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Faculty of Engineering/Department of Electrical and Computer Engineering

ECED2200: Digital Circuits

Winter 2024/2025

Tue. & Thur. 10:05-11:25 D406 (lecture)

Mon. 13:35-16:25 C234 (lab)

Section A: Course Information

Course Delivery Mode: In-Person

Instructor, Teaching Assistant (TA), and Marker Information

- **Instructor:** Yuan Ma
- **Office:** Sexton Campus C314
- **Office Phone:** 902 494 6129
- **Office Hours:** Tues. 1-3 pm
- **Email:** Yuan.Ma@Dal.Ca

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 48 hours.

TA / Marker	Justin Greige	Greg Bowes	Nicholas Fudge (Marker)
Email	js488811@dal.ca	gbowes@dal.ca	nicholasfudge@dal.ca

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

[1] For more information about the purpose of territorial acknowledgements, or information about alternative territorial acknowledgements if your class is offered outside of Nova Scotia, please visit https://native-land.ca/. Please note: Instructors may wish to create a personalized acknowledgement of the unceded territory of the Mi'kmaq nation in lieu of the Dalhousie statement.

asynchronous and synchronous sequential circuits and finite state machines is covered. Contemporary computer aided design, analysis, and implementation tools such as LogiSim, Intel Quartus, ModelSim and DE1-SoC boards are used throughout the course.

Description of Class Format
The course is delivered in a face-to-face format, and students are strongly encouraged to attend all lectures. Bonus points for attendance may be awarded periodically throughout the term. Labs are intended to offer hands-on experience and reinforce the lecture content. The attendance to the tutorial and lab sessions is mandatory.

Learning Management System Site Information
ECED2200 uses Brightspace to distribute lecture slides, lecture notes, and reference materials. A course website is also created for all course related information and resources. All assignments and labs will be submitted through the Brightspace assignment portal. The Brightspace site can be accessed through https://dal.brightspace.com/d2l/home. The course site will appear in the listing for the current semester for all students registered in the course. Please contact the instructor via email if you cannot access the site.

Course Pre-requisites, Co-requisites, Exclusions and/or other Restrictions
ECED 2000 Electric Circuits (reference book: ***Electric Circuits*** by Nilsson and Riedel)

Course Rationale and/or Other Restrictions and Requirements
This course covers the fundamental body of knowledge in digital design of the Electrical and Computer Engineering program. The combination of lectures and modernized lab sessions prepares students for innovative solutions from their design through their implementation.

Course Learning Outcomes
Upon completion of this course, students will 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)
Suggested readings:
1. "Digital Design" by M. Morris Mano
2. "Digital Design: With An Introduction to the Verilog HDL, VHDL, and SystemVerilog" by M. Mano
3. "Bebop to the Boolean Boogie: An Unconventional Guide to Electronics" by Clive Maxfield (Dal eBook)

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#: Dates	**Focus Topic**	**Activities**	**Readings**	**Important Dates**
W1: Jan. 6-11	Course introduction	A1	Syllabus	
W2: Jan. 12-18	Logic gates, Boolean algebra	Lab 1	Chapter 1	
W3: Jan. 19-25	Number systems	Lab 2A, A2	Appen. A	Lab1 due, A1 due
W4: Jan. 26-Feb. 1	Combinational logic (CL), K-map	Lab 2B	Chapter 2	
W5: Feb. 2-8	Multilevel CL, Hazards	Lab Tutorial	Chapter 3	Lab2 due, A2 due
W6: Feb. 9-15	Programmable and steering logic	Midterm	Chapter 4	Lab Tutorial due
W7: Feb. 16-22	Spring Study Break	----	----	
W8: Feb. 23-Mar. 1	Memory elements	Lab 3, A3	----	
W9: Mar. 2-8	Latches and Flip-Flops	Lab 4A	Chapter 6	Lab3 due
W10: Mar. 9-15	Sequential logics	Lab 4B, A4	Chapter 6	A3 due
W11: Mar. 16-22	Registers and counters	Lab 5A	Chapter 7	Lab4 due
W12: Mar. 23-29	Finite state machine	Lab 5B	Chapter 8	A4 due
W13: Mar. 30-Apr.5	Final review	Lab test	----	Lab5 due

Other University holidays and important dates:
Jan. 20: Last day to drop winter term courses with no financial implications.
Feb. 3: Last day to drop winter term courses without a "W".
Feb. 7: Munro day, university closed.
Feb. 17: Nova Scotia Heritage Day, university closed.
Feb. 17-21: Winter study break.
Mar. 5: Last day to drop winter term classes with a "W".
Apr. 7: Friday classes will be held; classes end.
Apr. 8: Break before exams.
Apr. 9-26: Exam period.
Apr. 18: Good Friday, university closed.

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).

Assignments (10%): Brightspace submission of four written assignments will be required. Each assignment (2.5%) covers the main topics taught in two modules.

Assignment	**Focus Topics**	**Due Date**
1	Logic gates, number conversions, Boolean Algebra	Jan. 25
2	Two-level Combinational circuits, Hazards, NAND/NOR network	Feb. 8
3	Latches, Flip-Flops, state diagram	Mar. 15
4	Registers, counters, finite state machines	Mar. 29

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 work with a maximum of two students per group. You are encouraged to work on the lab 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 March 31st during the lab sessions. Students are expected to simulate a combinational or sequential circuit, and program an FPGA board to test the circuit.

Midterm test (25%): The midterm is scheduled for February 10th between 1:30 and 3pm at B308. It is an 90-minute-long closed-book exam, and it covers material from lectures and labs through week 5.

Final test (35%): The final is a 3-hour closed-book exam, covering material from lectures and labs for the entire course. The final will take place during the examination period.

Supplemental Exam: There is no supplemental exam for the midterm exam. If you miss the midterm exam for an approved absence, the 25% weight will be added to the final exam.If you miss the final exam for an approved absence, a supplemental exam will be provided. For students with an FM (i.e. Marginal fail: 40-49%) final grades, you may apply to the Associate Deans Office to write a supplemental exam using the online form: http://forms.engineering.dal.ca. Only one supplemental exam is allowed per student per semester.

Associate Deans Office – Undergraduate Studies
Associate Dean: Dr. Darrel Doman darrel.doman@dal.ca
Undergraduate Office Coordinator: Jason Lecoure Jason.lecoure@dal.ca
Student Success Coordinator: Karyn Hemsworth Karyn.hemsworth@dal.ca
General Inquires: engineering@dal.ca or (902) 494-2963

Course-specific policies

- Late assignments and lab reports will not be accepted. Any absence leading to missed academic work must be reported through the Engineering Student Absence Reporting online system. This applies to both Student Declaration of Absence and Request for Accommodation. For more details and to submit a request, visit forms.engineering.dal.ca.

  The following policies apply to assessments missed due to self-declared absences:
  - Missed assignments may be submitted late without penalty until solutions are posted. After this, the final course mark will replace the assignment mark.
  - Missed labs must be completed as soon as possible on the student's own time.

- Generative AI and large language models (e.g., ChatGPT) are prohibited for use in this course. Plagiarism detection tools may be employed if the course instructor or TA suspects academic misconduct in submitted coursework.

Section B: University Statements

Please review statements and guiding notes for instructors below, as marked with an asterix (*). These notes should be moved when finalizing your syllabus. Ideally, these university statements should be integrated into the learning of the course, cultivating a culture of curiosity and helping to ensure a deeper understanding of their meaning.

Provide the following links and brief statements:

Territorial Acknowledgement:
Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights in Canada. We recognize that African Nova Scotians are a distinct people whose histories, legacies and contributions have enriched that part of Mi'kma'ki known as Nova Scotia for over 400 years.

*Note: Instructors may wish to create a personalized acknowledgement of the unceded territory of the Mi'kmaq nation in lieu of the Dalhousie statement. Instructors are encouraged to discuss the purpose of the inclusion of the statement with their class making explicit the connection of their statement with the content of their course. Instructors can encourage students to use the Dalhousie statement in their presentations or create their personalized land acknowledgement in lieu of this statement.

Internationalization
At Dalhousie, "thinking and acting globally" enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders."

*Note: Instructors can identify global learning outcomes and intercultural competency outcomes for the teaching and learning, and assessment activities and observe the achievement of these outcomes through the formal, informal, and the hidden curriculum.

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. 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.

Accessibility
The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation.

If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion please contact:

- the Student Accessibility Centre (for all courses offered by Dalhousie with the exception of Truro)

- the Student Success Centre in Truro for courses offered by the Faculty of Agriculture

Your classrooms may contain accessible furniture and equipment. It is important that these items remain in place, undisturbed, so that students who require their use will be able to fully participate.

Conduct in the Classroom – Culture of Respect
Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

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, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2).

Code of Student 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—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Fair Dealing policy
The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie.

Originality Checking Software (Mandatory to include if being used)
The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work, and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method.

Student Use of Course Materials
*Note: You may wish to include the following statement:

These course materials are designed for use as part of the Course Code at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books,

journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Section C: University Policies, Guidelines, and Resources for Support

Instructors may choose to include Section C with their Syllabus or may instead refer to it, providing a link, in their Syllabus. The University Policies, Guidelines and Resources for Support for Section C and their respective links will be made available on the Centre for Learning and Teaching (CLT) website, on the homepage of the Learning Management System (LMS) and on the Dalhousie Academic Support website.

Dalhousie courses are governed by the academic rules and regulations set forth in the Academic Calendar and the Senate.

Important student information, services and resources are available as follows:

Provide list of links as below OR use links above to direct students to these resources:

University Policies and Programs

- Important Dates in the Academic Year (including add/drop dates)
- Classroom Recording Protocol
- Grading Practices Policy
- Grade Appeal Process
- Sexualized Violence Policy
- Scent-Free Program

Learning and Support Resources

- General Academic Support – Advising Halifax, Truro
- Student Health & Wellness Centre
- On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond)
- Indigenous Student Centre. See also: Mi'kmaq and Indigenous Relations
- Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803.)
- Black Student Advising Centre
- International Centre
- South House Sexual and Gender Resource Centre
- LGBTQ2SIA+ Collaborative
- Dalhousie Libraries
- Copyright Office
- Dalhousie Student Advocacy Services
- Dalhousie Ombudsperson
- Human Rights and Equity Services
- Writing Centre

- Study Skills/Tutoring
- Faculty or Departmental Advising Support (Note: there is a different link for each faculty, and possibly for different departments or programs)

Safety

Required links to provide, if any of the following apply to discipline/course:

- Biosafety
- Chemical Safety
- Radiation Safety
- Laser Safety