

## Department of Electrical and Computer Engineering

### ECED 2200/Credit Hours: 3/Digital Circuits

Winter 2022/2023

Lectures (Mon. & Wed. 10:05-11:25 D406)

Lab sessions (Tue. 14:35-17:25 C234)

**Course Website:** [mems.ece.dal.ca/eced2200.php](http://mems.ece.dal.ca/eced2200.php)

**Instructor:** Yuan Ma (Email: [Yuan.Ma@Dal.Ca](mailto:Yuan.Ma@Dal.Ca))

**Office Hour:** Mon. 1-3pm C314

Individual meetings can be scheduled by appointment via email. In any email regarding this course, please include "ECED 2200" in the subject, and I will make every attempt to reply to your email within 24 hours.

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## Course Description

This is an introductory course on digital circuits. The material covered starts with a review of the fundamental digital circuit element - logic gates. Boolean algebra, binary number systems and Karnaugh mapping techniques are taught. Many digital circuit components such as encoders, decoders, programmable logic device, shift registers, asynchronous and synchronous counters are introduced. Design of asynchronous and synchronous sequential circuits and finite state machines is covered. Contemporary computer aided design, analysis and implementation tools such as Intel Quartus, ModelSim and DE1-SoC boards are used throughout the course.

## Course Pre-requisites, Co-requisites and/or other Restrictions

ECED 2000 Electric Circuits (reference book: *Electric Circuits* by Nilsson and Riedel)

## Course Learning Outcomes

Upon completion of this course, you should be able to:

- Use Karnaugh maps and Boolean algebra to simplify logic functions;
- Use logic gates and sequential elements to build circuit components;
- Design counters and finite state machines for the implementation of basic controllers;
- Optimize sequential circuits such as finite state machines in building an integrated system;
- Use a computer simulator package and hardware kit for the schematic entry design, evaluation and implementation of basic logic circuits.
- Exercise self-discipline, punctuality, and responsibilities for lab preparation and safety.

## Required Text(s)

Course Notes: <http://mems.ece.dal.ca/eced2200/Coursenotes2200.pdf> (free)

## Recommended Text(s)

*"Contemporary Logic Design (2nd Ed)"* by R. H. Katz

## Course Schedule

Hands-on experience is critical in learning digital circuits. You will have many opportunities to see and test the digital components in action in both the lectures and the weekly lab sessions.

Week	Focus Topic	Lab Activities	Readings
1	Course introduction	-----	Course syllabus
2	Logic gates, truth table, Boolean algebra	Lab 1	Chapter 1, Appendix B
3	Number systems	Lab 2A	Appendix A
4	Combinational logic, Canonical form, K-map	Lab 2B	Chapter 2
5	Multilevel combinational logic, Hazards	Lab Tutorial	Chapter 3
6	Programmable and steering logic	Midterm	Chapter 4
7	Spring Study Break	----	----
8	Memory elements	Lab 3	----
9	Latches and Flip-Flops	Lab 4A	Chapter 6
10	Sequential logics	Lab 4B	Chapter 6
11	Registers and counters	Lab 5A	Chapter 7
12	Finite state machine	Lab 5B	Chapter 8
13	Final review	Lab test sessions	

## Course Assessments

Components of your grade include assignments, labs, and exams. Any missed academic work without an approved *Request for Accommodation* from the Dean's office will be given a grade of 0 (zero). If you miss the midterm exam for an approved absence, the final exam will be reweighted and will count for 60% of the total grade.

**Assignments (10%):** Brightspace submission of four (out of five) written assignments will be required. Please see course website for the due dates. Any late assignment will not be accepted.

**Labs (20%):** There are five labs and one tutorial. Please see the course website for details. You need to work individually for the first two labs and one tutorial. Lab 3 to Lab 5 can be group works with a maximum of two students per group. You are encouraged to work on the labs ahead of the scheduled sessions so there is enough time for questions and lab demonstration during the lab hours.

**Lab Test (10%):** Lab skills will be tested on April 4<sup>th</sup> during the lab sessions.

**Midterm test (25%):** The midterm is scheduled on February 14th, covering material from lectures and labs through (including) week 6.

**Final test (35%):** The final will be up to three hours covering material from lectures and labs for the entire course. The final will take place during the examination period.

**Supplemental Exam:** Students with a marginal failure grade (45%-49%) will be allowed to take a supplemental exam in early May.

## Associate Deans Office – Undergraduate Studies

**Associate Dean:** Dr. Timothy Little [timothy.little@dal.ca](mailto:timothy.little@dal.ca)

**Undergraduate Office Coordinator:** Jason Lecoure [Jason.lecoure@dal.ca](mailto:Jason.lecoure@dal.ca)

**Student Success Coordinator:** Karyn Hemsworth [Karyn.hemsworth@dal.ca](mailto:Karyn.hemsworth@dal.ca)

**General Inquires:** [engineering@dal.ca](mailto:engineering@dal.ca) or (902) 494-2963

### Dalhousie Engineering Student Oath

*I, as one who is preparing to enter the profession of engineering, promise to conduct myself in an honorable and ethical manner, and, as such, I will not cheat, plagiarize or be involved in any other academically dishonest activities. I shall uphold the values of truth, honesty and trustworthiness. I shall study diligently so that I will be able to safeguard human life, to protect the welfare of society and the environment, and to uphold the reputation of the profession. In all this I shall be concerned for the well-being of others, and not just myself.*

### University Policies, Statements, Guidelines and Resources for Support

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. <https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog>

### University Statements

- Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (*The Center for Academic Integrity, Duke University, 1999*). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

[http://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](http://www.dal.ca/dept/university_secretariat/academic-integrity.html)

- Accessibility

The Advising and Access Centre and the Student Success Centre (Agricultural Campus) serve as Dalhousie's centres for expertise on student accessibility and accommodation. Our work is governed by Dalhousie's Student Accommodation Policy to best support the needs of Dalhousie students. Our team work with students who request accommodation as a result of: disability, religious obligation, an experienced barrier related to any other characteristic protected under Canadian Human Rights legislation.

[https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)

- Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

[https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/student-life-policies/code-of-student-conduct.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-life-policies/code-of-student-conduct.html)

- Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported.

<http://www.dal.ca/cultureofrespect.html>

- Recognition of Mi'kmaq Territory

Dalhousie University acknowledges that the University is located on Traditional Mi'kmaq Territory.

The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the McCain Building (room 3037) contact the programs at [elders@dal.ca](mailto:elders@dal.ca) or 902-494-6803.

### University Policies and Programs

- Important Dates in the Academic Year (including add/drop dates)  
[http://www.dal.ca/academics/important\\_dates.html](http://www.dal.ca/academics/important_dates.html)
- University Grading Practices: Statement of Principles and Procedures  
[https://www.dal.ca/dept/university\\_secretariat/policies/academic/grading-practices-policy.html](https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html)
- Scent-Free Program <http://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>
- Faculty Information: Student Self-Declaration of Absence  
[https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence/student-absence---for-faculty.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence/student-absence---for-faculty.html)

### Learning and Support Resources

- General Academic Support – Advising  
Halifax: [https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)  
Truro: <https://www.dal.ca/about-dal/agricultural-campus/student-success-centre/academic-support.html>
- Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/guidelines/fair-dealing-guidelines.html>
- Black Students [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)
- International Students [https://www.dal.ca/campus\\_life/international-centre.html](https://www.dal.ca/campus_life/international-centre.html)
- Indigenous Students [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)
- Library <http://libraries.dal.ca>
- Copyright Office <https://libraries.dal.ca/services/copyright-office.html>
- E-Learning website <http://www.dal.ca/dept/elearning.html>
- Writing Centre [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)
- Faculty or Departmental Advising Support: Studying for Success Program  
[http://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)
- Student Finance page: [https://www.dal.ca/admissions/money\\_matters.html](https://www.dal.ca/admissions/money_matters.html)

### Student Health and Wellness Resources

- Student Health and Wellness [https://www.dal.ca/campus\\_life/health-and-wellness/services-support.html](https://www.dal.ca/campus_life/health-and-wellness/services-support.html)
- Student Services @ Sexton [https://www.dal.ca/campus\\_life/academic-support/student-services-sexton.html](https://www.dal.ca/campus_life/academic-support/student-services-sexton.html)
- Online Resources for Students [https://www.dal.ca/campus\\_life/health-and-wellness/online-resources.html](https://www.dal.ca/campus_life/health-and-wellness/online-resources.html)

### Safety

- Biosafety (<http://www.dal.ca/dept/safety/programs-services/biosafety.html>)
- Research Laboratory Safety Policy Manual (<http://www.dal.ca/dept/safety/documents-policies-procedures.html>)
- Laboratory Chemical Safety Manual <http://www.dal.ca/dept/safety/programs-services/chemical-safety.html>
- Radiation Safety Manual <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>