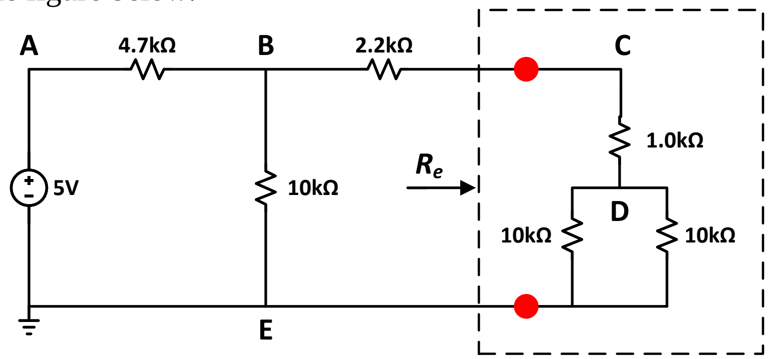
KNOWLEDGE INTEGRATION #1

PART I – BACKGROUND INFO

For this KI, we have decided to focus on a simple circuit from ECE202 Lab#3. Circuit with nominal values of resistors is given in the figure below.



KNOWLEDGE INTEGRATION #1 (KI_1) PREP

To prep data for KI #1, each ECE202 Lab team has filled-in the provided excel spreadsheet and emailed it to their TA.

During lab session, each team has picked ten 10-kΩ resistors and measured their values using a Hand-Held Digital Multi Meter (HH DMM) and using an HP Impedance Analyzer in C105 lab. Each team has recorded the following:

1. Ten measurements from HH DMM
2. Ten measurements from HP Impedance Analyzer

In the following step, teams have setup the circuit for measuring V_{Th} and R_{Th} four times, using different 10 kΩ resistor, and measured V_{Th} and R_{Th}. The following data that will be used in this KI was recorded:

3. Four measurement results for V_{Th}
4. Four measurement results for R_{Th}

As the final step, the TAs had taped one resistor on the whiteboard in C105 lab. We labeled this resistor as R_{202}. Each student measured the value of this resistor using HH DMM and an HP Impedance Analyzer and entered the measured values in the table. Measured data has been recorded in two additional columns:

5. Measured value of R_{202} using HH DMM
6. Measured value of R_{202} using HP Impedance Analyzer

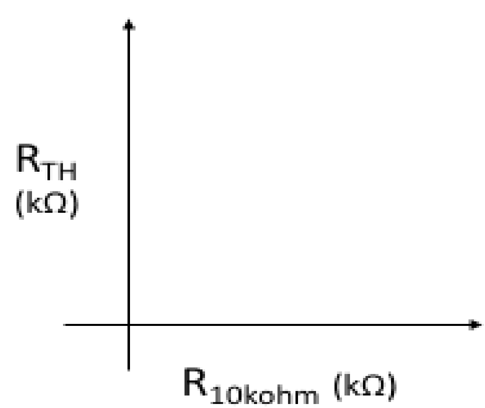
The purpose of (1) and (2) will be to analyze values of resistors, given manufacturing precision.
The purpose of (3) and (4) will be to analyze how actual values of circuit variables differ from the nominal (ideal / designed) values.
The purpose of (5) and (6) is to analyze whether there is experimental error involved, given that different people had measured the same resistor, using different HH DMM and the same HP Impedance Analyzer.

Lastly, one half of the students have worked with 1% precision resistors and the other half of the students have worked with 5% precision resistors.
The R_{202} resistor had 1% precision, and was the same resistor for everyone.

Your TAs have combined measurement results of all students and organized them in an Excel spreadsheet

PART II – CIRCUITS REVIEW, SIMULATIONS, AND FLUCTUATIONS (YOUR ASSIGNMENT)

1. Calculate Thevenin Voltage V_{Th} and Thevenin resistance R_{Th} for the given circuit, to the left of the two red dots.
2. Write a MATLAB script to read the values in the xlsx spreadsheet (you should use the MATLAB function xlsread) and compute the maximum and minimum values of all measured 10 kΩ resistors.
   Note: for a one-dimensional array A, you can get rid of all NaNs by using the MATLAB command   A(isnan(A))=[];
3. Divide this segment [Rmin, Rmax] into 200 values and write MATLAB script that computes and plots R_{Th} as a function of the value of 10 kΩ resistor. Make sure to label your axes. You should have 201 values in your plot. What values of 10 kΩ resistor in this range result in min and max value of R_{Th}?
   Note: To answer this question, assume that the 10 kΩ resistor is the only one that changes value and keep the rest of the resistors at their nominal values.



4. Create a triple-nested loop in MATLAB that will vary each of the three resistors in the range +/- 1% and compute every possible combination of the resistors. From these data, find the worst-case scenario (specifically, which resistance values yield the min and max values of R_{Th} and which set of resistor values produces the R_{Th} furthest away from the nominal value). Perform this check for 100 values of each resistor (Each loop will execute 100 times). This will result in 100^3 sets of resistors that should be evaluated.

5. Research and find on the internet the precision of the used HH DMM (Grey: HP E2373A, Flat: Mastech MS8216 DMM and Green: Mastech 8217) and HP Impedance Analyzer (HP 4192A), when measuring resistances and voltages.
6. Write a MATLAB script to extract the mean and standard deviation from each column in the xlsxs spreadsheet.
7. Plot six histograms of the measured resistor values (different histograms for 1%, 5%, HP, DMM, and 202).
8. Draw conclusions about different factors that contribute to fluctuations in the measured resistor values. Estimate to the best of your ability the standard deviations in the resistance of the 1% and the 5% resistors. Estimate the mean value of these resistances.
9. The manufacturer "guarantees" that the resistors will be within the given accuracy (1% or 5% in these cases). How many σ's are these reported accuracies?
10. Elaborate on why people are needed to perform data analysis instead of simply cranking the experimental data into a machine.

KI1- Engineers and Code of Ethics

Engineering is not only a technical discipline. Engineers have a huge impact on people as they solve problems to improve life quality.
Ethics education is an important part of every engineering discipline. One of the critical components in our program is exposing you, the students, to ethical considerations that you may encounter in your professional careers and prepare you to deal with them. The core goal of RED project in our department is to provide a holistic education that is a collaboration between students and faculty. As part of the professionalism thread, with the help of your professors, we are integrating ethics education into the technical content of your curriculum through ethical foundations and various case studies.

Code of ethics is a set of principles designed to guide professionals to have an honest and professional career. There are different code of ethics available to ECE students. The IEEE Code of Ethics has been in existence since 1963. Every IEEE member agrees to abide by the IEEE Constitution, Code of Ethics, Bylaws and Policies when joining [1].

IEEE Code of Ethics:

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members, and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

National Society of Professional Engineers (NSPE) also provide a good Ethics resource. To access NSPE Code of Ethics for Engineers please refer to [2].

Association for Computing Machinery (ACM) also provides a Code of Ethics and Professional Conduct. This code that was recently updated, is a collection of principles and guidelines designed to help computing professionals make ethically responsible decisions in professional practice. You can access to code in [3]. For some examples on how the code in used in practice or in the media please refer to [4].

Social Responsibility of Engineers[1]

Responsibility itself is a complex subject. In moral philosophy and engineering ethics, the term responsibility has varying meanings and qualifications. For example, some speak of responsibility as a form of accountability, while others link it with conditions for blameworthiness. The requirements to prove an individual is responsible and what they can actually be responsible for are also variable. In moral philosophy distinctions are drawn among various types of responsibility, including causal, legal, moral and professional responsibility. Not all responsibilities are co-extensive. For instance, one can accidentally be causally responsible for an incident, but not held legally responsible.

In the contemporary engineering ethics literature, authors often contrast social and technical responsibilities, and there is disagreement about which kind of responsibility should be prioritized. For example engineers in the 1960’s and 1970’s criticized the technocratic movement of previous decades for its lack of social consciousness. This highlights the difference between thinking that engineers are responsible for technological advancement only, as opposed to being responsible for the consequences that technology has for people.

There are two problems with an overemphasis on technical progress. First, much energy, including economic resources and time, is spent on the development of technologies, such as weaponry, that one can argue does not benefit society. Second, even established engineering technologies, such as water sanitation, are not available to everyone who needs them. One point of view is that engineers should work to correct the imbalance between technological ability and social need by prioritizing people. However, it is unclear whether the responsibility should be one belonging directly to engineers or if society should be responsible for resource allocation and support so that engineers can work toward such priorities.

Finally, there is significant debate about the extent to which engineers have the responsibility to contribute to the betterment of society. Some base the responsibility to benefit society upon aspirational ethics, appeals to codes of engineering ethics requiring engineers to ‘‘hold paramount the safety, health, and welfare of the public,’’ or duties of professionalism. There is also a contrary, though less popular, view that the responsibilities of engineers ought to be limited to the realm of professional competence, committing engineers only to the responsibility of avoiding harm to others while absolving engineers of the commonly accepted responsibility to benefit humanity. As with the difference between the technical and social responsibilities, this disagreement between an obligation to avoid harm or to benefit society in part depends upon where one chooses to draw the line between harmless and beneficial technologies.

Please answer the following question:

Q. As you consider your professional development as an engineer, where do you think you fall on the spectrum of social responsibility, from do no harm to it should be for some social benefit? Please explain in a short paragraph.

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[1] Adopted from [5] page 520-521.

Bibliography

[1] IEEE, "IEEE Code of Ethics," 2018. [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed 05 05 2018].

[2] National Society of Professional Engineers, "NSPE Code of Ethics for Engineers," 2018. [Online]. Available: https://www.nspe.org/resources/ethics/code-ethics. [Accessed 05 05 2018].

[3] Association for Computing Machinery, "ACM Code of Ethics and Professional Conduct," 2018. [Online]. Available: https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct. [Accessed 05 05 2018].

[4] Association for Computing Machinery, "ACM Ethics," [Online]. Available: https://ethics.acm.org/code-of-ethics/using-the-code/. [Accessed 05 05 2018].

[5] J. Smith, P. Gardoni and C. Murphy, "The Responsibilities of Engineers," *Science and engineering ethics,* vol. 20, no. 2, pp. 519-538, 2014.