The Edward S. Rogers Sr. Department
of Electrical & Computer Engineering
UNIVERSITY OF TORONTO

ECE295H1: Hardware Design and Communication

Winter 2022

1. Course Description

This course is an introduction to engineering design processes for hardware systems. In addition to familiarizing students with hardware design practices, tools, and skill sets, it also aims to develop effective oral and written communication in a team context. Principles of engineering design, project management and teamwork are developed and applied as students work in teams to create and implement a complex hardware system comprising analog and digital electronic circuits. Students learn how to synthesize, prototype, and assemble designs realized using printed circuit board technology, as well as how to test them using modern measurement equipment. They learn about computer-aided design (CAD) and other development tools including those for electronic circuit simulation, schematic capture, board layout, version control (git), and instrument control. Students develop and apply communication techniques through preparing a variety of documents and presentations, including status reports, proposals, design reviews, and presentations.

2. Learning Outcomes

By the end of this course, students will be able to:

- Work in a team environment in developing a complex hardware project;
- Interpret design specifications and translate them into a design that attempts to achieve them;
- Be familiar with agile methods in hardware development, and apply ideas from these methods in their own design process with their team;
- Demonstrate proficiency using computer aided design (CAD) and electronic design automation (EDA) techniques for hardware development, in particular, schematic capture and printed circuit board layout tools;
- Demonstrate ability to solder components, familiarity with surface-mount technology, and awareness of the restriction of hazardous substances directive (RoHS);
- Be familiar with electrostatic discharge (ESD) handling guidelines and protection;
- Confidently use using laboratory instruments and apply them for testing circuits and systems;

- Assemble instruments and controlling software for the purpose of automated hardware testing (test automation);
- Be aware of standards and regulatory compliance when pursuing industrial design; and
- Demonstrate confidence preparing oral presentations and written documents on technical engineering hardware design.

3. Instructors

Section	Instructor	Email	Office
LEC 0101 (ECE)	S. V. Hum	sean.hum@utoronto.ca	BA 5122
LEC 0101 (ECP)	M. Strohack	m.strohack@utoronto.ca	SFB 670

4. Course Logistics

Required Text

Made to Stick: Why Some Ideas Survive and Others Die. Random House, 2007.

Available at the U of T bookstore, or you can buy it for ~$20 from amazon.ca. You are encouraged to begin reading ASAP; in the third week of term you will submit an assignment testing your understanding of principles from the book.

Teams

Students are required to form terms on Quercus in their PRA sections at the beginning of the term. Please refer to Quercus for the team formation procedure. With the exception of WD0, you will work with your team on virtually all other course deliverables, though marks are assigned individually via:

- Assessments by CIs and TAs during weekly meetings and communication deliverables;
- Assessments by TAs during structured tutorials and laboratories;
- Attribution tables.

5. Marking Scheme

ECE295 is a milestone-driven course with a variety of written and oral milestones due throughout the term. A brief description of the milestones, their weight, and due dates are as follows:

Total	Weight	Date	Assessed By
Myhal Online Safety Training	1%	January 10	MY435 staff
Written Document 0 (WD0)	5%	January 28	CI

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Technical Milestone 0 (M0)	4%	January 31	TA
Written Document 1 (WD1)	10%	February 11	CI
Oral Presentation 1 (OP1)	14%	February 28	CI
Technical Milestone 1 (M1)	20%	February 28	TA
Technical Milestone 2 (M2)	5%	March 3	TA
PCB submission deadline	0%	March 20	-
Technical Milestone 3 (M3)	20%	April 8	TA
Oral Presentation 2 (OP2)	19%	Exam week	CI+TA
Participation and professionalism	2%	-	CI

You are expected to meet each week with your TA and CI where you will present a written status update on your team's wiki page. These updates will be used as a project management tool throughout the course and will factor into your professionalism grade, as well as your milestone grades.

6. Lecture Schedule

Section	Day	Time	Location
LEC 0101	Monday	17:00 – 18:00	SF 1101
	Wednesday	17:00 – 18:00	SF 1101

7. Tutorials

The tutorials comprise the following activities, one or more of which may take place during your tutorial slots. **Attendance of tutorials with structured activities is mandatory.** For the latest tutorial times / locations, please refer to Quercus.

- Structured tutorials (STs) on various topics, including usage of CAD tools such as Multisim and Altium Designer, which take place in BA3128;
- Mandatory one-on-one meetings with communication instructors (CIs), which take place in the tutorial rooms or online (not BA3128), beginning the week of January 28;
- Computer-aided design of your project with TA support, which take place in BA3128.

8. Labs

The labs comprise the following activities, one or more of which may take place during your practical slots. **Attendance of practicals with structured activities is mandatory.** For the latest practical times / locations, please refer to Quercus.

- Structured labs (SLs) on various topics, including soldering, instrument usage, test automation, microcontroller programming, and peripherals. These take place in MY435;

- In certain weeks, computer-aided design of your project with TA support, which take place in BA3128;
- Unstructured lab time in MY435, to build and test your project, with TA support (MY435);
- Mandatory one-on-one meetings with TAs, which take place wherever the labs take place that week or online, beginning the week of February 14.

9. CAD / Computer Tools

- Altium Designer
- NI Multisim
- Git
- Microchip MPLAB IDE
- PyVISA (virtual instrument software architecture library for Python)

10. Academic Integrity Policies

For the university's academic integrity policies and consequences, see:
http://www.academicintegrity.utoronto.ca/ and
https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019.

Students will submit written work online through Quercus. Please take note of the following, which pertains to written work:

> Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq).

11. Absences and Term Work Petitions

If you are unavoidably absent and miss term work (e.g. test, quiz, assignment, lab), discuss the matter with your instructor immediately. If necessary, submit a term work petition.
All term work petitions must be submitted through the online petition system, which is accessible through the Engineering Portal:
https://portal.engineering.utoronto.ca.

Term work petitions must be submitted within seven days of the term work in question and include valid

documentation (see https://undergrad.engineering.utoronto.ca/petitions/term-work-petitions/ for more details).

12. Additional Information and Resources

12.1. Statement on Inclusivity, Equity and Diversity at U of T

You belong here.

The University of Toronto commits to all students, faculty and staff that you can learn, work and create in a welcoming, respectful and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach here.
We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. Engineering denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the Ontario Human Rights Code. If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can disclose incidents of discrimination or harassment to our Assistant Dean, Diversity, Inclusion and Professionalism through email or through a disclosure form. You can also talk to anyone you feel comfortable approaching, including your professor, TA, or CI, an academic advisor, the Engineering Equity Diversity and Inclusion Action Group, any staff member, or contact the U of T Equity Office.

You are not alone.
Here you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

12.2. Accessibility Services

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.
If you have a learning need requiring an accommodation the University of Toronto recommends that students register as soon as possible with Accessibility Services.

To schedule an appointment:
Phone: 416-978-8060
Email: accessibility.services@utoronto.ca

12.3. Mental Health Awareness

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have a First-Year Advisor, a Departmental Undergraduate Academic Advisor or a Departmental Graduate Administrator who can support you by advising on personal matters that impact your academics. You can book an appointment with your advisor or an engineering learning strategist on the Engineering Portal. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage, and a small selection are also included here:

- Accessibility Services & the On-Location Advisor
- Graduate Engineering Council of Students' Mental Wellness Commission
- Health & Wellness Services and the On-Location Health & Wellness Engineering Counsellor
- Inclusion & Transition Advisor
- U of T Engineering's Learning Strategist and U of T Academic Success
- U of T Engineering's Mental Health Programs Officer
- My Student Support Program (MySSP)
- The Registrar's Office
- SKULE Mental Wellness CLub
- Scholarships & Financial Aid Office & Advisor

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at My Student Support Program (MySSP) or visiting U of T Engineering's Urgent Support - Talk to Someone Right Now webpage.

13. Land Acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

For more information motivating this acknowledgement visit Indigenous U of T.