ
R_2 measured value: 2.14 KΩ
R_3 measured value: 4.97 KΩ

1.4 Use appropriate measurement techniques to find:

1.5 The resistance as seen by the voltage source 4.77 KΩ

1.6 The total current supplied by the voltage source 2.1 mA

1.7 The voltage across R_3 3.16V

1.8 The current through R_2 2.07 mA

1.9 The current through R_3 2.07 mA

1.10 And use these to calculate the total power supplied by the voltage source 0.021026W

1.11 Comment on the insight and utility of *simulation* and the verification of *realization*:

simulation gives us a model that approximates what's supposed to happen, actually doing it shows how accurate the model was

1.12 So what utility remains in *analysis*?

showing the accuracy of the model

1.13 How might *simulation* then compliment and enhance *analysis*?

one can act as a sanity check for the other

Takeaways:

- Engineers employ multiple techniques to gain insight to systems and to assess their performance *BEFORE THEY ARE BUILT.* Primarily, these techniques include: *Analysis* and *Simulation*. The third, and usually final, process is that of *Realization*.
- In this course, we have the luxury of access to all three processes. Modern systems are often too costly to build, test, and build again, etc. It is therefore of utmost importance for engineers to become proficient with simulation tools.

  From *WikiPedia*: A simulation (or "sim") is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. By changing variables in the simulation, predictions may be made about the behavior of the system. It is a tool to virtually investigate the behavior of the system under study.

  ... Traditionally, the formal modeling of systems has been via a mathematical model, which attempts to find analytical solutions enabling the prediction of the behavior of the system from a set of parameters and initial conditions. Computer simulation is often used as an adjunct to, or substitution for, modeling systems for which simple closed form analytic solutions are not possible. There are many different types of computer simulation, the common feature they all share is the attempt to generate a sample of representative scenarios for a model in which a complete enumeration of all possible states would be prohibitive or impossible.
- The models for circuit elements and circuit quantities are **always wrong**, but hopefully close enough to be useful.
- Resistors in series add.
- Resistors in parallel have an equivalent lower than the minimum of any individual resistors.
- The voltage across series resistors add to the value of the supply.
- The current through series resistors is the same for each resistor.
- The voltage across parallel is the same for each resistor.
- The current through parallel resistors add to the value of the supply.