EN 1-10: Engineering in the Kitchen

Fall 2023
M/W 3:00-4:15pm, Barnum 100

Welcome to "Engineering in the Kitchen"!

In this course, we will explore engineering through the lens of food and kitchen gadgets. Although humans have been cooking for millennia, we now have countless electrified gadgets to measure, mash, melt, mix, and microwave our food. During the semester, we will disassemble every kitchen gadget we can get our hands on, learn how they work, and use our newfound skills to build a few of our own. Along the way, you'll analyze and design basic electrical circuits, program microcontrollers to take measurements and respond to them, and connect the Things you build to the Internet. We'll also explore some of the complex social and ethical issues at the intersection of technology and food: at what level is it appropriate to "engineer" our food? Does a cloud-connected refrigerator make us more efficient, or more lazy, or does it just result in more e-waste? And what responsibility do engineers have when working with something so deeply human as food?

What will you learn in this course?

This course is designed to be a "preview" of many areas of engineering, giving you a taste of how real products are designed and built. Since I'm an electrical/computer engineer by training (and by job title), we'll spend much of our time on ECE-related topics. We'll also take detours through areas that are traditionally the domain of computer science and mechanical engineering. Specifically, some of the questions and topics we'll study are:

- Fundamental behavior of electrical circuits. *How can I predict how much power my toaster (or anything else) will consume? How much electricity is dangerous?*
- What "real electicity" looks like. *What's the difference between AC and DC power, and why does it matter? Is the voltage in a US wall socket 110 V, 120 V, 220 V, or something else? Is 10 amps a lot or a little?*
- Programming with Python, and controlling circuits with code. *How can software make things happen in the real world, like, outside of my computer screen?*
- Measuring physical quantities with circuits and code. *How do I turn temperature into an electrical signal? And how do I turn an electrical signal into a meaningful measurement?*
- How data moves around in the Internet, and how to send and receive data with code. *What's the difference between a MAC address and an IP address? How do IoT devices send data and commands around?*
- How to build a web server which provides an interface to circuits you've built. *What does it take to make a button on a website which controls a physical device?*
- How semiconductors work. *What exactly* is *a transistor? And a diode? And why are they useful?*
- Social and ethical implications of the "Internet of Things". *What are the unintented impacts of the technology we create?*

How will you and I evaluate your progress?

You'll complete a series of five team projects over the course of the semester, roughly one every three weeks. These will have a technical component (disassmbling something, building something, or running an

experiment), and a documentation component (taking photos, drawing diagrams, or writing about what you did). Each one will culminate in a "show-and-tell" where you'll have the opportunity to share what you've done with the rest of the class and get feedback from your peers. The TAs and I will also offer feedback to help you improve, and we encourage you to revise and resubmit your work.

To help you assess your understanding of the theoretical content of the course, there will be a series of homework assignments. On each one, you'll complete some problems, and then check your answers with the posted solutions. You'll turn in a short reflection sheet where you'll evaluate your understanding of the topics.

We will be giving you lots of feedback on your work, but no "grades" in the traditional sense. This may be a bit disorienting at first, but I hope it will free you to take charge of your own learning, to explore and take risks (and sometimes to fail), and to learn for the sake of learning — because engineering is fun!

Obviously I do have to submit a letter grade for your transcript, so at the end of the semester you'll sign up for a brief conference with me where we will discuss your learning in the course and decide on a final letter grade together.

I want everyone to succeed in this course, and to have fun. If you're not having fun, let me know and we can talk about how to fix that!

Where should I look for information?

Anywhere you want! Practicing engineers use all sorts of sources in their work — websites, books, journals, datasheets, manuals, and more. While I will be giving you lots of pointers to material, I also expect you to supplement this with your own research and reading. This is especially true toward the end of the semester, when you'll have the freedom to pursue open-ended projects.

That said,

- Most materials will be posted on the **course website**: http://www.ece.tufts.edu/en/1EK.
- **Announcements and class Q&A** will be on Piazza.
- **Assignment submission** will be done via OneDrive (more on this in class).

If you have a general question about the course content or course logistics, please post on Piazza rather than emailing the teaching staff. You'll usually get a faster response, and everyone benefits from the answer.

There is no required textbook for this course. Reference readings will be posted in the course website.

If you feel the need to buy a book anyway, consider "The Food Lab" by J. Kenji Lopez-Alt (ISBN 978-0393081084). It's loaded with pictures of delicious food and good science, and is a lot more fun to read than most textbooks. It's also larger and heavier than most textbooks, and at $35, it's a fraction of the cost.

Teaching staff

Instructor:

Steven Bell <sbell@ece.tufts.edu>

Curtis 001-C (See course website for directions)

Office hours:

- Mondays 10am-12pm
- Thursdays 10am-12pm
- I'm also available other times by appointment (either in person or via Zoom).

To minimize distraction, I generally only check email a few times a day. However, I will make a strong effort to answer all messages within 24 hours on weekdays.

Teaching Assistants:

- Pushkar Jha <pushkar.jha@tufts.edu>

Schedule

The schedule and assignments will be posted on the course website: http://www.ece.tufts.edu/en/1EK. The schedule may be adjusted to meet the needs of the class.

Late policy

Things happen during the semester — illness, family emergencies, travel for sports or other activities, or just overcommitting and ending up unable to complete everything. If you will not be able to turn something in on time, send me an email before the deadline letting me know what's going on *and* when you will be able to turn in the work. I will grant any reasonable request, but I will hold you to the deadline that you set for yourself.

ADA Accommodations

I want every student to succeed in this course. If you have a disability that requires reasonable accommodations, please contact the StAAR Center at StaarCenter@tufts.edu or 617-627-4539 to make an appointment with an accessibility representative to determine appropriate accommodations. StAAR will give you a letter to share with me, which describes the accomodations you're entitled to. Accomodations often take a few days to arrange (e.g., booking a separate room for a quiz) and cannot be provided retroactively, so please do this sooner rather than later.